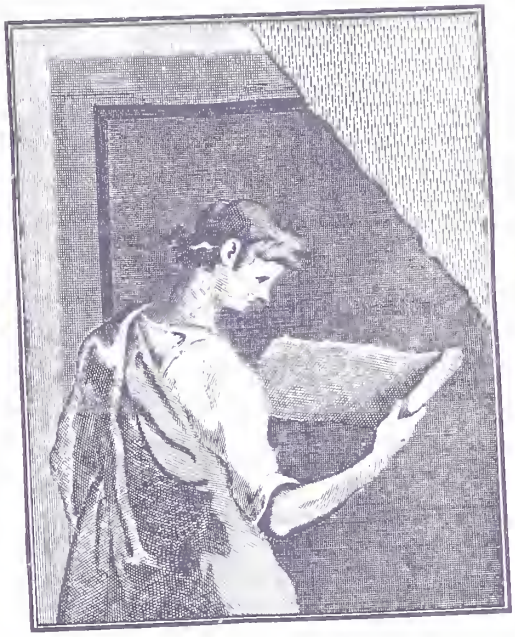

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WORK

An Illustrated Magazine of Practice and Theory

FOR

ALL WORKMEN, PROFESSIONAL AND AMATEUR

FROM MARCH 19, 1892, TO JANUARY 14, 1893.

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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WORK WORLD.

Sheffield ivory-cutters have plenty of work, there being a good demand for table-knife handles, chiefly of the commoner varieties. Ivory still maintains its high prices, choice cut pieces ranging from 32s. to 60s. per pound.

* *

One of the largest colliery wire ropes made in Sunderland has just been sent from Messrs. Glaholm & Robsen's. It is six miles in length, and weighs twenty-four tons. It required two heavy waggons and twenty horses to transport it from the works to the railway station.

* *

An uncommon way of using enamel in jewellery—viz., where it is quite transparent, or *à jour*, as it is called—is now to be well seen in a pearl, diamond, and enamel bracelet, which forms part of Mrs. H. Bolckow's bequest in the South Court of the South Kensington Museum.

* *

Machine-cut files are being turned out in Sheffield in great perfection, the process being to machine-cut them first, and then cross-cut them by hand. There would be no objection to this provided the goods were sold as partly machine and partly hand-cut, but complaints are abroad that the machine-cut files are sold as hand-cut.

* *

In connection with the Leather Trades Exhibition, to be held at the Agricultural Hall, Islington, N., from the 4th till the 18th of April next, the committee have decided to hold a series of competitions for students and craftsmen in various branches of the boot trade. Twelve silver medals will be given as first prizes, and for the second best in each class a certificate will be awarded.

* *

The dock deliveries of timber for London still show a considerable decrease, owing mainly to the late strikes. The returns up to the present show a decrease of 1,887 standards under the delivery for the same period last year. The demand for all kinds of timber is just now very limited, and the stagnation is pervading every department of the trade. Some prime parcels of Tabasco and Cuba mahogany were sold recently, and realised good prices, one log, containing 175 ft. sup., fetching as much as 1s. 9½d. per foot.

* *

There is little change to notice in the heavy iron trades of Sheffield. Prices remain unaltered, and there is not much prospect of improvement, excepting special lines, such as railway material. The slight improvement noticeable in the cutlery trades has just continued, and matters are moving more freely, so far as the home markets are concerned. In the departments and markets where trade was moderately good last year there is a large falling-off, not only in common goods, but also in the more expensive class of merchandise.

* *

Fashion is as paramount in furnishing and decorating as with ladies' costume, of which fact the new season's designs in grounded paperhangings give irrefutable testimony. Stripes—in half-satin and talc effects of plain colours and self-tones—we have in plenty with which to satisfy the present craving for drawing-rooms in "the French style." In best bedroom lines, and for morning rooms, etc., there is a surfeit of charming semi-natural floral designs, all very full and harmonious in colour, although approaching too dangerously near imitations of nature to be satisfactory as designs for wall-coverings. Imitation tapestry papers are also in strong demand, chiefly for dining-rooms, for which they are very suitable, if selected with judgment and hung with skill.

* *

The dinner of the Birmingham Jewellers' and Silversmiths' Association, which was postponed from last month on account of the death of the Duke of Clarence, is to be held to-day at the Great Western Hotel, Birmingham, with Mr. Chamberlain in the chair as usual. Have those people anything to announce this year? They have had something to say on three occasions. First, there was a lecture on jewellers' art by Mr. Chamberlain, with comparisons and illustrations drawn from Egypt. Another year he announced the starting of a jewellers' technical school at Birmingham; and last year that they had so moved the authorities at the City and Guilds Institute here in London as to get the subject of goldsmiths' work officially recognised, thus showing London the way. But is this creditable to London? Goldsmiths' Company—wake up!

To facilitate the transportation of exhibits for the Chicago Exhibition, arrangements have been made with five hundred railways and steamship lines. The British railways have undertaken to carry goods for English exhibitors to and from the port of shipment at half rates. The American railways will charge the usual rates to Chicago, but will bring back the goods free. Many of the steamship companies have reduced their tariffs to 11s. per ton, and have consented to adopt a reduced passenger tariff for exhibitors and their employees.

* *

The Midland Counties Trades and Industrial Exhibition will be held at Bingley Hall, Birmingham, from April 11 to May 14. It will embrace twenty sections, including Engineering and Machinery, Mining and Metallurgy, recent inventions of all descriptions, Decoration, Furniture, Gas and Electricity, Domestic Appliances, etc. Sections 19 and 20, for which free space will be allotted and medals and certificates awarded, are set aside specially for the artisan classes. No. 19, Women's Industries, will include Carving, Ceramics, Domestic Furniture Designs, Artificial Flowers, Painting, etc. No. 20, Artisans' Industries, will embrace Models, Designs, Fretwork, Inventions, Specimens of Handiwork, etc.

* *

In Halifax the engineers' tool trade is still depressed. Many of the shops are working short of usual hands, while others are dividing the work into week "shifts." No large contracts are on hand, except, perhaps, one or two local contracts for pipes in the foundries. The prospects of the small and thick wire-drawing trade show improvement. Coating weaving and worsted spinning are also depressed; while Brussels carpet weaving remains firm, and tapestry shows slight improvement. Card-making, depending on the textile trades, remains moderate, as is also the leather-belting industry. There is a strike in the brush trade, which, combined with the present high price of materials, is likely to make difficulties with the masters. The Halifax County Council have received powers from the Board of Trade to construct electric-lighting stations and supply current through the principal thoroughfares. This will, no doubt, brighten the prospects of trade in the electric engineering departments.

INDUCTION COILS: HOW TO MAKE AND WORK THEM.

BY G. E. BONNEY.

INTRODUCTION—DEFINITION OF INDUCTION—PROFESSOR OERSTED'S DISCOVERY — PROFESSOR FARADAY'S EXPERIMENTS—USES OF INDUCTION COILS—BATTERIES FOR INDUCTION COILS—VOLTAIC BATTERY—CHROMIC ACID BATTERY—BATTERIES FOR MEDICAL COILS, ETC.

Introduction.—On seeing the title of this series of papers, the reader may be inclined to ask—What is induction? and what are induction coils? The word "induce" comes to us from the Latin, and means to influence, to persuade, to impel, to allure. Induction, then, is the act of inducting—that is, influencing, persuading, impelling, or alluring. An induction coil is, therefore, a coil employed for inducting purposes. By general consent the term is confined to a coil of wire employed in inducing electricity.

How does a coil of wire induce electricity? It will be my business to show, in the following series of papers, how this is done. But before I set about describing a coil and its mode of action, it will be instructive to briefly trace the history of the discovery which led up to the invention of the induction coil and its numerous congeners.

Whilst Professor Oersted, a Danish philosopher, and Secretary to the Royal Society of Copenhagen, was filling the office of Doctor of Philosophy to the University of that city, he made a most important discovery, which, when published, attracted the attention of philosophers in all parts of the world. He found that when a magnetic needle was brought near to a wire conveying an electric current, the needle appeared to be influenced by the current, for it immediately deviated from its usual position of lying with its ends pointing to north and south, and placed itself across the path of the current. It was rendered clear by repeated experiments, that the electric current exerted an inductive influence on the needle, causing it to swerve aside from its usual line of magnetic attraction. This discovery received close attention from French scientists, who found in their experiments, that the electric current in a conducting wire not only exerted an influence on a magnetic needle, but also affected the current passing in another wire laid parallel to it—in fact, the current in both wires influenced each other. M. Ampère made the discovery that two conducting wires laid parallel to each other, exerted a mutual attraction whilst the currents passing in both were in the same direction, but when the currents were passing in opposite directions the wires exerted a mutual repulsion.

In 1831 Professor Faraday wound a long copper wire around a wooden cylinder, with the coils at a slight distance from each other. In the spaces between these coils he wound another copper wire, carefully insulated from the other. He connected the two ends of this second coil to a galvanometer, and the two ends of the first coil to a powerful battery. On the instant, when closing the circuit of the first coil, a current was induced in the second coil, and its presence demonstrated by a deflection of the galvanometer needle. A similar deflection was caused at the instant when the wires of the first coil were disconnected. By winding a coil of wire around some steel needles and connecting this to the second coil, the needles became magnetised by making and breaking contact with the first coil and the battery. This proved that the current passing in the first wire possessed the power of inducing a current in the second wire wound on the cylinder parallel to the first, but separated from it by an insulating substance.

Out of these most important discoveries in electrical science, have grown the splendid achievements in the application of this science enjoyed by all the world at the present day. Induction coils play a most important part in nearly all electrical instruments and machines. The discovery of Professor Oersted led to the invention of the single needle telegraph instrument, the galvanometer, and some forms of ammeters. The discovery of Professor Faraday, and his subsequent researches and experiments in the same direction (some of which were published in 1837), led to the invention of electric bells, the Morse telegraph instrument, electric relays, electro-motors, dynamo-electric machines, electric transformers, and many more electric instruments, in all of which induction coils are employed. The tiny electro magnets employed in telegraph instruments, and the monster coils on the largest electric light dynamos, are all induction coils, depending for their efficiency on the inductive influence of electric currents circulating in coils of wire.

Were I to deal with all of these in the present series of papers, I should monopolise entirely quite two volumes of WORK, and it would then become solely an electrical journal. As, in Vol. I., under the heading of

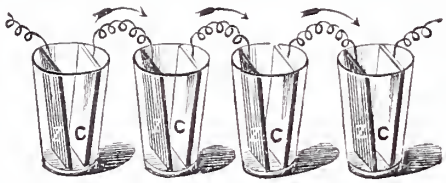

Fig. 1.—Simple Voltaic Battery of Glass Cells—C, Copper or Carbon Plate; Z, Zinc Plate. Arrows show direction of Current.

"Burglar Alarms," I have shown how electric bells are made, and in Vol. II., under the heading of "Model Electric Lights," I have shown how dynamos are made and used, I propose in the following papers to deal only with one or two other forms of induction coils, paying special attention to those little coils made and used for purposes of amusement and recreation.

Batteries for Induction Coils.—Before we can obtain an induced current of electricity, we must have some means at hand of generating a primary current. The generator may be a dynamo-electric machine, a magneto-electric machine, or a battery of voltaic cells. It matters very little what kind of generator we employ, but we must have one.

A Voltaic Battery.—A battery of voltaic cells is the generator usually employed with induction coils for purposes of amusement. Voltaic cells are those in which zinc is oxidised or consumed to furnish a current of electricity. They are sometimes named galvanic cells, and a number of them connected together form a galvanic battery. One cell alone may contain a galvanic pair or a voltaic pair, but cannot be said to form a galvanic or a voltaic battery. We need more than one cell to form a battery. The most simple voltaic battery is one made up of two or more glass tumblers for cells, each of which contains a strip of sheet zinc and a strip of sheet copper, immersed in water made acid by adding to it a few drops of oil of vitriol or of common vinegar. The electric current from a battery of this kind will be very feeble and inconstant, but will serve the purpose of furnishing current for first experiments. A copper wire must be soldered to each zinc plate and each copper plate. The cells must be connected in a row by twisting the wire from a zinc plate in one cell to the wire from the copper plate in the next cell, as shown in Fig. 1. When connected thus, the cells are said to be connected in series. By adding cell to cell in this way, we increase the pushing power of the battery—that is, the power to push its current through a high resistance. This rule holds good in all batteries, and is therefore given here to act as a guide when it is desired to increase the pushing power of a battery.

This small battery may be used for first experiments, such as those mentioned further on, but would be useless in working a real induction coil. For this purpose we must have a constant battery, giving a strong volume of current. The shocking coils met with in the streets, at fairs, and sometimes at bazaars, are usually worked by a Bunsen battery, this being the strongest and most constant battery. As the nitrous fumes exhaled by this battery (easily detected by their odour) are noxious and injurious, the use of it is inadmissible in a room. We therefore dispense with it in favour of the chromic acid battery.

A Chromic Acid Battery.—This battery may be as easily made as the simple voltaic battery just described. We may even employ the same cells, for glass cells are preferable to those of any other material. For a small coil, say 3 in. in length by 2 in. in diameter, glass tumblers will be large enough, but glass jars with an incurved top, or the wide-mouthed vessels known as pomade jars, are preferable, because the acid liquid is not so readily spilt from these as it would be from glass tumblers. The pint size is also preferable to the half-pint size, if required for long experiments, as the charge in a large cell lasts in working order for a longer period than that in small cells. The plates required in a chromic acid battery are made of zinc and carbon—that is to say, there is one plate of zinc and an opposite plate of carbon in each cell. The zinc plate may be of any thickness from $\frac{1}{8}$ in. to $\frac{1}{4}$ in., but it is not advisable to employ thin plates, because these soon get cut through by the action of the charging acid mixture. The width and length must be regulated by the diameter and height of the cell. It should be slightly longer than the depth of the cell and slightly narrower than its width. Each zinc plate must be coated with mercury—that is, amalgamated before it can be used; and it will need to be frequently cleaned and re-amalgamated to prevent waste of zinc and ensure full power from the battery. Connection may be made by means of a stout copper wire soldered to the upper edge of the plate before it is amalgamated, or by means of a brass clip sold for the purpose, and named a binding-screw. The last method is preferable, because, when thus connected, we can turn the plate when the lower end is worn, and thus use up the last scrap of zinc, and can also keep the connection clear. The carbon plate may be cut from gas retort carbon, or it may be bought from dealers in electrical instruments, cut to any required size. It should not be less than $\frac{1}{4}$ in. in thickness, and should have a surface area slightly in excess of that of the zinc plate. The highest efficiency is secured when the zinc plate is suspended in the cell between two carbon plates, one on each side, as then both sides of the zinc wear away equally, and the larger surface of carbon secures more constancy in the

current, together with a lower internal resistance of the cell. A very handy arrangement of the plates, easily made by amateurs, is as here directed. Procure plates of zinc and carbon of a size suitable to the cells about to be used. Get two pieces of hard wood, ½ in. in thickness, ¾ in. in width, and long enough for the two ends to rest on the edges of the battery cell; cut a recess in each piece of wood to fit the zinc plate on each side when the plate is clipped between them; then give each piece three coats of varnish, or soak them well in melted paraffin. The two strips of wood are then to be placed on each side of the zinc plate, with ½ in. of its top above the wood, and the two pieces fastened together with brass screws at the ends. A binding-screw on the zinc will hold it up and serve as a terminal, and a wide-jawed brass clamp will secure the two carbon plates on each side of the wood.* When the battery is not in use, these clamps can be loosened, and all the plates put into water, to cleanse them from traces of the solution.

Solution for Chromic Acid Battery.—The mixture for charging the cells of this battery is made up of 3 ozs. of chromic acid dissolved in one pint of water, to which must be added 3 fluid ozs. of sulphuric acid. The mixture must be allowed to cool before placing it in the battery cell. If chromic acid cannot be obtained, a similar mixture with bichromate of potash may be employed, but chromic acid is preferable to bichromate of potash.

Bichromate of Potash Battery.—The bottle form of bichromate of potash battery may also be employed in working an induction coil, or any one of the box batteries described in No. 89, Vol. II., of WORK, in the series of papers on "Model Electric Lights."

Bunsen and Grove Batteries.—The best effects from spark induction coils are obtained from them when worked with current from a battery of Bunsen cells or of Grove cells. Persons who have these cells and object to the nitrous fumes given off by the nitric acid in the porous cell, may substitute for this a solution of chromic acid, using the same cells and the same elements.

Batteries for Medical Coils.—Almost every generator of electricity known, and almost every form of battery invented, has been and is used to work these coils. The simple voltaic arrangement of copper and zinc plates immersed in dilute sulphuric acid, held in glasses, as shown at Fig. 1; Dr. Wollaston's improvement of zinc plates enclosed in a loop of sheet copper; Smee's battery, with platinised silver plates opposed to zinc; Walker's battery of carbon plates opposed to zinc; and many other single fluid cells worked with dilute acid, have all been used for the purpose. Some inventive minds have launched out into modifications of these batteries, and have called the modified batteries by their own names. Similar modifications have been made, and named from batteries in which carbon, surrounded with peroxide of manganese, forms the negative element, and zinc in a solution of sal-ammoniac, forms the positive element, as seen in the well-known Leclanché battery. The sulphate of mercury series of batteries, such as the Marie Davy and Latimer Clark cells, and also the chloride of silver series, represented by the Gaiffe, Warren de la Rue, Skrivanow, and Schanchieff cells, have all had attention from the modifiers of batteries for medical coils. In all these inventions, portability and freedom from messy liquids and noxious vapours has been the chief aim. The closely-sealed forms of batteries have therefore been in most favour. For pocket coils (those ingenious little instruments for giving unpleasant electric shocks to unwary and meddlesome outsiders) a compact and non-messy form of battery became a necessity; hence these have been generally operated by some modification of the silver chloride series of batteries. These have the disadvantage of soon running down, so to speak, and ceasing to give current after a short period of activity.

Lithanode Battery.—Perhaps the best battery for these coils is the sealed lithanode battery, manufactured by Messrs. Cathcart, Peto, & Radford, the electrical engineers, for lighting portable electric lamps. These cells are made small enough to go into the inside pocket of a coat, and are curved to fit the body. As the electro-motive force of each pair of elements is 2·3 volts, and the cells are only of pocket-book weight, a most powerful battery can be easily carried without inconvenience. When once charged, they remain in this condition ready for action during a period of several months; they yield a large quantity of current, and when exhausted can be easily re-charged, as accumulators are charged, by sending a strong current through them from another battery or from a dynamo machine.

The E. S. dry battery, the Gassner, and other so-called dry cells, may also be employed in working small medical coils. These have the advantage over ordinary cells in that they are unbreakable, and contain no liquid to be spilled by overturning the cells.

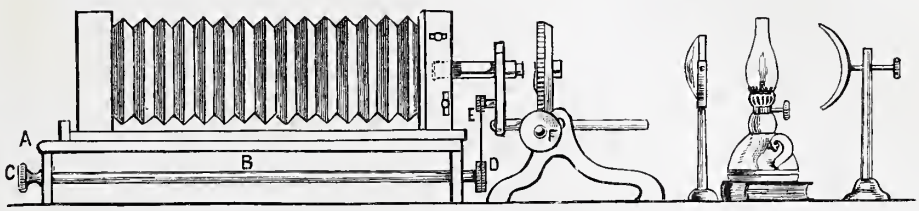

Fig. 2.—A Convenient Arrangement for Fine Adjustment—A, Stand for Camera; B, Connecting-Rod turned by Milled Head, C; D, Pulley connected with Fine Adjustment, E; F, Screw for roughly focussing Object.

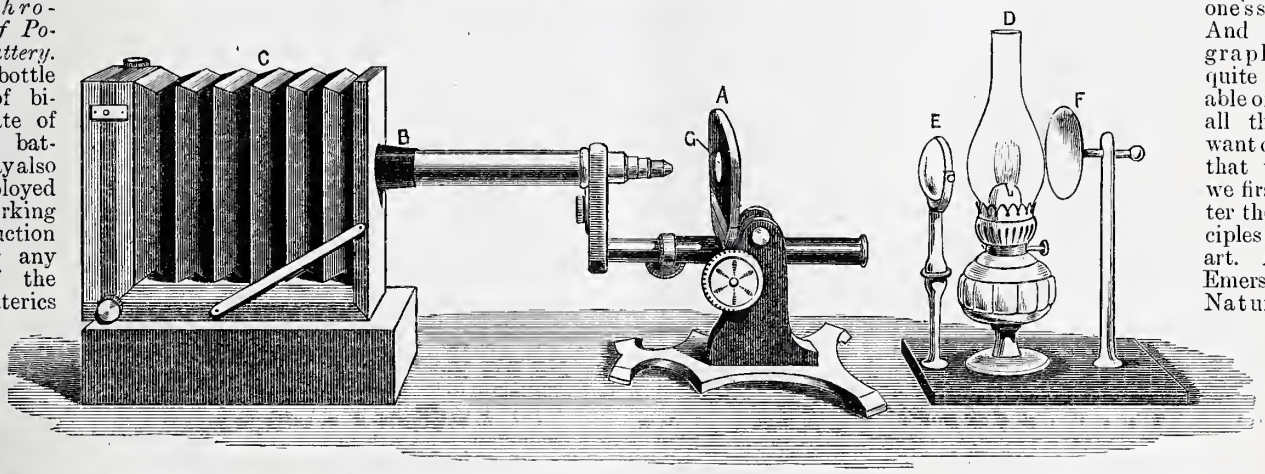

Fig. 1.—Method of arranging Camera and Microscope for Work by Lamplight—A, Microscope, the Tube of which is inserted in the Front of the Camera, C, and the Joint rendered Light-tight by means of the Velvet, B; D Lamp, the Light from which is reflected from the Concave Mirror, F, and concentrated on the Object by the Bull's-eye Condenser, E. The Object is placed at G.

MICRO-PHOTOGRAPHY WORK.

BY ARTHUR RENAUD (B.A. OXON.).

PHOTOGRAPHY, as an accessory to scientific research, is making daily advances, and a knowledge of its principles is becoming more and more necessary to the student. Whether one is a devotee of the telescope or the microscope, or even the chemical laboratory, one finds the process of delineating the objects under one's notice which photography gives us of immense value in prosecuting one's studies. And photography is quite capable of doing all that we want done in that way if we first master the principles of the art. As Dr. Emerson, the Naturalistic Photographer, says, in a description which certainly does not fail in its object for want of elaborateness of expression:—"Not content with her vast triumphs over the infinitely great, she dives down to the infinitely small, and stores up for us portraits of the disease-bearing generation of *Schizomycetes*, the stiff-necked *bacteria* and the wriggling *vibrio*, the rolling *micrococcus* and the fungoid *actinomycosis*, with deadly tresses: these she pictures for us, so that we may keep them on small plates, or else she throws them on screens, so that we are able to study their structure. On those screens, too, we can gaze on the structure of the Proteus-like white blood-corpuscle, and we are able to study the very cells of our tongues, our eyes, our bones, our teeth, our

* Illustrated in WORK, p. 36, Vol. III.

hairs, and to keep drawings of them such as man never had before. So the kindly goddess stints us in nothing, for wherever the microscope leads she is at our bidding. With the greatness of an all-seeing mind, it matters not to her whether she draws the *protococcus* or the blood-cells of an elephant, whether she depicts the eroding cancer-cell or the golden scale on the butterfly's wing. Anything that we ask of her she does, if we will but be patient."—("Naturalistic Photography," p. 2.)

This is flowing language, and goes to prove that the writer, however extraordinary his views on the focus question may be regarded by some people, is at any rate an enthusiastic admirer of his art. We are only concerned, at present, with the latter part of his eulogium—viz., the making of photographs of microscopic objects, chiefly with a view to turning them into lantern slides. It is frequently thought to be a very complicated subject, and so many books have been written descriptive of the process, which have represented it as carried out by means of such elaborate apparatus, and made use of such voluminous scientific terms, that the mind of the average amateur has been appalled at the thought. As a matter of fact, it is an extremely simple affair, and though (as in most other pursuits) you *can* have expensive and elaborate apparatus if you like, it does not follow that you will get any better results therewith. In these papers it will be my aim to give directions for accomplishing the feat in a plain and straightforward manner, and by means of very simple apparatus which most amateurs will have already, or at any rate will be able easily to make for themselves.

First of all, as to the microscope. This must, of course, be a good instrument, if the results are to be good; unless the definition is very good the negative does not stand much chance of being sharp, and then where will the definition be when it comes to be made into a lantern slide and magnified hundreds of times? The microscope should, therefore, have the benefit of any superfluous cash you may have to spend upon it, and the photographic part of the business can be simplified to make matters equal. The particular make of microscope does not much signify; preferably it should be a *monocular*, as you could only use one tube of a binocular, and it would be a very awkward performance. If selecting a microscope after reading this, with a view to microscopic photographs, you should select one that will not only stand erect vertically, but also turn (with a screw joint on the base), so that the tube is horizontal. This is much more convenient to the beginner, as it renders elaborate apparatus for the photographic work quite unnecessary; but if the reader has already a microscope in his possession which will only stand vertically, there are still several methods whereby the difficulty may be overcome, with a little more expenditure of time and trouble.

To begin with, I will assume that we have at our disposal a microscope of the first kind —viz., one that will stand with the tube in a horizontal position. The first thing to do is to fasten it in this way: if it has a screw joint it can be firmly clamped; if not, as a general rule the friction of the sides of the joints will keep it steady, but if it is loose it must be carefully supported, by hooks or otherwise, during the work, for the slightest movement during exposure will, of course, completely ruin the photograph.

I may say here that when the microscope is in this position only mounted objects can be used, as the glass is standing on edge; consequently, if objects in a cell, or living specimens, are to be photographed, the microscope must be placed vertically, and one of the methods referred to above employed.

A good deal of the scope for the work which we have depends on the object-glass of the microscope. This may be a power of fifty diameters, and for a beginner it is best not to exceed this limit. With this power, or lower, the work can be done either by day or night. For higher powers sunlight has to be employed, which generally involves the use of a *heliostat*, which is rather an expensive piece of apparatus.

The *camera* may be of any ordinary type, preferably a modern bellows-bodied one, and the longer the bellows the better for our purpose. Some people say that a camera as much as 6 ft. in length should be used, but practically this is quite unnecessary, as the ordinary length answers well; it should, however, rack out to 18 in., if possible. If it will not do this, an extra extension must be made of stout cardboard, for temporary use.

The camera and microscope being provided, and the latter arranged horizontally on its stand, the camera must be supported by books or boxes, at such a height that the hole for the lens is just on a level with the tube of the microscope. The tube of the latter has now to be inserted in the front of the camera. They should not be rigidly attached to one another, but at the same time they must be temporarily so fixed that movement of either during exposure, or shifting of their positions when drawing the slide, or otherwise (it is a very difficult thing to draw the slide of a camera simply placed on a book, without its tripod screw to hold it, without shaking it), is practically impossible. A very good way to join camera and microscope together is the following:

Take off the ordinary lens used with the camera, and fit into the flange a piece of brass tube about 1½ in. long, and wide enough for the tube of the microscope to slip into it. The tighter the microscope tube fits into it the better, and, by having an "adapter" outside, it can be fitted to the flange, however small it may be. When the microscope tube is inserted in this tube, the joint has to be made light-tight. To do this, a cylindrical bag of thick black velvet, open at both ends, is made, and one end being slipped over the tube fixed to the camera, the other end goes over the microscope tube; two elastic bands are placed to fasten it round each of the tubes, and a perfectly light-tight joint is the result.

This arrangement having been made, and the object slide placed on the stage of the microscope, the source of illumination has to be considered. Those who can give up time to work by daylight, and prefer that method of illumination, can use a condenser to concentrate the rays of the sun on to the object, but this being liable to produce a considerable amount of heat, which may crack the slide, it is generally thought necessary to place a small trough of alum solution between the condenser and the object: this cuts off some of the heat-rays, without materially affecting the light. If working by sunlight, the course of the rays must be so arranged as to be parallel with the axis of the object-glass, and a continuation of it.

Most workers, however, prefer lamplight, for obvious reasons—the sun not being always at our disposal. A good paraffin lamp gives out more actinic rays than gaslight, and should, therefore, be employed. Any strong lamp will do; the three-wick lantern used for the optical lantern will also serve for this purpose. In front of the lamp is placed a bull's-eye condenser to concentrate the rays on the object; behind the lamp is placed a concave mirror to add to its illuminating powers. To produce the best effect, the axis of object-glass, condenser, and mirror must all be in the same plane. Fig. 1 will show the arrangement of the different parts of the apparatus.

The practical details of taking the photograph are, of course, simple enough to anyone accustomed to photographic work. The object is first firmly fixed on the stage of the microscope, in the centre of the field of view. If the microscope stage is provided with springs for the purpose, well and good; if not, the glass must be fixed by means of clips or wire springs, so that no movement at the wrong time is likely to occur. The object is now roughly focussed on the ground glass by means of the ordinary microscope screw, after which the fine adjustment is used to get it quite sharp. Great care is needed in focussing, for if the negative is not sharp in the extreme the lantern slide will be of no practical value. There is no room for naturalistic "focalising" here, whatever may be thought of it elsewhere. A magnifying focusser should be used to get the picture sharp on the ground glass. When it is sharp enough, the dark slide is inserted, and the plate exposed in the ordinary way.

This is a simple enough arrangement, and will not take long to put together. There are, however, several points on which success is more or less dependent, and which I will, therefore, enumerate.

The tube of the microscope must be placed accurately horizontal, and so must the camera, and the axis of the tube of the microscope must be coincident with that of the tube fixed in the front of the camera, the former being thus exactly in the centre of the latter.

It is a moot point whether the eye-piece should be left in the tube of the microscope or not. It really depends on the eye-piece itself, some adding to the clearness of the picture and some detracting from it; the operator must, therefore, be guided by circumstances. If it is used the picture may be made larger; but, except for this, some writers say that they have seen pictures taken both with and without the eye-piece which were quite undistinguishable. If the eye-piece is not used, the tube of the microscope can be abolished, and the tube containing the objective used alone. The tube holding the eye-piece limits the field to a certain extent, and it is not wanted if the eye-piece is not used.

High powers are very difficult to manage to obtain good pictures. The beginner had, therefore, better begin with a low power—say 1 in.—and proceed to higher powers when he has mastered the beginning of his craft. He will find that ¼ in. or ⅛ in. are as high as he can work with comfort, but using sunlight one can get much higher than that, with skill.

There is one curious fact which, seeming trifling enough in itself, may influence the resulting negative, and therefore must be allowed for. Unless the microscope is a very first-class one, on looking at the object when in focus it will be found that it is surrounded by a *red* ring in one position, but if the plane of focus is slightly altered the object will be just as sharp, but surrounded by a *blue* ring. This is owing to the glass of which the object-glass is made not being achromatic. The latter position, in which the

object is surrounded by the *blue* ring, is the one to be employed, as red, being a non-actinic colour, will produce a black band round the object in the photograph, while the blue, being actinic, does not interfère with the white ground behind it.

One obstacle, which slightly interferes with the results obtained, consists in the diffraction images of parts of the object. These are more likely to be formed by the higher powers, as they depend mainly on the relative sizes of the object and the aperture of the object-glass. This is one reason why better photographs are generally obtained with lower powers. One writer says that the difficulty may be overcome by throwing the light from the source of illumination on to a translucent screen, and making this surface the source of illumination. The exposure, however, will of course be far longer under such a system of lighting.

A practical difficulty with which the worker has to contend is, that the long extension of the camera necessary places him so far from the fine adjustment of the microscope that it can sometimes only be reached with the tips of his fingers, and turned at the risk of upsetting the whole concern. This difficulty can be overcome in the following way, which is used by Messrs. Perken & Rayment in their microphotographic apparatus. A table A (see Fig. 2) is made of sufficient length to support the camera when racked out to its farthest limits, and of a height to make the camera when placed on it of the right height for the microscope. Through the centre of the supports (which are of the same length as the breadth of the top) is fixed a bar (B), having a milled head (C) at one end and a pulley (D) at the other. This latter is connected with the fine adjustment (E) of the microscope by means of an endless band, so that the fine adjustment can be moved by the milled head (C). The focussing is now begun by means of the screw (E), and the remainder accomplished by turning the milled head (C), which can of course be easily accomplished while keeping the head under the focussing cloth.

Ordinary ground glass is too coarse to focus upon, if very great accuracy is required. Two surfaces of ground glass can be rubbed together with a little of the finest emery powder, which will render the frosting finer; or an ordinary negative glass can be coated with the following mixture and substituted for the ground glass:—Gum mastic, 40 grains; gum sandarach, 160 grains; ether, 4 ozs.; benzol, $1\frac{1}{2}$ ozs.

Mr. G. E. Davis, in a book recently written by him, advises the use of an idea of his own for focussing, which entirely dispenses with the ground glass. It is, he says, much preferable to the old plan.

The ground glass slide is removed, and another of mahogany is substituted for it. This is pierced with a series of seven holes, into each of which the ordinary A eye-piece of the microscope will fit. The thickness of the slide is such that, when the eye-piece is pushed in as far as it will go, the diaphragm lies in the same place as the surface of the glass slide. It is very important not to make the slide thicker or thinner than this, or the surface of the plate will not be in the same place, and the picture will therefore be more or less out of focus. "To anyone accustomed to focus by the old method," says Mr. Davis, "the present system will be found a considerable improvement, it being easy, under these circumstances, to obtain a sharp focus with an ordinary paraffin lamp when using the $\frac{1}{16}$ in. objective."

BENT IRON WORK, AND HOW TO DO IT.

BY J. H.

The Advantages of its Pursuit—The Strips of Iron Employed—Tools—Tinmen's Snips—Pliers—Cutting Pliers—Round-nosed Pliers—Long-nosed Pliers—Pincers—Punching Holes—Vice and Anvil—Gloves—Elementary Forms—How to Bend Curves—Difficulties—Templet Rods and Pins—Various Curves.

The Advantages of its Pursuit.—Since the Italian Exhibition was held in London, this branch of amateur work has been steadily growing in favour. It has many claims to recommendation. It is almost the only kind of metal-work that can be pursued by ladies and invalids. It is inexpensive, for though prices charged for the iron strips—the chief expense—are prohibitory to many, I shall show how they may be obtained for the merest trifle of cost. The work when finished is saleable at moderate prices. When followed as a pastime many very pretty articles of domestic service can be wrought in it, which, unlike wood-work, are unaffected by temperature, and are not so liable to fracture and distortion. It opens an extensive field for amateur design, and for an endless variety of pretty detail. It is much more easily mastered than most amateur pastimes, than repoussé work, for example, or wood-turning or carving, or the construction of elaborate designs in fret-work; and much show can be made in very little time. There is practically no limit to the kind of work that may be made or ornamented with bent iron. It is applied to lamps, lanterns, vases, hyacinth-stands, wall-brackets, ornamental chains, candlesticks, panellings, lamp-shades, screens, flower-bowls, and kindred articles. There is scope, not only for variegation of form, but also of colour, not only by the use of paint and varnish, but by the combination of tin, and copper, and brass with iron. There is no doubt, therefore, that this branch of work will ere long become very popular. At present it is in its infancy, and many are seeking information about materials, methods, and designs. I will treat of the first in this article, and of the latter in subsequent papers.

The Strips of Iron Employed.—The bent iron work is formed, for the most part, of narrow strips of thin sheet iron, of about 20 gauge. It is usually cut in three widths, $\frac{3}{8}$ in., $\frac{3}{16}$ in., and $\frac{1}{8}$ in. The first is employed for main frameworks, the second for minor and ornamental details, the third for clips to hold the work together. These strips are sold in coils at from 1s. to 3s. per pound. Now this involves a heavy and an unnecessary outlay. As the sheet iron from which the strips are cut does not cost more than $1\frac{1}{2}$d. per pound wholesale, and as small quantities can be bought at about 3d. per pound, it is clear that an enormous profit is made by the ironmongers who cut the strips from the sheet metal. For those, therefore, who intend to do much work in bent iron it is much cheaper in the end to purchase a stout pair of shears, buy, say, half a sheet of iron, which would measure about 3 ft. by 3 ft., line it out, and cut it into strips by hand. A half-sheet, costing 6s. or 7s., would thus provide a stock of strips sufficient to make a large number of articles. Many might be able to borrow a stout pair of shears of a friendly blacksmith, and so save their cost. Working in this economical fashion, the cost of material need not become a deterrent to taking up this beautiful department of work which all can do.

When the strips are cut out they should be kept ready for use in a small compass by rolling them into little coils of about 3 in. diameter, and binding them with clips cut from the narrowest strips.

Tools.—There are other expenses to be incurred besides those for material. A few plain tools are necessary. But, at the outside, these need not cost more than 30s. The essential tools are the following:—

Tinmen's Snips.—Fig. 1 shows a pair of tinmen's snips. A pair 8 in. long costs about 2s. 3d. These are used for cutting off the strips of iron to the lengths required.

Pliers.—Pliers of various sorts and sizes are used for bending the iron. Their numbers and size will, of course, depend upon the cash available. With a wider range of tools a wider range of work can be done, with less of makeshift and lost time.

Cutting Pliers.—First there is the pair of cutting pliers (Fig. 2). These comprise flat jaws (A) and a cutting edge (B). The latter is not required so much, because the snips fulfil the purpose. Nevertheless, the pliers will cut off the narrower strips of iron if the snips do not happen to be at hand. The primary function of the pliers, however, lies in the jaws. Between their flat, roughened-up faces short lengths of strip are flattened out and straightened, curves that are not regular are corrected, the kinks being pressed out, and one end of a strip is held while the length left free is bent to any curvature required, or waved, or twisted.

Round-nosed Pliers.—The curves are imparted to the strips by means of round-nosed pliers (Fig. 3). These range from 4 in. to 8 in. in length. A single pair from 7 in. to 8 in. in length is the most generally useful. To this a smaller pair may be added at discretion. The jaws of the pliers being taper, give a gradation in diameter that renders them adapted for a slight range of curvature. But, for the most part, the curves formed do not correspond with the curvature of the pliers, being much larger, and much of the art to be acquired consists in the regular formation of these curves without being alternately flat and curved or "kinked." The only portions whose curves correspond with those of the pliers occur at the commencement of the volutes.

Long-nosed Pliers.—The long-nosed pliers (Fig. 4) are used both for turning round the larger curves and for correcting the flatter portions that occur during their formation. They are also employed in clinching the clips by which the scrolls and other ornamental portions are secured to one another and to the framings, the iron clips being pinched between their jaws upon the work.

Pincers.—Common pincers are also used for a variety of purposes in the manipulation of the strips.

Punching Holes.—Holes have to be punched in the iron for rivets. The punches are made of steel. What are called "brad punches" will do, being about $\frac{1}{16}$ in. in diameter at the point (Fig. 5, A). The iron (B) is laid upon the end grain of a block of hard wood (C) for support, while the punch is being driven through. A bench hammer of about $\frac{3}{4}$ lb. weight is also required.

Vice and Anvil.—A bench vice is also wanted. A watchmaker's vice will do very well, but a small parallel bench vice is better, because more suitable for the heavier work of the framings. A small anvil (Fig. 7, A), or a stake (B), or both of them, will also be very serviceable for bending and riveting upon. These can be pinched in the vice.

Work is commenced, and held in the vice during some sections of its manipulation,

and during filing. Upon the vice iron strips may be flattened, and upon its beak some curved portions can be more conveniently bent and hammered than with the flat- and round-nosed pliers.

Gloves.—For ladies' delicate hands, a pair of old kid gloves is almost indispensable. Without them the rough edges of the cut iron will scratch, and make the fingers sore. The inconvenience of working with gloves on will wear off with practice.

Elementary Forms.—Most of the elementary forms of curves used in the bent iron work are shown in the group (Fig. 8). They are not numerous, but are turned in many sizes and united in many combinations. Before attempting to construct any design in this work, it is better to devote a few hours to practice in these elementary forms.

How to Bend Curves.—In any of the volute or scroll forms marked A proceed as follows:—

Take the strip to be bent in the left hand, or in the jaws of the flat-nosed pliers held in the left hand, take the round-nosed pliers in the right hand, and twist the free end of the iron into the small curve, *a*. Work the pliers gradually outwards, forming in detail the enlarging curves of the volute, and so diminishing down to the small curves, *b*.

Difficulties.—But I must be a little more precise than this; for it is not so easy to form these curves as the description would seem to imply. The difficulty is to form flowing curves without flats or kinks. The first efforts will produce these results, and the way to prevent this is to work very deliberately, not trying to bend too much at once, and, where practicable, to avail oneself of the aid afforded by templet curves. The chief error to be avoided in bending curves is that of trying to do too much at a time. The small curves, whose diameters correspond pretty closely with the diameter of the pliers, are easily done; the difficulty lies in the flatter ones. The flatter parts should, therefore, be bent by a succession of rapid movements of the pliers, a very slight bending of the iron being imparted in each successive position of the pliers.

Templet Rods and Pins.—Have also a number of tapered rods of wood or metal handy. The curves can be bent quickly and accurately around these, the gradual increase in the curves being obtained by moving the work from one section of the rods to others. Also a number of short wooden pins of various curvatures can be tenoned into a board (Fig. 9), standing up only about half an inch, and the iron bent around these. Very many curves can be finished perfectly with such an appliance. The pins also afford a ready means of testing the uniform accuracy of a number of similar curved scrolls. Again, when finishing the smaller parts, *a* and *b*, it is better, when the terminal curve is very small, not to turn it completely with the wire pliers, for the force requisite to turn it is apt to alter the curvature of adjacent portions and produce kinks. It is better, then, to insert the small end of a mandrel and *pinch* the terminal curve round it with the flat-nosed pliers.

There is this advantage about bending the work: that the iron being so thin, all flats can be pinched out and good curves ultimately produced; but a great deal of time is wasted thus, so that it is better to learn the art of producing perfect curves at once, even though the process may seem tedious until practice produces expertness in the art.

Various Curves.—In Fig. 8 the curve, A′, is one of the minor curves that occur plentifully, being fastened with clips (shown enlarged at H) to the major curves, A. The curves at B are slightly modified forms of A, but they are very useful and very common. C and C′ are leaves, and are most easily bent. The centre of C′ is filled in with a midrib and scrolls: these are frequently formed in copper. For the tendrils (D) the iron is simply bent backward and forward with the wire pliers. E, E are tendrils of a different type, that lie closer to their scrolls than D. E′, E′ are supension chains, formed by twisting the iron continuously in one direction with two pairs of pliers. F, F are double curves, extensively used in ornamentation. G is a chain link used in bent iron work. H is one of the clips for binding the curves together. J is an ornamental border, carried round a panelled design.

We shall meet with the applications of these forms in subsequent articles, so that I need not dwell on them now. In the meantime, I want my readers to become familiar with their outlines, and to practise their formation. Strips of tin cut from old biscuit-tins will serve for preliminary practice, and cost next to nothing. In our next paper we shall treat, among other points, of riveting and the methods of punching holes; and so lead our students on by easy stages to a useful knowledge of Bent Iron Work.

Bent Iron Work. Fig. 1.—Tinmen's Snips. Fig. 2.—Cutting Pliers. Fig. 3.—Round-nosed Pliers. Fig. 4.—Long-nosed Flat Pliers. Fig. 5.—Punching Holes in Iron. Fig. 6.—Rymer. Fig. 7.—Small Anvil and Stake. Fig. 8.—Elementary Curves and Forms. Fig. 9.—Templet Pins.

AN ARTISTIC PARLOUR BOOKCASE.

BY F. JERMAN.

INTRODUCTION—DIMENSIONS—WOOD—PLINTH AND DRAWER—SIDE PANELS—ORNAMENTAL GALLERY—SHELVES—CONCLUSION.

THE accompanying drawings show how a very useful piece of furniture may be made ornamental, without the application of expensive material and fittings to attain this desirable object. Besides this, I have endeavoured to give a character of its own to the design, and at the same time to be careful not to violate the rules of good taste and proportion.

I have refrained from giving elevations, plans, etc., as they take up a good deal of room which might otherwise be filled with more interesting matter, and perhaps it might not be found convenient to adhere to the sizes given in such elevations. The sketch sufficiently shows the design and general appearance of the bookcase, so that the reader may easily get out his own working drawings from it, and the following description if he is so inclined. I should, however, mention a few sizes of the object from which the sketch is taken. The height from floor to cornice is 5 ft.; height to top, 2 ft. 7 in.; height to bottom of plinth, 1 ft. 4 in.; width along front, 2 ft. 10 in.; depth of bottom part, 1 ft. 3 in.; depth of bookshelves, 9 in. If these measurements are thought too small, they can easily be enlarged, care being taken to keep the same proportions: for instance, if it is advisable to make the case higher, the width and depth should be increased in similar proportion.

Walnut is about the best wood for the execution of this design, but it can be made cheaply in white deal. In this latter case the wood should be selected of an even grain and without large or loose knots. It is better to pay a higher price for the wood than to have cheap material covered with these defects. Brass fittings will afford a pleasing contrast with the wood. Figs. 6 and 7 show suitable designs for the handles and escutcheon.

The legs are $1\frac{1}{2}$ in. square, and taper, with brass shoes at the bottom for their protection. All the rails are $1\frac{1}{4}$ in. square, tenoned into the legs. Fig. 5 is a section through the bottom part of the front, and, as the reader will observe, shows the manner in which the boldly projecting plinth is made up, moulded fillets being applied in three places and the angles mitred properly. If the bookcase is made in walnut I would strongly recommend that the plinth be inlaid with lines of narrow brass, which will give a very charming effect. Care must be taken in setting out the contour of this plinth, as it makes a great difference if the profile is correct or not. The plinth gives an appearance of strength and solidity to the lower part of the bookcase. Small cut aprons are introduced to connect the legs and plinth.

The drawer is intended for the reception of loose prints and drawings. In making its front, allowance must be made for the projecting half-bead. This detail is very frequently met with on the edges of the door in old clocks. The drawer is otherwise made in the ordinary way with hidden dovetails. In fitting together, the front mould is apt to get damaged, and the necessary precautions should be taken to avoid this. Fig. 4 is the section of a mould run round the edge of the top. The two side panels are filled in with $\frac{1}{2}$ in. stuff, fitting at the back into rebates in the legs, etc. An excellent method of ornamenting it is to fill up the front with a design in fretwork. If this is cut out and filled in closely against the sides, it will have the rich appearance of sunk or "incised" work, as it is technically called, in which the ground is removed, leaving a flat projecting design. Fig. 2 is an original design which would prove suitable for the panel. It may be applied to various other purposes, apart from this bookcase. An ornamental brass-headed nail is shown in the centre.

Fig. 3 is a section of the cornice and the gallery above. This latter is formed of a top and bottom rail (the former has a mould worked on the edge). The turned balusters, or "spindles," are $2\frac{1}{2}$ in. high sight size—that is, between the rails—but allowance must be made for circular pins at top and bottom. When these have been procured from the turner's, the centre of each pin must be marked in the proper place, at equal distances apart on the rails, and the holes bored to admit them, being careful not to bore too deeply into the top rail. After trying the pins and holes, they are glued and put together. The top will accommodate a few vases or other ornamental articles.

The bookcase proper is formed of $\frac{3}{4}$ in. sides and shelves, the latter fitting into grooves cut in the sides. The shelves should be fixed to suit the size of the majority of volumes which they are required to accommodate. A row of books of different heights does not look well in a parlour. This bad effect is partly obviated by a leather bordering, cut to a scalloped or other ornamental pattern, and nailed with brass-headed nails to the shelf, at the heads of the books. The border also helps to keep out the dust from settling on the tops of the books.

In conclusion, I might add that the design will admit of much alternative treatment. Besides enlargement, as explained before, the plinth may be omitted and another drawer put in similar in size to the one above (in which case, of course, the apron piece must still remain), or the gallery may be removed and an ordinary or a circular pediment inserted at the top.

Much might be added concerning matters of detail, but as "Shop" is open to all readers of WORK, any question which it may be necessary to ask will be speedily answered in that part of our Journal. Thus, if any reader should be in difficulty about markets and prices for woods, I will willingly answer his queries, or possibly our specialist A. J. H. will do so. Then as to polishing or staining, so much has already appeared in WORK upon these subjects that little need be said on this head. Yet our Editor would prefer that no reader should debar himself the privilege of asking any specific questions on any matter not clear to him. With all this encouragement, then, wood-workers can safely go ahead with the present design.

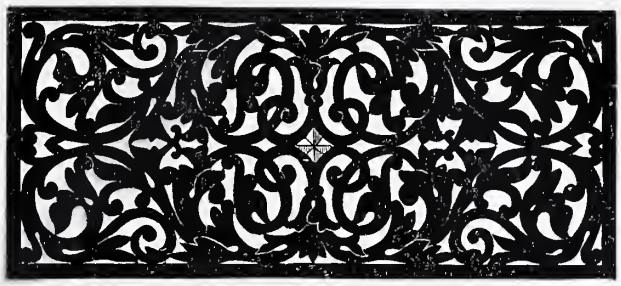

Fig. 2.—Fretwork Panels at Sides.

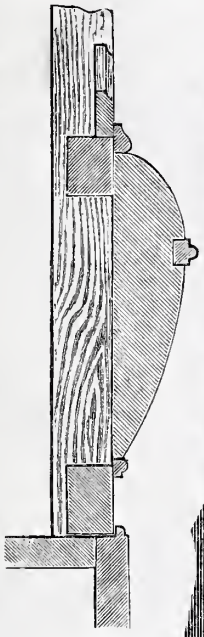

Fig. 5.—Section of Plinth, etc.

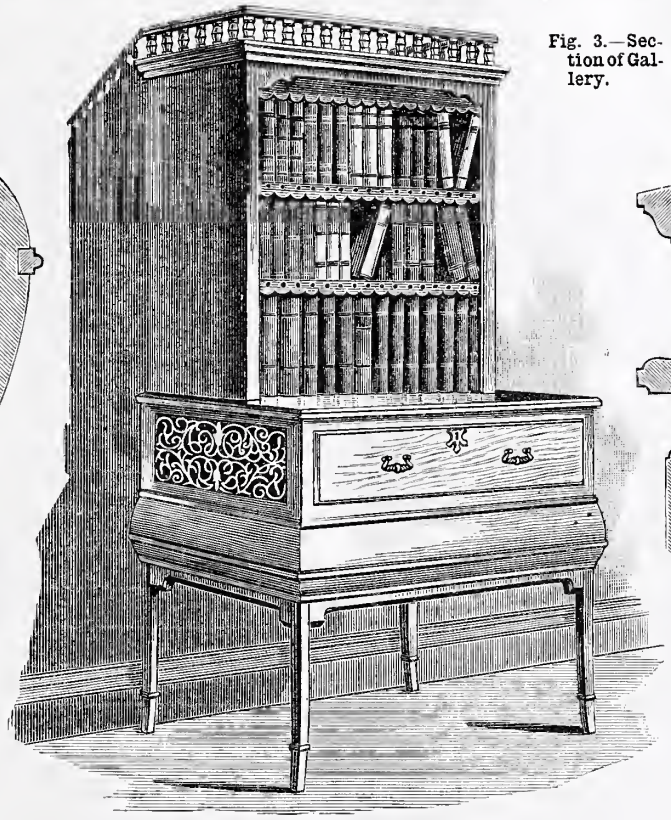

Fig. 1.—Perspective Sketch of Parlour Bookcase.

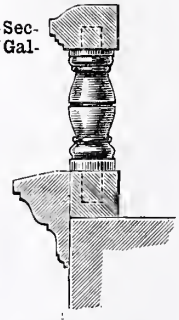

Fig. 3.—Section of Gallery.

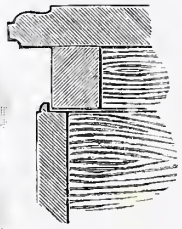

Fig. 4.—Section of Top.

Fig. 6.—Handle.

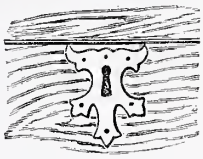

Fig. 7.—Escutcheon.

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OUR PROGRAMME. — With the present number of WORK this publication enters upon the fourth year of its successful, vigorous existence and influence, the latter extending —as the "Shop" columns constantly evidence—to the remotest corners of the world. A sense of this wide and rapidly-growing acceptance of the publication has led to a desire to still further extend the sphere and usefulness of WORK as a journal for workers; and it is with this view that arrangements have been made to incorporate those many new and important features announced in our previous number—features which will have the effect of rendering WORK unique amongst journals of its class. As the present number indicates, the variety, character, and excellence of matter and illustrations will continue as heretofore, while the new and important papers which have been arranged for publication in the present volume will show that much new ground will be opened up in nearly every branch of professional and amateur work. Most important, however, is the position which WORK will in the future occupy in relation to the Trade and Labour market—a position in which we are sure to have the cordial support of our thousands of well-placed readers. Already arrangements have been made for a weekly supply of Trade and Labour notes, and news from the chief home workshops and industrial centres; while from time to time will be presented direct intelligence from Colonial districts offering fields and opportunities for emigrants and workers who suffer from the overstocked condition of the home labour market, the fluctuations in which so immediately affect the workman, and in which he cannot but feel the deepest interest. Thus WORK enters upon something of a new existence, with a much wider and more extended field of usefulness before it.

ELECTRIC LIGHTING.—With a fitfulness which has hitherto been characteristic of this species of illumination, the electric light is once more disputing the place of gas in London. The St. Pancras parish authorities are making experiments which bid fair to become a complete success. The huge standards along the centre of the Euston Road are a great improvement upon the roadside uprights, inasmuch as a better distribution is afforded for the light, and the shadows, which were so great a defect in some of the experiments in other parts of London, are avoided. When the Euston Road lighting is completed, one of the worst thoroughfares by night in London will be transformed into a perfectly safe and valuable route for increased vehicular and pedestrian traffic. Hatton Garden—an important spot, as being the centre of the diamond trade, and where any day merchant and dealer may be seen disputing, in true Semitic style, the colour and carat value of treasures from Kimberley, Brazil, and New South Wales—is also to have the new light. This, too, in the offices as well as the street. Remembering the eight months of black, foggy weather which this climate affords us annually, the electric light will be a priceless boon to the buyers and sellers of precious stones who here do congregate.

BETTING.—No greater evil besets working men and youths in shops and factories than the disastrous habit of betting in small sums, especially upon horse-racing—a mischievous system which seems to have obtained with a class, who can least afford it, throughout the length and breadth of the land. With the flat-racing season in the immediate future, it is well to sound a note of warning against this pernicious practice, and to urge all employers of labour to exert themselves to an endeavour to abate the nuisance. Remedial measures are sorely wanted, and it is not difficult to indicate the direction from which these should spring. Schemes to make saving and habits of thrift more tempting to the working man are chiefly required. Betting and gambling largely obtain because the interest which the workman can get for his superfluous shillings is not worth his thinking of, and it is not surprising that the Post Office Savings Bank has no attraction for him. It ought to be within the power of every working man to become a part proprietor in the business—even though it be a small one—in which he has spent, or hopes to spend, the best years of his life; and when this system is liberally considered and carried out by masters and directors, a most effective blow will be given to the hopelessly unsound betting transactions in which working men somehow find time and money to engage—of course profitlessly. From time to time the bishops and ministers decry the evil from congress rostrum and pulpit. This is not enough. A practical effort is needed, and here a real piece of work is presented to the heads of religious denominations in this country. With the machinery at the command of the bishops, for instance, and their personal knowledge of the wants, ways, and means of their dioceses, it is not unreasonable to assume that many plans might be formed of a local nature for the profitable employment of monies of the poor, which as savings should come under the trusteeship of the bishops. Co-operative stores in every parish ought to be possible, and these with working results which, not forgetting the element of perfect security, ought to offer some better return for the invested savings than the Government $2\frac{1}{2}$ per cent. Some little practical effort of this kind would do more good than much pulpit oration in abating the betting evil amongst factory hands and shopmen.

DESIGN FOR MILKING-STOOL OR PLAQUE.

BY FLORENCE HUDSON.

This design may be carried out in various ways. It works out very effectively in wood carving, in low relief, with a roughened ground, and also may be treated in either of the ways suggested for carrying out the design for a chess-table in Vol. III., p. 769. It would look still better carried out in brass repoussé work.

As a decoration for a plaque, various methods suggest themselves. It may be painted in the natural colours of flowers and leaves on ordinary red terra-cotta, leaving the natural red as background; or on white terra-cotta or china, a soft blue background, gradually merging into brownish-green at the base, would blend well with the leaves and stalks there.

It might also be treated conventionally—the flowers white, or any fancied colour, with a gold or silver centre, the leaves and grasses in such colours as would contrast or harmonise well. The background might be entirely gold, or silver, or any metallic bronze, or the design might be outlined with gold after painting, and the background of one colour diapered with gold. It would help the student to have the natural corn and daisy before him or her.

Ox-eye Daisy and Corn Design for Wood Carving, Painted Plaque, or Milking-Stool; or for Repoussé Work.

HOW TO WHITEWASH A CEILING.

BY E. DICKER.

The first thing is to have the room as clear as possible, and tack a width of old newspapers round the walls half an inch from the ceiling to protect the wall-paper. The best way to tack the paper up is to cut sections or slices about a quarter of an inch thick off some ordinary corks, and drive the tacks through these, then through the paper into the plaster, making drawing-pins of them, as it were, with cork-heads.

Our next object is to thoroughly wash off the old distemper or whiting from the ceiling, being careful to wash the *ceiling* only, and not to let the dirty water run down the paper or splash all over the place.

It is of the utmost importance to have a scaffold board, at such a height from the floor that you can comfortably reach the ceiling. Have a pair of steps at each end of the board, though two chairs will answer the purpose, or even the table alone. Now, with a pail of clean water, a distemper brush, a large piece of sponge, and a piece of coarse canvas on the board or table beside you, start at one end of the room to lay or soak in a patch with water, gently stirring the old distemper with the brush. Get the old distemper thoroughly soaked, then wash it off with the canvas, finishing with the sponge, frequently rinsed in water. *The object for this is to get rid of every trace of the old distemper or whiting.* Do not wet the ceiling more than is absolutely necessary, and frequently change the water as it gets dirty. If the distemper is difficult to get off on account of the original coat having been "bound down," as it is called, instead of being washed off before it was re-whitened (and this is very often done for the sake of cheapness), two pennyworth of liquid ammonia in half a pail of water—in a separate pail—when you are soaking in, will greatly assist you. I should caution you against touching the paper with the brush, but to finish the last inch or so from the paper with the sponge or canvas.

If there are any cracks in the ceiling they should now be repaired by filling in with a

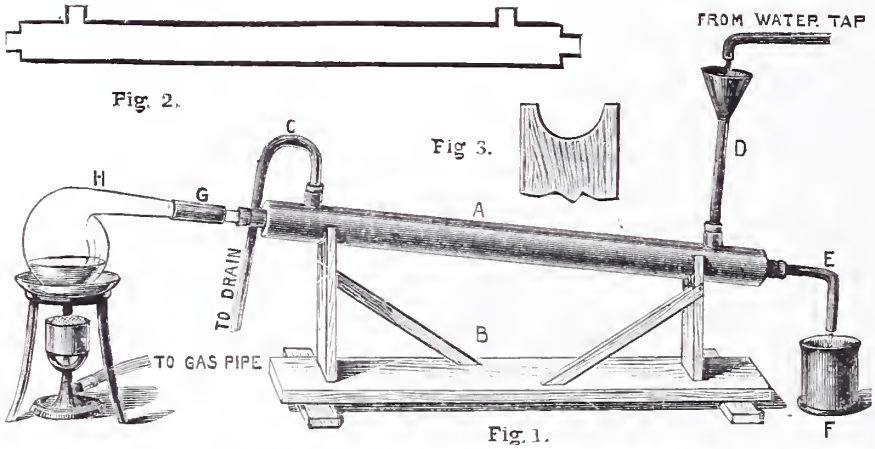
stopping-knife a little plaster-of-Paris mixed with water. Any loose plaster in the cracks should be got rid off before filling in. A little whiting mixed with the plaster will keep it from setting too quickly. Any dirty stains in the ceiling should have a coat of thin white paint, and if you have to paint any stains I should paint the cracks when they are dry. Now put a double handful of Young's patent size in a saucepan with about two pints of water, and put it on the fire until it thoroughly melts, stirring it all the while, being careful not to let it either boil or burn. When quite dissolved, turn it into a clean pail, and give the ceiling a coat of the size with your distemper brush, which must have been thoroughly washed before using it for this purpose. Of course, any paint, etc., on the ceiling must be dry before doing this, and you must take care to cover every part of the ceiling with the size. Do not take up a lot at a time in your brush, but simply dip it in the size about two inches.

To prepare the whitewash, break up into large pieces about four balls of whiting into a pail, and, just covering it with cold water, let it stand all night. In the morning pour off all water that will run away, and thoroughly mix the wet whiting with your hand until it becomes a thick, even paste. Now add about half an egg-cupful of dry ultramarine blue, stirring it well in with the whiting. Next put 2 lbs. of Young's patent size in a saucepan over the fire, with only just sufficient water to keep it from burning, and stirring it all the time, taking great care that it neither boils nor burns. When it is thoroughly dissolved pour it on the whiting, and mix the whole well together. Now set it aside in a cool place until it turns to a jelly. When it is quite cold, with a distemper brush rub it through a coarse piece of canvas stretched over the top of a clean pail, and it will then be ready for use. Now lightly rub over the whole of the ceiling with a piece of fine glass-paper, to take off any little knots or brush-hairs left by the clear-coleing. Dust the ceiling, and whiten it. The way to lay the distemper on is not to take up too much in the brush, and, whatever you do, be careful not to flick the brush at the end of each stroke, or you will splash everything. You can work the brush in any direction, but be sure that every part of the ceiling is covered with distemper, taking care to keep the edges of the various patches going—that is to say, do not let any edge get dry before you come to it again. This is why it is so essential to have a scaffold that is easily movable from one end of the room to the other. The whitening must be done very expeditiously; in fact, any ceiling over 14 ft. square should not be attempted single-handed without some previous practice.

If there is an ornamental cornice in the room too niggling to be got at by the brush, a smaller brush called a "distemper tool" is used both in the washing off and whitening. In using this brush in the whitening, push it up, as it were, into the ornamental parts as you would a stencil brush; in fact, it does not much matter how you get it on, so long as it is put on evenly and all covered.

A new distemper brush should be worn in a bit before you attempt to whiten a ceiling. The fact of washing off a ceiling will be almost sufficient to wear it in. After it is done with, wash it out thoroughly and lay it by, but particularly bear in mind, before you attempt to use it on any other occasion, to soak it in water, or you may find that the hairs will fall out through it being too dry. This last remark applies to nearly all brushes used in house decorating. The price of a good 12 oz. distemper brush is about 5s. or 6s., and a distemper tool 1s. The rest of the materials—which you would most likely have to purchase at an oil shop—are as follows:—4 lbs. size, 4d.; 4 balls of whiting, 2d.; ½ bag plaster, 2½d.; blue, 1d.; ½ lb. paint (if necessary), 3d.

The next paper of this series will be on How to Paper a Room—a most important consideration in view of coming hot days (which are certainly due to us) and the callousness of the average landlord respecting the comfort of tenants.



Liebig Condenser. Fig. 1.—View of Condenser complete—A, Large Tube; B, Stand; C, Tube through which heated Water escapes; D, Tube with Funnel at End; E, End of Glass Tube; F, Receiver for Condensed Liquid; G, Indiarubber Connecting Tube; H, Vessel in which Liquid is heated. Fig. 2.—Section of Tube. Fig. 3.—Upper Part of Support.

HOW TO MAKE A LIEBIG CONDENSER.

BY R. W. C.

The Liebig condenser is an instrument which is used in distilling operations. It is suitable for distilling water for photographic purposes, or for manufacturing scents.

Fig. 1 shows the condenser when completed, and the manner in which it is set up when in use. It consists of a large tube (A), which rests in a slanting position on a wooden support (B). Each end of the tube is stopped up with a metallic plate, and a long glass tube is passed through it and projects at both ends, but is bent at E and straight at the opposite end. A vessel (F) is placed under E to catch the distilled liquid as it drips out. The upper part of the large tube is pierced with two holes, into which are inserted a tube (D), having a funnel fixed to its upper end, and another tube (C), which is bent over as shown in the illustration. A retort or other vessel (H), in which the liquid to be distilled is boiled, is connected to the glass tube by a piece of indiarubber tubing (G).

The first part of the condenser which we will construct is the large tube (A). Procure a metal tube about 30 in. long and 3 in. in diameter; solder a piece of sheet zinc over each end so that it is quite water-tight. A hollow brass curtain-rod will form a very good tube, and will have a neater appearance than an ordinary soldered tube. Then bore four holes about ¾ in. in diameter, two through the centres of the metal plates and two through the top in the position shown in Fig. 1. These holes can be easily made by an ordinary metal drill fitted into a brace. Get a piece of brass tube 1 in. in diameter and 8 in. long, and cut it into four pieces, each two inches in length. Then solder one of these pieces over each of the holes which you have made in the large tube, which will now have the appearance presented by Fig. 2. Having done this, solder a flap of metal under the large tube about 3 in. from each of its ends. These flaps are to prevent it from slipping downwards when placed on the stand. Fit each of the four tubes with a sound cork, and paint all the metal work with any colour that you please. The tube may now be set on one side to dry while we proceed with the construction of the stand.

The shape of the stand is shown in Fig. 1. It consists of a base about 7 in. wide, on to which two upright pieces are fastened. These uprights support the tube: one is about two inches higher than the others, and the top part of each is hollowed out so that the tube will fit into it. The shape of the uprights is shown in Fig. 3. They are further strengthened by fastening braces, the position of which is shown in Fig. 1, on to the side of each and on to the base. In fixing the uprights on to the base they must be arranged so far apart that the distance between them is equal to the distance between the metal flaps which you soldered on to the large tube.

We will now construct the tubes C and D (see Fig. 1). The former is simply a brass tube bent into the shape shown in the figure. It is fitted on to the large tube by inserting it into a hole bored in the cork which was fitted into the small brass tube nearest to the end where the vessel which holds the liquid to be distilled is. The tube D is also a brass tube, and is fixed on to the large tube in the same manner as E. A tin funnel is soldered on to the top of it.

The glass tube which passes down the centre of the tube A must now be fitted into its place. It is about ½ in. in diameter, and can be procured from any chemist's. It is fitted into the metal tube in the same way that C and D are.

The condenser is now completed. To use it, the water or other liquid to be distilled is placed in a glass retort, which is connected, as was before observed, to the glass tube by a short piece of indiarubber tubing. The metal tube is filled with water by pouring some into the funnel until it begins to run out at the tube C, under which a vessel is placed to catch the overflow. The water in the retort is then boiled by placing a spirit-lamp or gas-burner underneath it. In a short time the distilled liquid will begin to drip out at E. Fresh water must be continually poured into the funnel, which will expel the heated water through C. This operation is performed by allowing water from a tap to drop slowly into the funnel.

STORY OF THE ST. GOTHARD TUNNEL.

BY HENRY FRITH.

There are five great European tunnels, each one of which has something to specially recommend it, whether as a marvel of engineering skill, for its elevation, for its peculiar scenery, or for difficulties of construction overcome. Of the Alpine railways connected with the great tunnels, the St. Gothard and the Arlberg will here chiefly claim our attention. But the Semmering line was the pioneer railway over the Alps of Europe. It connects Vienna with Trieste, and was opened in 1854. The Brenner railway is the most lofty; but, unlike the Semmering and other Alpine lines, it boasts no "summit" turned. The Mont Cenis tunnel was, in 1871, an easy first in magnitude until St. Gothard was pierced, and this magnificent success put all the other tunnels in the shade most completely.

Before the St. Gothard Railway was built, there was no direct line from frequented Switzerland into Italy. In 1869 M. Favre accepted the contract for this stupendous undertaking—how stupendous, how toilsome, and how dangerous comparatively few people stop to consider. What amount of work is represented by the railway? Just glance at a few simple facts and figures before peeping into the tunnel itself.

The line occupied nearly ten years in construction—from 1872 to 1882. It was opened on the 1st of June in the latter year. The cost of the line was 238,000,000 francs; or, roughly, £9,520,000. It climbs from the level of the Lake of Lucerne to a height of 3,786 ft., and its greatest gradient is 1 in 4. It will give some idea of the work generally performed if we state that there are altogether fifty-six tunnels of more than twenty-five miles collectively in length; there are forty-two viaducts and bridges of considerable size and span, besides arches. The wonderful spiral tunnels are a peculiar feature of this truly magnificent route.

On the 6th of December, 1871, the St. Gothard Company was formed; the chairman was Doctor Escher, of Zurich. To the aggregate amount already mentioned as finally required, Italy, Germany, and Switzerland contributed in certain proportions: Italy paid about £2,250,000, and the others £1,500,000 each as subsidy.

The construction of the tunnel through the summit of the pass was confided to M. Louis Favre, who took it in hand on the 12th of September, 1872. The preliminary work of pushing in the headings was performed at Göschenen on June 4th, 1872, and at Airolo on July 2nd. The obstacles met with were almost sufficient to damp the boldest spirits. At first only hand-labour was employed, and the hard, stubborn rocks, the invading water, the unyielding clay, the giving way of masonry caused by pressure, all militated against M. Favre and his army of workmen. The springs tapped were formidable, the want of air trying; still the labourers persevered. Four thousand men, all of the nationalities interested, dug and carted and bored doggedly day by day.

Boring machines—Ferroux perforators—were employed, and worked by air compressed into one-twentieth of its volume by water-power at hand. This air was stored in large reservoirs, and admitted by means of pipes into the workings, where the rock perforators were forced by it with the greatest velocity of the pistons. Eighteen hundred strokes a minute, each stroke hitting the rock with an estimated force of two hundred pounds, meant business!

The cutting of this immense tunnel was proceeded with in a straight line from both ends simultaneously. When a number of holes had been perforated by the machines, dynamite was introduced, the match was lighted, a horn blown to warn the men, and then, after an anxious pause, a tremendous explosion shook the mountain. The smoke was driven out by compressed air, the shattered masses removed, and the boring was recommenced.

An "air locomotive" was employed to drag the train of trucks laden with the *débris*. The appearance of the workings was fantastic in the extreme. A deep, dripping aperture, in the gloomy depths of which lanterns could be seen flitting about, the sound of trickling water and rushing cascade, a dull explosion, the rattling of the "engine," the banging of trollies, the glistening rocks, the sense of impending danger, and the consciousness of 6,000 ft. of solid mountain overhead, were quite sufficient to occupy one's senses and furnish food for reflection.

But not to Nature alone were all the difficulties to be ascribed. A riot occurred amongst the workmen in July, 1875, and serious consequences were feared. But it was quelled after a while. Then the burning of Airolo interrupted operations in 1877; but of all the saddest days in those sad years of toil was the 19th of July, 1879, when M. Louis Favre died.

He was visiting the works with some friends, and speculating upon the completion of the work, when, inside the tunnel, he was struck by an apoplectic fit, and fell into the ready arms of his companions. Every possible remedy was tried, but in vain: he died almost immediately, on the scene of his great undertaking, amid the darkness and the turmoil of the works.

This untoward event, however, could not be permitted to interfere with the progress of the tunnel. A touching tribute to the energetic and practical Favre was paid by his workmen to his remains, and a public funeral attested the estimation in which his native canton held him. He "should have died hereafter!" Meantime, the great work proceeded.

During the month of February, 1880, it became evident that the tunnel would be perforated shortly. The workmen could hear each other, and speculation was rife concerning the point at which the first perforation would be made. Would the men and machines meet? Had the levels been correctly estimated? Had the direction been properly maintained? More than nine miles of solid earth, and still more solid rock, had originally separated the workmen. Would they meet within the mountain depths, or were they pursuing each other in vain? Were those echoes or the tapping of the rival machines?

On the 29th of February, 1880, all doubts were set aside. The last thin stratum betwixt the northern and southern armies of labourers was pierced. The men greeted each other cheerfully, delighted that the bore had been so true. But for awhile the hand-grips were withheld. A small case containing a portrait of Louis Favre was the first thing to pass from hand to hand. So the men recognised their master, and honourably gave him the *pas*.

There was only 2 in. difference in the levels, and only 13 in. in the directions of the cuttings, through all those miles of mountain! The actual length of the tunnel proved to be just 25 ft. shorter than the estimate calculated in surveys! Well might we exclaim "Prodigious!" in the face of such close calculations as these.

The men had met, but the tunnel was by no means yet completed. It was not actually finished until New Year's Day, 1882—now ten years ago. The cost of the tunnel was about £2,320,000. Its length is 16,308·9 yards—9¼ miles. Its elevation varies from 3,638 ft. north to 3,756 ft. south, above the sea, and 3,787 ft. in the centre. It is 2,930 yards longer than the Cenis Tunnel; the slope is 6 in 1,000 on the Swiss, and 2 in 1,000 on the Italian side.

The St. Gothard Tunnel has a double line of rails, and is lighted by lanterns. There is no inconvenience in the transit of sixteen or seventeen minutes; and last year the writer experienced no sense of discomfort, save "blacks," even outside the carriage. The "helicoidal" tunnels are unique, but we have no space to describe them here. The other tunnels are lengthy. Of all on the line, fifty-six in number, twenty-seven are to the north and twenty-eight to the south of the Great St. Gothard Tunnel.

In our next paper in this Series of Great Engineering Triumphs we shall hope to interest our young readers especially in another not less wonderful example of labour and enterprise; and from time to time so extend the stories as to gradually make our readers familiar with the greatest among these vast monuments of skill and patience.

SCIENCE TO DATE.

Diamonds in Meteorites.—During the early part of last year a discovery was made of several masses of meteoric iron in Arizona. An examination of these meteorites in the laboratory has revealed the interesting fact that they contain diamonds, both black and white. They are small, and of little commercial value, but the discovery is interesting mineralogically, as it is the first time that diamonds have been found in meteorites, though their presence has been suspected.

Carbon and Iodine Compound.—A very interesting compound of carbon and iodine, of which the formula is CI_4, has been recently discovered by M. Moissan, the eminent French chemist, who is so well known by his experiments on fluorine. Carbon tetra-iodide, as the compound is called, is prepared by heating boron iodide (a substance which has also been recently discovered by M. Moissan) and carbon tetra-chloride in a sealed tube for one hour at a temperature of 80° to 100° C. The new substance is, after purification and sublimation *in vacuo*, obtained in magnificent brilliant red crystals, resembling the artificial rubies prepared some time ago by M. Fremy. It possesses very remarkable chemical properties, acting energetically with many substances. One particularly interesting reaction is that when dissolved in carbon tetra-chloride and warmed with silver fluoride it gives off gaseous carbon tetra-fluoride.

Electricity and Light.—M. Blondlot has recently made a determination of the velocity of propagation of electro-magnetic waves. He finds it to be approximately 186,000 miles per second. This agrees with the best determinations of the velocity of light, and lends valuable evidence in support of the conclusion that luminous vibrations are only particular cases of electro-magnetic vibrations.

New Alloy of Aluminium.—A new alloy of aluminium and titanium has been discovered by Mr. Langley, the well-known American astronomer, which possesses a hardness almost equal to that of steel, while it is not much heavier than aluminium itself. The proportion of titanium added must be less than ten per cent., for if it exceeds this quantity the alloy becomes too brittle for ordinary purposes. It is very probable that this alloy will become of great industrial importance.

NOTES FOR WORKERS.

British oak timber is stronger than that grown in Canada and Dantzic.

Ivory can be made soft and nearly plastic by soaking in phosphoric acid. If washed with water, pressed, and dried, it will regain its former consistency.

The best wood for an aquarium is East India teak. No metal should be exposed to the water.

Edison will exhibit at the St. Petersburg Electrical Exhibition a speaking watch. The dial represents the human face, and within is a phonograph. The mouth opens and tells the hours, half-hours, and quarters. It can also be used as an alarum, remarking several times running at the set time, "It is time to get up."

Canada Balsam can be cleaned from microscopical slides by rubbing them with a rag dipped in spirits of turpentine or benzine.

The velocity necessary to carry a gaseous molecule from the moon to the earth is a little over two miles per second.

Fifty-three per cent. of all the sugar now sold is obtained from the beetroot, the remaining forty-seven per cent. coming from the sugar-cane.

When first tried—about one hundred years ago—the amount of sugar got out of a beetroot was only two to three per cent.; it is now about fourteen. This is due to improved machinery and to the improvement of the roots themselves from careful cultivation.

During the late earthquake in Japan there were seven hundred and thirty distinct shocks. This earthquake is thought to have been caused by a mountain, which has disappeared, falling into one of the bottomless underground cavities which are known to exist.

The quantity of blood in the human body varies, but is generally about one-tenth the total weight of the body.

TRADE: PRESENT AND FUTURE.

Cycle Trade.—The season 1892 has opened auspiciously. Makers and wholesale dealers are everywhere jubilant over the reception given their representatives and the large orders placed with them for the season just opening. Apart from home consumption, so to speak, large consignments of cycles are exported to America, our colonies, as well as the continent of Europe. These consignments are larger and earlier than in any preceding year. The St. George's Engineering Co. despatched to the Continent last month the largest consignment that ever left Birmingham. The magnitude of the orders placed this season may be gathered from the fact of a Glasgow firm of dealers having received from a Birmingham maker a consignment of 1,000 safety bicycles, and in little more than two weeks they had sold of them over 150. The run on these machines has been so great that the firm has raised the prices. This firm can show a stock of 1,500 machines. A Wolverhampton maker—by no means the largest—has orders on his books amounting to £5,000, and is prepared to turn out 2,500 machines during the present season.

Timber Trade.—As an instance of the great increase in the consumption of wood in London, it is worth noting that, while in 1855 it was 6,802,000 pieces, in 1890 the number had increased to 33,198,000. Padouk—an East Indian wood very similar to mahogany, but of a redder colour—is now making its way in the market, and is much used for handrails, bath-tops, panels, and for furniture, as it looks very beautiful when polished. Some ceiling ornaments made of wood-pulp in imitation of plaster were offered up at a timber sale-room in London last week, and were sold at prices varying from 2s. to 9s. 6d. each, according to pattern and size.

Joinery Trade.—At the last meeting of the Edinburgh and Leith joiners, a report from the Conciliation Board was submitted, embodying the draft of the working rules. A good deal of discussion took place, but ultimately it was agreed to accept them in the meantime, and to modify them afterwards in the light of subsequent experience of their working.

Painting and Decorative Trades.—Trade in London this season will be rather quiet. White lead is low in figure; leading London houses are offering "Genuine" at £20 per ton for this season's delivery. The strike of London carpenters has done for the building-trade house-painters as much injury as the recent death amongst royalty has effected in West-End trade. The uncertain condition of political matters is also very prejudicial to a good season of work in town. The prospect for the provinces generally is good. Sanitary papers are the special feature of this season's "new goods." Although, like the early Japanese leather-papers, these paper-hangings were originally chiefly noticeable for their faults, the great improvements in trade machinery that have taken place these last three years have put sanitaries in the front rank of 1892 sales. Not only are they practically perfect in artistic effect, but the prices are this year cut remarkably low. An eminent North of England house, who make "sanitaries" their speciality, have produced some cheap lines for retailing at 6d. per roll, the appearance of which is equal to many pulps and grounded papers sold at 1s. per piece.

Hardware Trades.—Cutlery and silver trades, as also razor and scissors trade, and the fine kinds of steel trade, which since the opening of the year have been so depressed, are looking up a little, and if the improvement is steady we may look forward hopefully. A strike has recently been averted at a large Sheffield steel worker's by the masters conceding an advance in wages. This was only after notices had been handed in and the representatives of the trade society requisitioned. A large firm in Sheffield has taken the initiative in pensions for aged workpeople employed. There is real need of wage reform in the hardware trades, it being the lot of workers, even after working for firms for thirty years without short time, and through no fault of their own, to end their days in need and want. A great deal of talk is going on amongst the manufacturers of Sheffield as to their not sending goods to the Chicago Exhibition, and it does not appear as if very many would take part in it.

Boot and Shoe Trade.—Trade is not brisk in the best London hand-sewn work. At a recent meeting of the London County Council the Joint Store Committee reported having ordered twenty pairs of boots to be made by Mr. G. Clark at 45s. per pair, and ten pairs of Mr. G. H. Beaver—these ranging from 30s. to 45s., according to height of leg—the object being to thoroughly test them before ordering a large quantity, as it has been found difficult to get the kind of boot required by men working in sewers. It was urged "that the committee be authorised to order the boots, subject to an estimate being submitted to the Council by the Finance Committee as required by statute," and this was agreed to.

Glass Trade.—The plate-glass market has of late been subject to some very striking fluctuations, and prices have recently been at a very low ebb. If anything comes of the talked-of Yankee patent, which is supposed to make best plate at about one-third its present cost, there will surely be a revolution in this line. This is the age of big panes, when a polished plate 200 in. by 150 in. is no rare thing.

Engineering Trade.—The present condition of the Lancashire engineering and iron trades is anything but encouraging, and unfortunately the prospects of improvement are very slight. Many of the leading firms of machine-tool makers, who for the last three years or so have been exceedingly busy, report an almost complete dearth of new orders, and several establishments are already very short of work. Most of the large stationary engine builders report a marked decrease in activity, while the locomotive-building firms are decidedly quiet. This latter fact is generally considered to indicate the likelihood of a continued absence of new business in the engineering industries. The general depression in the iron trade of the district continues, the disturbance in the coal market affecting makers' prices but slightly.

Building Trade.—There is every prospect of a good year for workmen in the building trades in Rochdale and district. Cottages, Co-operative Stores, and a new Board School and Technical School are in the hands of local firms, and, as most of the mills in the neighbourhood are fairly busy, matters may be said to be going well. In the adjoining village of Castleton some large engineering works are making rapid progress, bricks being used up at the rate of about thirty thousand per week, and much more building is expected to be done in connection with them. This improved outlook has caused the workmen to consider their interests, and one section of the building trades (the joiners) has given notice of an advance of wages, to take effect in July. This action has been taken at the instigation of the local branch of the Amalgamated Society of Carpenters and Joiners, and will most likely be followed by similar pressure on the part of the other trades.

SHOP:

A Corner for Those who Want to Talk It.

*** In consequence of the great pressure upon the "Shop" columns of* Work, *contributors are requested to be brief and concise in all future questions and replies.*

I.—Letter from a Correspondent.

Industrial Exhibition. — The Secretary writes:—"Lady Jeune will open, on March 23rd, the fourth exhibition in connection with the Waterloo Road Chapel Sunday School, Lambeth, S.E. Readers of Work may send exhibits to the Loan section, which will consist of Drawings, Paintings, Maps, etc., Models in Cardboard, Cork, etc., all kinds of Woodwork, Fret Cutting, Turnery, Photography, Models (working, etc.), Curios, Microscopical, Electrical, or other Scientific Apparatus, Engraving in Wood, Steel, and Copper; also Wood Carving, Modelling, and Pottery. Certificates of merit will be awarded."

II.—Questions Answered by Editor and Staff.

Battery for Small Coil.—W. W. (*Forest Gate*).—Yes, you can work a small coil with current from a pint Leclanché cell, but the coil must be very small, and the work expected from it be also small. As you have omitted to state the intended use of the coil, I cannot tell you how to construct one. As the induced current from a small coil capable of being worked with a pint Leclanché cell would be very feeble, I cannot imagine any real use for such a coil. If you will read carefully the series of articles on "Induction Coils" now appearing in Work, you will learn how to make and work a small coil.—G. E. B.

Electrical Engineer.—W. J. M. (*West Kensington*).—(1) I do not think it possible to get your brother into a good firm of electrical engineers to learn the profession without paying what you would deem a high premium—say, from £150 to £250. (2) There are several good firms in London who receive pupils or apprentices when a vacancy occurs. You will find their names in an Electrical Directory. There are also some in the provinces, but I do not know of one in the Isle of Wight. (3) The usual term is from two to three years, without salary. (4) Undoubtedly electrical engineering is likely to prove a good profession, and there will soon be room at the top in this and other countries for many thorough good men. (5) There is a School of Electrical Engineering in Prince's Street, Hanover Square, London, W. Write to the secretary for prospectus and terms, or see him yourself, and be guided by his advice. This will be better than I can give you here, as you will have the advantage of a personal interview with him.—G. E. B.

Tools for Turning Parts of Model Engines.—S. C. T. (*Knutton*).—You should certainly get a book on Model Engine Making. Send 2s. 6d. to J. Pocock, Garth, Bangor, North Wales, and he will send you a very useful little book; we could not get such helps when we were boys. You require but few turning tools, and you can make them out of old files if you like, and if you know what shape they should be. You require, first, a graver: this is made of square steel, and will do of $\frac{3}{16}$ in. square. It would be best to buy a Stubbs' graver at a tool shop for a few pence, though you could make it from an old square file. Secondly, you want a side tool, which may just as well be made out of a saw-file about 4½ in. long. These two are shown in the sketch at Figs. 1 and 2, and they are for use on iron and steel. Also you want Figs. 3 and 4 for use on brass. Fig. 3 is called a router, and is made of

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Turning Tools. Fig. 1.—Graver for Iron and Steel. Fig. 2.—Side Tool for Iron and Steel and for Scraping. Fig. 3.—Router for Brass. Fig. 4.—Scraper for Brass in Lathe and for Flat Surfaces.

square steel; you can make it from a square file, or from a $\frac{3}{16}$ in. graver, by grinding a rounded end almost squarely off: it is a good plan to have it ground square, because then you have two sharp half-round edges, and can turn it over when one side is blunt. The router is used for roughing out in brass. Fourthly, you want a flat tool or scraper for brass (Fig. 4). This will do of a flat file about 5 in. long by ⅜ in. wide: a fine-cut file would be best, as you must grind off the teeth at the end, as shown; the front edge should be quite thin—say, $\frac{1}{16}$ in. thick—and, after grinding, you can rub it on an oilstone, holding it perfectly upright. No. 2 will also do for scraping iron, such as a valve-face; and No. 4 will do to scrape up the brass slide-valve to work upon it. The temper or hardness of these tools, as made from gravers and files, will be better than anything you could have forged by a smith. When you have got them, show them to a workman, and ask him if they are rightly shaped, and get him to show you how to use them.—F. A. M.

Lenses.—H. S. M. (*Highgate*).—The price of the object-glass mentioned in the note to which you refer was taken from the catalogue of H. and E. J. Dale, of Ludgate Hill. However, since your letter reached me I have written to several dealers, and find in the catalogue of Mr. Caplatzi, of Chenies Street, Tottenham Court Road, W.C., lenses of various qualities and prices, and this catalogue you should obtain. I notice that he supplies a 2½ in. achromatic object-glass *in a brass cell* for 3s., 6s., 12s., and 21s., according to the quality. Your other question respecting the refracting telescope will be answered in illustrated papers which will shortly appear in Work.—E. A. F.

Lithographing on Zinc.—Zinco.—In answer to your question, How to prepare common sheet zinc for lithography, if you refer back to my answer to Litho, in "Shop," on p. 509, No. 136, Vol. III. of Work, I think you will find all you require to know. In etching the plate, after the drawing has been completed, use a preparation of nut-galls in preference to acids, which should not be allowed to remain on the plate longer than is absolutely necessary just to etch the work. It should then be washed off, and the plate gummed in the ordinary way; when dry, wash the plate with turpentine, without first washing off the gum (which would be done in the case of a stone); after which, roll up in the usual way. I think if you try the above etch without allowing it to remain on the plate too long, you will find the printing ink catch in the right places. It was perfectly right to use litho-writing ink to do the drawing with, and certainly lithography can be done with a hand-press.—A. J. A.

Dimensions of Dulcimers.—W. S. (*Appleby*).—There is practically no limit to the size of a dulcimer, so long as you keep the proportions correct. Thus, an octave D would be half the size of an ordinary D, and one twice the size would be called a D D (double D), and the same with F's or G's. The largest made in the ordinary way is the A, the dimensions of which would be: length in front 4 ft., at back 2 ft., depth 2 ft., compass 3½ octaves. This, however, is a rather unwieldy instrument, and is very seldom made, the most useful for all purposes being the D. The A is always made with five, or even more, strings to a note, and this necessitates a much stronger construction of the shell to stand the increased pressure, or "draught," of strings, and also a considerable strengthening of the belly by means of stays. Its tone is not nearly so pleasant as that of the smaller ones, owing to the confusion arising from the undamped strings.—R. F.

Corner Cupboard.—BARKIS, B.A. (*Australia*).—I should like to draw our readers' attention to the land of your abode as evidence of the extensive popularity of our journal. The corner cupboard which I have designed will, I believe, be acceptable to you. As you see, it is very simple; but my suggestion for the arrangement of the upper parts will provide an effective disposition of light and shade, which is desirable, as a rule, in dark corners. Make the job in two carcases, screwed together at the point immediately above the lower brackets and the bottom of the top cupboard. Unite each pair of sideboards by dovetailing, or else by mitring the

Fig. 1.

Fig. 2

Corner Cupboard Design.

back edges, and screwing a stout post in the angles, as in Fig. 2. Run a post up at the front apexes between the two top doors to receive the free ends of the latter. Both the vertical edges of the lower door will need bevelling. The bottom and top boards of the upper carcase are proposed to be quite square. You can either use solid boards as back boards, or construct them as rebated frames to receive a matchboard backing. The sizes I hereafter name will be suitable, but they really depend upon the size of your room. Lower door, 20 in. wide and 24 in. high; space, 12 in. deep; total height, 6 ft. Side boards, 1 in. thick; top and bottom boards and doors, ¾ in. thick; intervening boards, ½ in. thick.—J. S.

Stage Carpentry, etc.—A NEW READER.—Articles on Stage Carpentry appeared in Nos. 140, 144, and 149; and Short Lessons in Wood-working in Nos. 138, 139, 140, 141, 142, 143, 144, 145, 146, 148, 149, 151, 152, 153, 154, 155, and 156 of WORK.

Most Useful Chuck.—CHUCK.—You are anxious to know whether the American scroll chuck is the most useful. I must suppose you have the usual fork chuck for driving wood, the driver chuck for iron, etc., to be turned between centres, and the screw-nose or cup chucks, for holding wood or other materials to be bored or hollowed out. These are the most useful, and they are supplied with all new lathes. Next to these in utility would come either a face-plate, bell chuck, or an American Universal; and which is best for you I cannot possibly tell without knowing what work you wish to do: it is almost like asking which is the most useful of carpenters' tools. A very good Universal is Cushman's 3 in., with three pinions and two sets of jaws (for inside and outside work): it costs £2 15s.; the 2 in., £1 14s.; and another £3 6s. These chucks are imported by Churchill, of 21, Cross Street, Finsbury; any ironmonger would get one for you. Then you would have to make a cast-iron flange to screw on to the mandrel nose, having a projecting fitting turned on it to fit into the recess in the back of your chuck. If you cannot do this, you will have to send the new chuck and your headstock to a workman, who will probably charge you about eight shillings for fitting the flange.—F. A. M.

Lacquer and Black for Iron Goods.—J. W. (*York*).—By describing the bronze lacquer you want, you will doubtless be able to get it (at first hand) from Tubbs & Wilkins, Hockley, Birmingham. Drop-black ground in turps, with an addition of one-eighth bulk of japanners' gold size to bind it, has been recommended as a good black for iron-work.—S. W.

Overmantel.—NEW READER.—Much has been written concerning overmantels; and I strongly advise you to obtain the indexes to Vols. I., II., and III. of WORK, which are procurable through any newsagent at 1d. each. White chestnut is a wood I rather incline to. If, after you see back numbers, you are still doubtful, write again.—J. S.

Macramé Board.—W. S. (*No Address*).—As the board described on p. 681, No. 147, differs from others only in minor matters, the method of commencing is the same as for them. I may say that the first foundation string is tied or looped on to the nail or pin at the left hand of my board (see Fig. 1, p. 681), and then tightened up as much as possible by means of the peg at the right. Two, or even three, strings are usually employed, and when strained quite taut, raise the bridges. Now comes the setting on of the strings; and the number and length of these depend entirely on the pattern chosen. But should W. S. be conversant with the stitches, he will surely have no difficulty in going ahead; if he is not, let him learn them first, and then, if he is at a loss for a "tip" or a "wrinkle," I shall be very pleased to give him either—always supposing our Editor to be sufficiently long-suffering. I might remind W. S. that macramé lace is as much out of place in the pages of WORK as knitting or crochet would be.—PASQUIN.

Incubator.—R. W. (*Fence Houses*).—All your queries have been dealt with in my replies to previous correspondents, which please refer to. Purchase the index to Vol. III.—LEGHORN.

Hot-Water Supply.—NO NAME (*Manchester*).—If you syphon the cold-water supply before allowing it to enter the return, it will prevent the water boiling back into the cistern, and you will, no doubt, find the apparatus work properly. Do not lower the cistern in putting in the syphon; it is quite low enough already. If you raise it, you must lengthen the air-pipe in proportion. You will probably find that the two leaky joints have "taken up"—*i.e.*, stopped leaking—by this time. It is not an uncommon thing for a joint to leak a little at first. If they do not stop, you must empty the pipes, rake the joints out, and re-pack them again as before.—T. W.

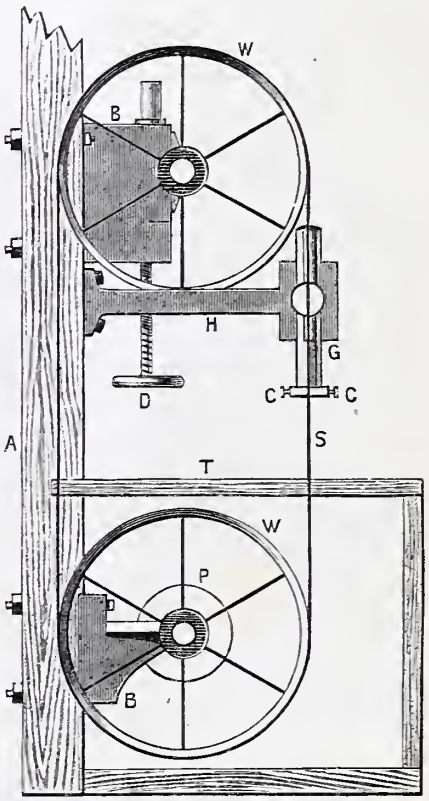
Waterproofing Canvas Shoes.—G. E. B. (*Ipswich*).—There is a solution of rubber, sold in tins by the waterproofers and indiarubber manufacturers, which is used for joining the seams of rubber-proofed material, which we think might be successfully used for the purpose named by our correspondent. We would not advise the *manufacture* of the solution, as it is both slow and troublesome. It seems to us if G. E. B. procured some of the solution, with about half a pint of strong mineral naphtha, and had his canvas shoes perfectly clean and dry, he might damp them well with the naphtha, and then apply the solution with a moderately stiff brush all over the canvas; and when the naphtha has evaporated he will find that the surface of the canvas and the interstices will be covered with a thin coat of indiarubber, which, so long as it is sound, will keep them thoroughly water-tight. He must be very careful not to use the naphtha or the solution near any lamp, candle, or gas; and as the solution thickens by evaporation, he may add some of the naphtha to produce the required consistency. The proofing of the material for an air mattress will have to be done by a firm possessing the necessary plant, machinery, and facilities, as well as experience, needed for this work.—C. E.

Saw Hammers.—A. C. R. (*Cardiff*).—In my reply (see p. 699, Vol. III.), please read, "The roundness of the faces of the cross-face hammer should not be so much in a hammer used for hammering saws after they have been ground."—A. R.

Auriphone.—AURIPHONE.—If our correspondent will apply to Messrs. J. G. Murdock & Co., Farringdon Road, E.C., he will obtain the music he requires.—G.

Small Dynamo.—C. F. W. M. (*Enfield Lock*).—To build a receptacle for a dynamo, and then build a dynamo to fit the limited space at your disposal, seems to me to be the converse of a wise arrangement. You have left me in the dark except on one point: "The dynamo must not be longer than 1¼ in." I cannot plan a dynamo for you with such meagre information, so will merely advise you to wind as much silk-covered No. 26 wire as you can get on the armature, and as much silk-covered No. 32 as you can get on the fields, connect in shunt, and drive at from 2,000 to 3,000 revolutions per minute. You *may* then get enough current to light a 4 volt 2½ c.-p. lamp, or a smaller one, as shown in your sketch. You have not told me enough. I must know more to advise you properly.—G. E. B.

Band-Saw.—N. DE P. (*No Address*).—As you want to fit this up yourself on a cheap scale, you must not expect to do it with all the latest improvements. I give a sketch of a machine. The upright (A) is a piece of timber fixed in the ground or to a beam stayed and sufficiently strong to prevent vibration; B, B are cast-iron brackets, bolted to the pillar or upright (A). The bottom bracket has a long bearing, in which the shaft runs that carries the bottom wheel. This is keyed on one end of the shaft, and on the other is a tight and loose pulley, over which a belt is driven. The top bracket is a hollow casting, in which a spiral spring is enclosed, and in which slides a plate of iron, with a pin cast in it, to carry the top wheel. D is a hand-wheel and screw; by the turning of it the top wheel may be raised, giving the saw its required tension; H is an arm to hold the saw-guide (G), which has a slot in it, so that it may be raised or lowered to suit different depths of wood; C, C are guide-screws, which keep the saw in the centre and from twisting, if small pieces of wood are placed on either side of the saw. A similar guide should be fitted underneath



Band-Sawing Machine.

the table. T is the table, which is made of wood, on which rests the wood while being sawn; W, W are the wheels on which the saw runs. These should be covered with rubber bands, to lessen the possible breakage of the saw. The top wheel should not be less than one-third lighter than the bottom wheel, which will prevent the top wheel over-running the bottom wheel; it also to a great extent prevents saws breaking. P is the pulley on which runs the belt that drives the machine. If N. DE P. finds any difficulty in getting the brackets cast, he might send a rough sketch of them to a maker of wood-working machinery, stating what he wants them for, and he will, I have no doubt, get them. If, by having iron wheels, it will be a too expensive affair, two wheels may be cut out of a seasoned piece of wood. Then bore holes in the centre and bush them with iron or, better still, brass. See that the wheels are perfectly round and properly balanced; cover them with soft leather or rubber. N. DE P. does not say by what power he intends driving his saw. If by hand, I must say that I never knew a hand-saw to give satisfaction driven by hand. In reference to joining the ends of saw, the only satisfactory method with which I am acquainted is to braze them. Should N. DE P. wish for further information, let him write again, stating clearly what it is, and I will do what I can to help him.—A. R.

III.—Questions Submitted to Readers.

**** The attention and co-operation of readers of* Work *are invited for this section of "Shop."*

Roller Skates.—F. (*Huddersfield*) writes:—"Would any correspondent of Work please tell me how to make a pair of roller skates of the ordinary pattern, giving the size of rollers and, if possible, an illustration of skates?"—[Effective roller skates can be bought so cheap—especially in London—that it seems a sheer waste of time and patience to attempt to make a pair.—Ed.]

Small Brass Castings.—E. L. (*Woolwich*) writes:—"Will any brother reader inform me where I can get small castings done, and if there is any material that I can make patterns from in the way of a wax—such that it can be softened at the fire, made the required pattern, and, when cold, hard enough for putting in the sand?"

Cottage Architecture.—Dorkin writes:—"Will any reader kindly refer me to any book, at a reasonable price, giving samples of cottage architecture, either detached or for terraces, as used in the Midlands, where, from passing trains, I have noticed many charming little houses? Cost not to exceed £350, without land value."

Catgut.—Canoe writes:—"Would some kind reader of Work inform me how to make catgut for angling purposes? It must be very fine and clear."

Soldering Flux.—Grateful writes:—"Will any reader kindly inform me, through 'Shop,' what is the best ingredient to use, instead of spirit, as a flux for soldering bright iron, where it is essential that the iron should not rust?"

Lantern.—E. H. L. (*Leicester*) writes:—"Will some kind reader give me instructions as to making a small lantern for throwing colours on to the scenery of a model theatre by means of inserting coloured glasses? Also what kind of glass must be put in front of lantern?"

Fancy Articles Market.—Cabinet-Maker's Tool writes:—"Could any reader kindly give me names and addresses of one or two agents, etc., who would introduce and place fancy articles, such as jewel-cases, boxes, inkstands, smokers' cabinets, etc.? How and where do dealers in such articles obtain them?"

Monogram.—Amateur asks:—"Would some reader be so kind as to work the initials M. W. T. for cutting in fretwork with fancy background?"

Fret Monogram.—Youthful Reader writes:—"Will someone give me J. T. E. for a fretwork monogram?"

Musical Combination.—E. P. B. (*Penge, S.E.*) writes:—"I saw at Olympia a flute attachment to the piano, fed by indiarubber tube, and bellows worked by right foot of operator. It simply rested upon the treble keys, and was actuated by them, the depressing of the key evidently allowing the vertical wire which rested upon it to drop, and thus open a valve in the pipe corresponding to the key depressed. I should be greatly obliged if any reader could give me instructions for making the above—premising at the outset that I am a tyro at musical instrument building, and should buy the set of pipes ready-made, but should be equal to the construction of the remainder if anyone can kindly give me a few hints as to details of same."

Brass Polish.—Quill-Driver writes:—"I have fender, five brasses, dogs, and coal-box, which I cleaned with some kind of paste, purchased at an ironmonger's. Immediately afterwards the whole became dull, with blue-black patches. Could any reader please help me and instruct as to cleaning in future, so that the polish would last? The lid of coal-box is embossed."

Inlay Polish.—H. S. P. (*Brixton, S.W.*) writes:—"Will any reader kindly tell me the best way to polish pearl inlaid work after filing down, and what with?"

How to Make a Sand Yacht.—C. O. S. (*No Address*) writes:—"Can any reader give me some information as to making a boat for sailing on the sands, or the address of anyone who would do so?"

Mechanical Saw Set.—F. B. (*Rochdale*) writes:—"Will any of your readers who have tried the mechanical saw set described by M. Powis Bale state whether it sets the saw accurately, also gauge of saws set by it? State price, and where to be bought."

IV.—Questions Answered by Correspondents.

Gas Engine.—M. (*Bishop Auckland*) writes, in reply to Lathe (see No. 150, p. 733):—"I should advise you to try an Otto gas engine. One fixed in this district has been very satisfactory."

Oilstone.—Eddifra writes, in answer to A.E.M. (*Cheshire*) (see No. 149, p. 718):—"I had an oilstone—a Washita—which, when new, had a splendid grip; but after using about a year, it became hard. I took the case off, and placed it in a deep tin full of oil for about three weeks. I think the reason the stone became so hard was that the oil—perhaps an inferior kind—set in the stone and choked it up. The best oilstones—Washitas—I have now are thin with wear, and the oil I place on soon soaks through and keeps the pores clear."

Gas Engine.—A. B. (*Blackburn*) writes, in reply to Lathe (see No. 150, p. 733):—"The area of floor space the gas engine would take up depends, to a great extent, on the power of the engine. Taking Crossley's Otto engine as a type, their vertical 'Domestic' motor, ¾ horse-power, takes a space of 2 ft. 3 in. square; a 2 horse-power horizontal would require 6 ft. by 3 ft. 7 in.; a 6 horse-power horizontal takes up 8 ft. 10 in. by 4 ft. 6½ in.; while a 50 horse-power would require a space of 12 ft. by 8 ft. 2 in. If Lathe will settle on the power he requires, he can soon get at the floor space needed from the makers or their agents. A 9 horse-power vertical would stand on a space about 4 ft. square."

Blowing Fan.—Hall writes, in reply to Warehouseman (see No. 151, page 750):—"I think Blackman's is as good as any, if not the best. Their address is Blackman Ventilating Company, Limited, Fore Street, London; also at Manchester, Bradford, Birmingham, Glasgow, and Bristol."

Rock Drills.—Panko Burtina writes, in reply to Mont Cenis, on Rock Drills (see No. 151, page 750):—"I should recommend the Rand drill, manufactured in America by the Rand Drill Company, but for sale in the British market. It is a very good drill indeed when in use by practical men. It is fitted with a column and a tripod, also a duplex column. The duplex column is generally used for sinking purposes; also the tripod can be used in sinking, and is also adapted for quarrying. The single column is very good for mining or tunnelling. The same Company supplies a battery and wires of all descriptions, also exploders for blasting operations, and a much safer process of blasting than by using fuse. I have had about three years' experience with the drill I recommend, and have come to the conclusion that it is one of the best machines I ever used for drilling. I hope that Mont Cenis will give over the steam idea for a drill."

Tailors' Cutting and Fitting.—W. W. H. (*S. Albert Grove, Leeds*) writes, in answer to Dodo (see No. 151, page 750):—"He can obtain a catalogue of all their published works, post free, from the John Williamson Co., 93, Drury Lane, London. He can also get prices of the West End system from Mr. F. T. Prewett, 23, Warwick Street, Regent Street, W. All the works on cutting of any practical value are expensive, and not easily understood by anyone outside the tailoring trade. If Dodo finds the works I have quoted too elaborate, if he will communicate with me, I will put him in possession of systems for a much smaller sum than he can buy them elsewhere for."

Shoe Mending.—W. writes (in reply to Dummy) (see No. 150, page 733):—"I think if Dummy refers to No. 149, Vol. III. of Work, he will find in the answer to A. H. (*Nottingham*), in column 2, page 716, all that he wishes to know, with diagrams of various stages of the process."

Shoemakers' Size.—W. G. writes to One in a Fix:—"In answer to your second query (see No. 144, page 637), the size you ask for is made in the following manner: Ingredients, ¼ lb. yellow soap, twopenny-worth of glue, and one quart of soft water. Process: Cut the soap up fine, and break the glue into small pieces; put them into a saucepan, and pour the water over them; put it on the fire, and well stir it till it just boils. Pour it out into another vessel to cool. It is then ready for use."

Enamelling Fretwork.—Lifeboat writes, in reply to G. F. R. (*Bournemouth*) (see No. 150, page 750):—"He will find his troubles vanish if he will, previous to applying the enamel, give the work one or two coats of French polish. Allow this to get quite dry, then smooth down with worn glass-paper. And he will find it an advantage if he will mix a little dry colour, such as Venetian red, yellow ochre, etc., in the polish, to make it match his enamel, and so form a foundation."

Coal-dust.—Hall writes, in reply to Householder (see No. 151, page 750):—"Use it as a backing, first having wetted it with water, but of course not too wet; or make a heap of it, and mix coal-tar with it to the consistency of soft putty; mould it in iron moulds brick-shape, and, if practicable, bake it in low temperature."

Machine Fan.—A. P. (*Longsight*) writes, in reply to Warehouseman (see No. 151, page 750):—"Respecting fan for cleaning warehouse, these are made by the 'Union Engineering Co.,' Pollard Street East, Manchester, who will supply all particulars and price lists. They have fans working in all the large towns in the world."

Glass Mending.—Hall writes, in reply to H. H. (*Chacewater*) (see No. 151, page 750):—"The old Polytechnic cement is very good, also Imperial Liquid Glue; no heating required: Hayden & Co., Warwick Square, London, E.C. There is a very good cement made and sold by Keye, Filter Maker, Hill Street, Birmingham. Several excellent glues are advertised in Work. (See Work advertisements)."

V.—Letters Received.

Questions have been received from the following correspondents, and answers only await space in Shop, upon which there is great pressure:—F. B. (*Leek*); J. G. (*Glasgow*); W. S. (*Batley*); J. H. B. (*Pendleton*); T. W. M. (*Bolton*); T. A. (*Oldham*); J. B. (*Keighley*); W. W. (*Salford*); Cottages; J. H. C. (*Rochdale*); A New Reader; Electrolier; Anxious; W. W. (*Caverton*); Liquorice; F. R. S. (*Horsham*); Liquid Glue; J. H. B. (*Penaleton*); G. E. (*Upper Clapham*); A Reader of "Work"; Still Waiting; F. R. M. (*Wallsend*); W. A. G. (*London, E.C.*); T. C. (*Birmingham*); J. P. (*Reigate*); R. W. (*Liscard*); A. E. (*Birmingham*); R. F. (*Norwich*); Amateur; G. H. (*Swansea*); Screen; J. K., Junr. (*Glasgow*); J. J. McQ. (*Drogheda*); W. J. (*Brownsey Coll.*); A Monthly Subscriber; W. J. S. (*South Shields*); S. W. (*Chesham*); A New Reader; Walsall; Fountain; W. W. (*Wokingham*); W. J. H. (*Shepton Mallet*); F. W. J. (*Pottam*).

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Planes.—Special Line. Trying, 5s. 6d.; Jack, 4s. 3d.; Smoothing, 3s. 6d. Bead and Rabbet Planes, 2s. All others equally low.—Marshall, Tool Merchant, 238, Old Kent Road, London, S.E. [17 R

Cycle Fittings, mail-cart wheels and shafts, mitre-cutting machines and cramps.—Walker Bros., Wellington Road, Leeds. [22 R

Moor's Simplex Chromic Acid Battery.—Send stamp for circular to Moor, 23, Hill's Road, Cambridge. [23 R

Fretwork Designs.—25 small, 4d.; six large Brackets, 1s. 1d.; six grand Photo Frames, 1s. 1d.; Catalogue of 300 Miniatures, 6d. Lists free.—Taylor's Fretworkeries, Blackpool. [25 R

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All Modellers and Fretworkers should send for Automatic Savings Box and Toy Design, price 1s. 6d.—I. and J. Soar, 21, Blake Street, Ilkeston, Derbyshire.

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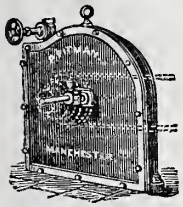

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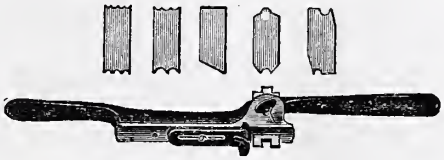

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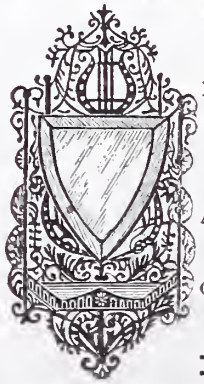

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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VOL. IV.—No. 158.] SATURDAY, MARCH 26, 1892. [PRICE ONE PENNY.

WORK WORLD.

WORK has been begun for the utilisation of the power of the Falls of Niagara. It is intended to construct a large turbine plant on the American side. The tunnel which forms the tail-race of the turbines is built for a capacity of 100,000 h.-p. The tunnel is expected to be completed next July.

* *

A patent has been granted for "spider" wheels for bicycles and other light machines. An influential company in Glasgow, on being shown the details, joined the patentee in getting it through the Patent Office. It remains to be seen whether there is anything good in the invention. Already cycle wheels appear sufficiently spider-like.

* *

At the Globe Works, Bankhall, Liverpool, one of the largest steel-wire cables ever made in this country is now being manufactured. It will be 3½ miles in one continuous length without a joint, and will weigh about twenty tons. It is 3¾ in. in circumference, made from the finest quality of patent crucible steel wire, and having a tensile guaranteed strain of over forty tons.

* *

A belt is now being made for the Electric Lighting Company, New Orleans, which, it is believed, will be the largest in the world. It is to be 6 ft. wide, 169 ft. long, and will require the skins of one hundred and seventy-five animals to complete it. The weight will be about forty thousand pounds, and the cost something like ten dollars, or £2 per square foot.

* *

A newly designed pulley has been brought out in America. On the face of the pulley, at regular intervals, are rubber strips with rounded surface, and fastened by projections passing through the rim of the pulley. Not only do these strips do away with slipping belts, but lessen the wear on the latter and reduce the friction to the minimum. When worn out they can be replaced at a slight outlay.

* *

Messrs. J. Willis & Co. are producing a "self-hardening" tool steel, which is expected to be much easier to forge, twist, and form into tools than other steels of this class. It is self-hardened by the air in cooling, and does not require hardening or tempering, although for extremely hard work it may be heated to a dull red heat and plunged into hot water.

* *

The Ameer of Afghanistan now possesses a mint, a cartridge factory with an output of seven thousand cartridges per day, a rifle factory, a boot and shoe manufactory, and a tailoring establishment for the manufacture of English costumes: and all are driven by steam. This would point to the Ariana of the Greeks as being something of a prospective area for an emigrant settlement, *i.e.*, if the Afghans offered no resistance!

* *

Judging from some of the dividends recently declared, the past year cannot have been an altogether disastrous one for the Sheffield hardware trades. Messrs. Henry Bessemer & Co., Limited, have declared a dividend of 25 per cent. for the past twelve months; while Messrs. Brown Bayley and Co., Limited, gave a similar dividend, and carried £15,000 to the Reserve Fund for the same period. Messrs. J. Vickers, Sons, & Co. gave 6½ per cent., and the Midland Iron Co. distributed 5 per cent. for the past year.

* *

An ingenious preparative method for the transport of sulphuric acid is being carried on by an enterprising chemical company on the Tyne. Hitherto this acid has been exported in carboys, a kind of large flask fixed in a hamper and packed with straw. This kind of receptacle being of a fragile nature, great care had to be exercised in the handling on board ship; naturally the acid had to be part of a deck cargo, and at the appearance of rough weather the acid was consigned to the deep. To get over this difficulty, the chemical company have arranged a process consisting of a large cast-iron pan lined with enamel, and having a furnace underneath. The acid is here heated to a high temperature, and mixed with nitre cake, afterwards being run off into tins or drums and hermetically sealed. When cold the acid has the appearance of hard-frozen snow. There will be no fear now of the carboys being broken during rough weather; and the acid, being highly concentrated, can easily be *thawed* by being diluted with 50 per cent. of cold water.

Old Age Pensions is the tune of the hour, but what time will transpire before practical effect can ensue, in the case of Mr. Chamberlain's or any other of the schemes set forth, is another matter. Meanwhile, a laudable step has been made by a Sheffield firm, who have set an example which every labour house in the kingdom might well follow. Messrs. Walker & Hall, the silversmiths and cutlers, have initiated a most generous scheme of long-service pensions for their *employés*, the workpeople not being called upon to contribute to the fund, the only condition being *continuous* long service, illness, or shortness of work, not to be considered as a break. The following benefits are to be derived after

	Men.	*Women.*	
21 Yrs.' service	8s. 6d. ...	4s. 3d.	per week
25 „ „ ...	10s. 0d. ...	5s. 0d.	„ „
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40 „ „ ...	17s. 6d. ...	8s. 9d.	„ „

This is, indeed, a sensible recognition of labour worth, and is an improvement upon the "at death" systems of benevolence.

* *

"Expanded metal lathing" is about to take the place of wood laths for plasterers' work—especially in the construction of fire-proof buildings. It is made from narrow strips of steel, which are cut into strands on parallel lines at intervals of width or length desired, and between these intervals of cuts or slashes are uncut sections; then it is opened up or expanded at the lines of cuts or slashes into sheets of lathing, from 18 in. to 2 ft. wide, and is cut into lengths of 8 ft. The sheets, which are ¼ in. wide in the strands, require no stretching, and are easily and quickly fixed. They can be easily cut with a pair of ordinary shears into any necessary length or shape, and by hand pressure made to conform to any curve required for cornices or mouldings, and a very few fixings will keep it in position. The shelf-like strands provide perfect lodgment for the lime and hair, and permit of a partial connection between the keys. The lathing and plastering thus becomes a homogeneous mass, and is much less likely to crack than ordinary lath work, as warmth will not expand or cold contract the lathing. Furring strips (unless an air space is required) are not essential to the use of this lathing, as it provides ample key when secured to a flat or curved surface.

HOW TO LEARN DRAWING OFFICE WORK.

BY ARTHUR BOWES, A.M.I.C.E.

In this and the following papers it is intended to deal with the work of the drawing office in as practical a manner as possible, describing in detail the methods adopted by the draughtsman in drawing, colouring, and finishing plans of every description, and dealing also with mounting, varnishing, and other processes which enter into the daily routine of the drawing office. The reader will be assumed to be familiar with the ordinary processes of mechanical drawing and geometry, so that unnecessary elaboration will be avoided. With the same object it will be taken as granted that the commoner forms of drawing instruments are known to the reader, and attention will be drawn only to such instruments or particular features as are of special interest.

The Drawing Office and its Furniture first call for our notice. The ideal drawing office is seldom found, because it is not often that it has been specially designed for the purpose for which it is used. The essential qualities which should mainly guide the choice of a drawing office are two: an abundance of daylight and freedom from dampness. Gaslight has, of course, to be used to a great extent in the confined offices of engineers and architects who are surrounded by buildings in such a manner as to block out the daylight, but there are many objectionable features in the use of gas. It is unhealthy, vitiating the air with noxious fumes; it casts strong shadows from the edges of T-squares and set-squares; and it is impossible to colour with any accuracy of tint by gaslight. So far as possible, then, an ample supply of daylight should be obtained. The windows should be large and lofty, and it is desirable to have them on both sides of the drawing office, so that no shadows shall be cast by the drawing instruments. Skylights afford an excellent means of lighting so far as the amount of light obtained is concerned; they are, however, the cause of much inconvenience when a tracing is being made on glazed tracing linen, or when a wash of colour is being laid, as the light is reflected upwards in such a manner as to make it difficult to see the work properly. They have also an unpleasant tendency to keep the office very cold in winter, as the heated air naturally finds its way to the skylight, and the heat is radiated at once through the glass. On the other hand, the summer sun pours his rays through them, and converts the drawing office into something very like a florist's hot-house. Skylights and windows should alike be provided with blinds for regulating the glare of the direct sunlight.

Freedom from damp is essential in the drawing office, or otherwise it will be found that the drawing papers and thin wooden instruments, such as T-squares and set-squares, will be injuriously affected. Fortunately, drawing offices are generally located, for the sake of the light, at the top of the building in which they are situated, and are consequently not very liable to dampness. The ordinary open fire-grate is much to be preferred before any system of heating by hot air, water, or steam in pipes. The latter cause an amount of dry dust and a stuffiness of atmosphere which are very objectionable.

Desks and Tables.—The desks should be of the firmest and most solid construction: in fact, they are best when built into the office as fixtures. The right position for them is along the walls, directly under the windows, so that each draughtsman has a window in front of him, and the advantage of the fullest possible light on his work. The tops of the desks should be made of plain, unvarnished pine, so that they are not too hard to drive drawing-pins into when it is desired to prepare a drawing too large for the drawing-board. This will also allow for the desks being scoured down occasionally with soap-and-water without doing any harm. A suitable height for the front edge of the desk is 3 ft. 3 in., with an upward slope of an inch for every foot in width. In Fig. 1 is shown an arrangement by which the draughtsman can work comfortably on the upper part of a drawing without soiling or creasing the lower part with his body. It will be seen that a rounded bar, an inch or an inch and a half thick, is fixed to the front edge of the desk in such a way as to leave a slot down which the lower half of the drawing is passed, while the bar acts as a guard to protect it from damage.

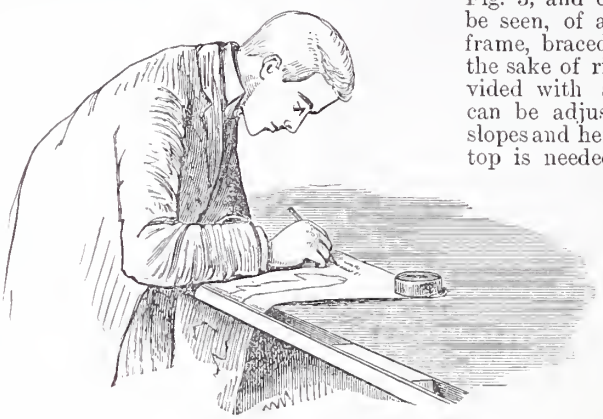


Fig. 1.—Slot in Desk to Protect Drawing.

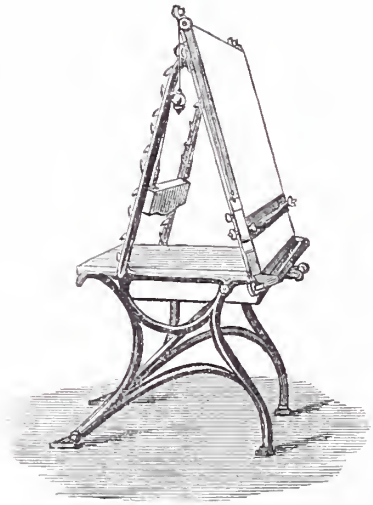


Fig. 2.—Adjustable Drawing-Table and T-Square combined.

An excellent combination of table and drawing-board arranged almost vertically and fitted with an attached T-square is shown in Fig. 2. It has the advantage of occupying very little floor space, and is extremely comfortable to work at, as the drawing-board can be moved up or down so as to bring any part of the work under the hand of the draughtsman. A counterpoise balances the board so that a slight pressure on the handle shown at the bottom is sufficient to effect the movement. The T-square is balanced in a similar manner. Both drawing-board and T-square are provided with narrow projecting shelves on which to place the drawing instruments and colours. The flat table is useful for carrying books or drawings in use, and a drawer is fitted under the table. The whole is carried on a light cast-iron framework. The inclined struts of the framework at the back of the drawing-board are provided with recesses for taking wooden laths, on which can be displayed the drawings that it is wished to consult for the work in hand. This useful piece of furniture is of German origin, and is as yet not so well known in England as its merits deserve. In WORK (No. 69) there was given an illustrated description of an American invention of a somewhat similar kind, having a drawing-table with adjustments vertically and to various angles.

Another useful appliance is shown in Fig. 3, and consists, as will be seen, of a light cast-iron frame, braced diagonally for the sake of rigidity, and provided with supports which can be adjusted to varying slopes and heights. No table top is needed, the drawing-board resting directly on the supports. The whole arrangement is so lightly constructed that its position can be easily altered as desired, and, as it occupies very little room, it is a convenient article of furniture where space is limited.

Stools.—Most draughtsmen prefer to stand to their work, as a rule, because in the various operations of drawing and finishing a plan of any size the work is seldom confined to one part of the paper at once, and it is necessary to alter the position of the body momentarily to obtain a proper command of the work. In some classes of work it is nevertheless possible to work while seated, and in such a case the form of seat which will be found most suitable is one which is adjustable in height on the principle of a music-stool. A rather elegant development of this form is shown at Fig. 4.

Gaslights.—It is almost impossible to have too much light in the drawing office. To this end jointed gas-brackets should be fixed in such a position as to enable the burner to be brought within a foot or 18 in. of the board. An ordinary burner with naked flame will generally be considered efficient enough, but, if practicable, Argand burners with opaque shades should be adopted. In this case, as the burner must be kept upright in all situations, some arrangement of parallel motion links becomes necessary, as shown in Fig. 5. One or two movable stands fitted with gas-burners and indiarubber tubing will also be of service occasionally.

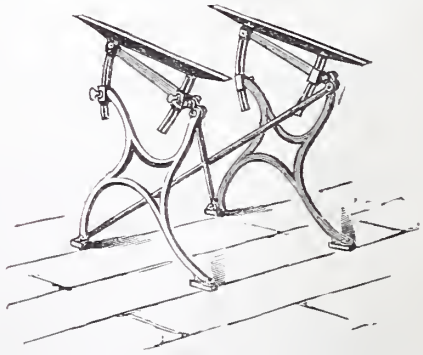


Fig. 3.—Adjustable Stand for Drawing-Board.

ABOUT WORK AND POWER.

BY W. C. CARTER, M.I.MECH.E.

FEW words are in more common use than those of our title, and their popular meaning is clear enough to everyone: Work being understood as the act of performing labour, or the produce of the labourer, and Power being used as synonymous with Strength.

But the words have a special scientific meaning, not by any means difficult to understand when attentively studied, though they are seldom so studied, except by those whose special business it is to master such matters. Experience often shows, indeed, that, even in the case of trained men, the scientific ideas conveyed by the words in question are not as clear as they ought to be. It is not inappropriate that the columns of WORK should be utilised for the purpose of illustrating these important points, and making clear to its mechanical readers the methods of applying the Principle of Work to the common, every-day questions of machine design. Its clear comprehension will cause many apparent difficulties to melt away, and often preserve inventors, who are large readers of WORK, from attempting impossibilities, the absurdity of which is sometimes veiled under complications of detail.

We shall see, as we proceed, the connection of our second title with the first.

What, then, is the scientific meaning of the word "Work"? Let us consider a simple illustration. Suppose that we have resting upon the floor a sack of grain weighing 500 lbs. Here we have the simple idea of weight without motion, or, in more general terms, force without motion; for weight is only the force of gravitation pulling towards the earth. We may therefore extend our idea to that of force generally, in whatever direction, and by whatever agency exerted. So far, the force is inert, and only results in a dead pressure upon the floor, and a corresponding reaction by the floor resisting the pressure and supporting the sack. We might conceive this force as acting for ever without change, as no waste is taking place. Let us now suppose that the sack is to be lifted on to a platform 3 ft. high. Now to the original idea of force we have to add that of motion through a certain distance, and we obtain, by multiplying together the force (500 lbs.) and the distance (3 ft.), a compound unit (1,500 ft.-lbs), which represents—to quote Longfellow—"something done," that is—Work. Work, then, is a compound idea comprising those of force and distance, and it is measured by the compound unit, composed of the simple unit of distance (the foot) multiplied by the simple unit of force (the pound), forming the compound unit of Work (the foot-pound).

The next point is that of Power, and here another factor comes into play.

We might suppose that our corn is carried, grain by grain, by a spider in the way attributed to the pertinacious insect whose perseverance gave renewed heart to the despondingKing, Robert the Bruce. In course of time the required task will be accomplished, and the grain be all lifted on to the platform. Or we might, and probably should, lift the sack at once bodily. It is clear that, in both cases, the result achieved—the Work done—is the same, and also that the difference between the agents is that between Weakness and Strength (*i.e.*, a difference of Power), the only difference between the operations being the time occupied. Time, then, is the third element that must be combined with that of Work to obtain a unit with which to measure Power.

The usual unit of Power in this country is the horse-power, which is well known to be 33,000 ft.-lbs. in one minute. It should be observed that these products always denote the same amount of Work or Power in whatever way the factors producing them may be mutually varied. For example, if

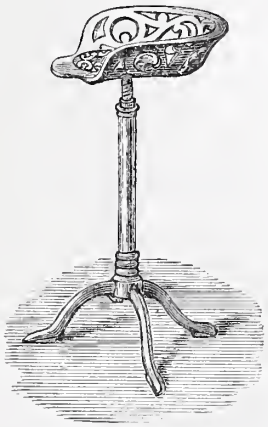


Fig. 4.—Adjustable Seat.

the weight of the grain in our illustration had been half as much (*i.e.*, 250 lbs.), and the distance had been twice as much (*i.e.*, 6 ft.), as the product (250 by 6) would still

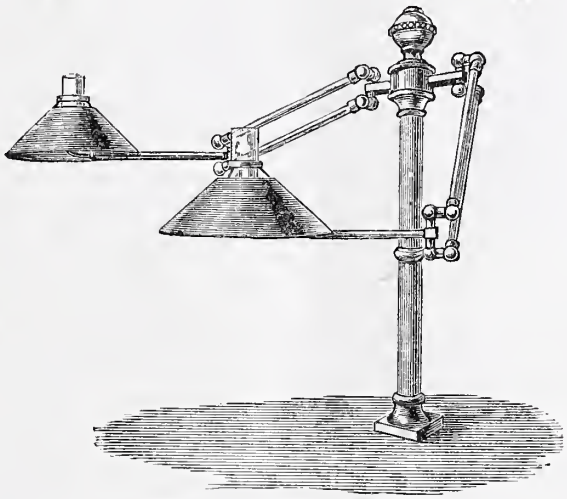


Fig. 5.—Adjustable Gas-Bracket, with Argand Burners.

equal 1,500 ft.-lbs., the amount of work represented by the operation would be exactly the same, and similar reasoning applies to quantities of Power. Having mastered thoroughly these conceptions, we will sum up our definitions thus:—

Simple units (one element) { of Force—the pound. of Distance—the foot.

Compound unit (two elements) of Work—the foot-pound.

Compound unit (three elements) of Power—the horse-power.

We are now in a position to understand the limitations within which man exerts his constructive faculties.

Few persons in these days will need to be told that matter, so far as Man is concerned, is indestructible. Man cannot create it, nor can he destroy it. All he can do is to rearrange it in some way, or change its form. For instance, he can take a block of marble, remove certain superfluous portions, and leave a statue and a heap of chips and dust, but, were all the portions preserved and weighed, we should still find the total weight the same as the original block, as the total amount of matter cannot be altered. He may apply molecular motion in the form of heat to a pound of ice, and may thus change it to a pound of water, and, by continuing the process, to a pound of steam. The form has been changed from solid to liquid, and from liquid to gaseous, but the weight remains as before. The pound of ice makes a pound of steam, proving that the original amount of matter still remains.

It is not, however, so commonly understood that Work comes under just the same law as to its indestructibility.

Just as in the case of matter, we can change its form, but can neither increase nor diminish its total amount, and this is the Principle of Work, which it is the chief aim of these articles to explain and illustrate.

The object of all machinery is to take work, in whatever form it may be available, and transform it into a condition suitable for the purpose required. In a large factory we might have work developed in the furnace of a boiler, which is transmitted by the steam through the mechanism of an engine to the shafting, from which it is taken and transformed by each different machine to each particular purpose. The revolving shafting supplies, through belting, a continuous linear pressure as the belt passes from the pulley, and this is transformed in the lathes to a revolving action, in the power-hammers and punching machines to a succession of blows and strokes, and so on, the object of each machine being simply to change the form of the work supplied by the shop shaft.

It may perhaps have occurred to the reader that it is a strange proceeding to estimate the work as commencing in the furnace, and not in the cylinder, where the first moving parts are found. The work really exists in the furnace, but in its alternative form of Heat. Thus we come to another important truth—viz., that Heat and Work are mutually interchangeable.

This truth began to be suspected about the year 1800, and when Count Rumford made his memorable experiment of boiling water by means of the heat generated in boring out a cannon, he gave the death-blow to the many fallacious guesses that had been made as to the nature of heat, as it was seen that nothing could have produced the heat observed except the work done by the cutter, and that, in fact, work was simply another form of heat. That the two are mutually convertible may be seen on every hand. A boy who rubs a metal button upon a form and claps it upon the back of his neighbour's hand supplies a simple illustration of the conversion of work into heat; while the illustration given above of the furnace of a steam boiler producing the work given off in the engine fly-wheel is an excellent illustration of the converse action—heat into work.

George Stephenson is credited with the remark that all power comes from the sun, and, considering the state of physical knowledge in his day, the remark shows his able grasp of first principles.

It will be a useful exercise for a mechanic to trace out thoughtfully the original sources of power in different cases, and will widen and simplify the mental view. For example,

we see a water-wheel, and we ask, How did the water obtain the power to do the work that we see given out? A little thought will show us that the sun, by evaporation, raised the water from the sea-level to the high ground, from which it falls, giving out work in its descent, and it is more difficult to conceive, but equally true, that if we could have weighed each particle of steam as it ascended under the sun's action, and have multiplied it by the distance it was raised, we should find *exactly* the amount of work it gave out in returning to its former level. Again, in the case of the steam-engine, the sun, by its action upon the vegetation of bygone ages, produced the coal which gives the energy to the steam. One writer has well compared coal to a coiled spring, which returns the work done upon it when the conditions are favourable.

Thus it would be found that, with a few exceptions, the sources of power with which we are acquainted are simply receptacles of the heat which is poured upon the earth by the sun, and that they will return that heat in the form of work when the conditions are suitable.

Now we will go a step further. Inasmuch as Work and Heat are the same things in different forms, if we apparently lose one of them we shall have a good idea where to look for it. For instance, we have a machine which—in spite of our statement that work is never destroyed—does not give out all the work put into it, as, of course, is the case with all machinery to some extent. Where, then, is the missing work? As it does not appear as work, we must look for it in its other form, and, on examining the bearings, we find that they are slightly heated, and this heat will be just that due to the work lost. The heat is produced by friction, and if we could measure the resistance of every rubbing surface in pounds, and multiply each by the distance it passed through in feet, we should obtain a total number of foot-pounds *exactly* equal to the missing work, and to the equivalent amount of heat produced.

The proportion of work given out by a machine compared with that put in, is called the Modulus of the machine, and is expressed as a fraction taking 1 to represent the work put in; 1, therefore, is the modulus of an ideal machine without friction, and the difference between the modulus of any given machine and 1, will represent the proportion of work lost in friction. In our next article we shall explain the method of comparing, with exactness, Work and the amount of heat corresponding to a given quantity of it.

HOW TO MAKE AN IMPROVED CAMERA STAND.

BY "DESDICHADO."

Some time ago the author of the present paper desired a tripod stand for his camera, which while being, in the first case, perfectly rigid and efficient, should be as light as possible and close up into a small compass. Having plenty of suitable material, he decided to construct one to meet his requirements, thereby finding profitable employment for leisure and keeping a guinea or thirty shillings in his pocket. Feeling that there are many who would be willing to have a few hints on the construction of a very portable and rigid tripod, which may be most easily made, the following particulars and method of construction adopted by the author in making his stand are given and described.

When making an article of the nature of the one at present under discussion, which is intended primarily for *use*, it is not desirable to spend time in unnecessary work, and the simplest way of attaining certain objects will usually be found the best. It will be very apparent that, other things and sizes being equal, the most rigid stand will be the one in which the legs are in single pieces—not folding or closing; and the more joints there are the greater the chances of a loss of firmness, which will be greater or less according to the degree of perfection with which the joints are fitted. Having regard to this, and to simplicity and ease of construction, a stand closing in three was decided upon—a fourfold stand, although closing up shorter, being somewhat bulky, besides necessitating an extra joint; and it being often a great convenience to be able to adjust the height of the camera without unduly spreading the legs of the tripod, and also on uneven and sloping ground to regulate the length of each or any leg individually, it was decided that the lowest limb of each leg should slide within the second or middle limb, the uppermost limb folding down alongside.

Fig. 1 shows a single leg of the tripod open to its fullest extent. It will be seen that the lowest limb, which is single, slides between the two members of the middle limb, and may be clamped at any desired point by the bolt, B, and plate, A, the bolt having a base or flange on the other side similar to the plate, A, which is not seen in the figure, but which is shown at Fig. 3. In most of the stands with sliding limbs which are sold in the shops, tongues are formed on one, while corresponding grooves are ploughed in the other limb, in order that the sliding limb may maintain its true direction; in the present case the tongueing and grooving are obviated, and the proper working ensured by the plates before mentioned, which are attached to the lowest or sliding limb and the plates, C, fixed at the lower end of the middle limb, and which also serve to hold its two members together. It will be seen that at whatever point it is desired to clamp the lowest limb, it will always be in the same straight line with the middle limb—indeed, it can never get out of it—while the labour and time saved to an amateur in adopting this simple mode of construction, as against ploughing and tongueing, are very considerable items, while nothing is lost in point of neatness or efficiency; and if the stuff from which the stand is made is properly seasoned, and, after being cut, is kept in a warm room for a few days before being finished off, there will be no necessity for having a tongue working in a groove: wood in such slight scantling is very liable to go out of truth unless it is very well seasoned, and even then it will go after being cut up; and the precaution should always be taken of thoroughly seasoning such slight pieces of stuff before planing them down to finished sizes, so that any slight warping or deviation may be corrected.

The upper joint of each leg about which the top limb moves is formed by a long bolt or screw, D, with fly-nut which passes through both members of the top and middle limbs, as shown, the whole being clamped by screwing up the fly-nut; a blocking piece, E, is fitted between the members of the middle limb at the upper end, to keep them apart when the nut is screwed up. The plates F, F, on the upper part of the middle limb, project over and catch the end of the top limb, giving stability when the leg is opened out. It was at this point of the preliminary considerations that it was discovered that these plates would be a somewhat troublesome necessity, and the author tried to think of some means of dispensing with them; for it will be seen that, in order for the stand to fold at this joint, the plates must clear the lower ends of the top limb; and this appeared to raise a difficulty. This, however, was got over by forming a slot in the upper end of the middle limb through the blocking piece for the clamping screw to work in, instead of a circular hole, thus allowing the top limb to be moved endways, so as to clear the plate when being opened or closed, and to lie alongside the middle limb without projecting beyond it at either end when folded up (see Fig. 4). The upper ends of the top members have brass plates, G, with holes which fit on to pins on the head—which is hereafter described—and are strained apart by a piece of tube or rod, marked H in the sketch, which turns down into a slot when the leg is closed. (See detail sketch, Fig. 5.)

The stand opens out to 5 ft., and is 1 ft. 11 in. long when closed, the three legs making a package 1 ft. 11 in. long by $2\frac{1}{2}$ in. square.

This fairly explains the action of the legs, and will enable the reader the more readily to grasp the mode of construction, which it is now proposed to discuss.

The size of the camera for which the stand was constructed was half-plate, but the dimensions given can easily be modified to suit any other size, although the legs could hardly be made much lighter; but the top might be reduced in size for a quarter-plate camera.

The wood most suited for the purpose is either ash, oak, mahogany, or pine. These are placed in order of suitability. The stand made by the author is of mahogany—oiled, not polished—and looks very well; but if either ash or oak is available, it is probably a better material for the purpose, being less liable to split under strain. Pine will do if none of the other materials is obtainable. Whatever is used must be thoroughly well seasoned, and the precaution previously suggested must be taken if a good result is to follow.

It has been assumed that one of the harder woods has been decided upon. By reference to Fig. 1, it will be seen that each leg consists of five pieces, each $\frac{3}{4}$ in. by $\frac{1}{2}$ in. in sectional dimensions, and the four members forming the two upper limbs are each 1 ft. 11 in. long; the lowest, or sliding limb, being prevented from closing right into the middle limb by the block E at the upper end, is only 1 ft. 7 in., so that fifteen pieces are required in all: twelve pieces 1 ft. 11 in. long, and three pieces 1 ft. 7 in. long, by $\frac{3}{4}$ in. by $\frac{1}{2}$ in.

The method of preparing these will be governed greatly by the material available, but if they are cut out of comparatively wide stuff, it will be well to thickness it down to $\frac{3}{4}$ in. or $\frac{1}{2}$ in., according to the thickness of the stuff, and then shoot or true up one edge. Set a gauge to the other dimension—for instance, if the stuff is $\frac{1}{2}$ in. thick the gauge will be set to $\frac{3}{4}$ in., or *vice versâ* if the stuff is $\frac{3}{4}$ in. thick—and mark and cut off the strips; then shoot the edge of the remaining piece again, and proceed as before until the required number of pieces is obtained; but, as has been remarked, circumstances will govern the method of procedure, and only by knowing the size of the

material available could the least wasteful and best method of cutting up be decided upon. Having cut these pieces out, and while they are seasoning in a warm, dry place for a few days to "take their bearing," the required brass-work may be looked up. If none is "in stock," it will be well to get it in strips as rolled, which strips may be obtained of almost any width. Much time is saved if the pieces have not to be cut out of sheet brass. It should be $\frac{7}{8}$ in. wide, and need not be of a very heavy gauge, so long as it is sufficiently thick to enable the heads of the small screws necessary to fix the plates being sunk in it.

For each leg three plates, $1\frac{1}{2}$ in long by $\frac{7}{8}$ in. wide, will be required (Fig. 6)—one for the top of the sliding limb and two for the bottom of middle limb. One, however, will not require the four screw-holes, but will have instead a hole in the centre for screw of flange bolt; and two plates, 1 in. long by $\frac{7}{8}$ in. wide, with one end of each rounded off (see Fig. 7), will be required to form the abutting pieces for the top joint. All these plates, after being cut to the required lengths, should have their ends squared up and the edges bevelled, and if they can be lacquered, so much the better. Two brass plates for the top of each leg, G (Fig. 1), are required; these should be $\frac{3}{4}$ in. wide and $1\frac{3}{4}$ in. long, and have three holes in each in the centre of the width; the two end ones may be $\frac{1}{4}$ in. from each end, and the other in the middle. Two of these holes are for screwing the plate to the leg, and the other for the pin in the top referred to in its place. (This plate is shown in the drawing at Fig. 8.) Messrs. Stanton's warehouse in Shoe Lane is a good place for such brass-work. The remaining fittings necessary to purchase—unless the amateur has a lathe and screwing tackle, and can make them; but even then it is cheaper and better to buy them—are three bolts and fly-nuts (Fig. 2), one for each leg, for clamping the top limb (these bolts will require to be 3 in. long), and three Assiter's flange bolts and nuts for clamping the sliding limbs (Fig. 3). All of these are specially made by Platt, Camera Maker, Dalston, and for this stand will cost but little. Three stretching pieces, which may be of light brass tube $\frac{3}{16}$ in. in diameter, will also be required; they will be 3 in. long, and will require a fine hole drilled at one end of each, about $\frac{1}{8}$ in. from the end, to fit a piece of steel wire—a piece of knitting-needle answers admirably—on which they will turn.

Assuming that the preparation of the legs may now be proceeded with, they should be finished off to their proper thicknesses and cut off to their finished lengths. Three blocks for fixing at the tops of the middle limbs of each leg, as before described, may be prepared; they are to be 3 in. long by $\frac{3}{4}$ in. by $\frac{1}{2}$ in. These blocking pieces may now be fixed at the top of each pair of middle limbs by fine $1\frac{1}{4}$ in. screws, screwing from the outside of the limb, near the ends of the blocking piece, so as to leave the centre clear for the clamping bolt; the heads to be sunk. Now place the lowest limb in position between the members of the middle limb, and take one of the brass plates, $1\frac{1}{2}$ in. long, already prepared for the bottom of the middle limb, and screw it in position $\frac{1}{4}$ in. from the end with $\frac{1}{4}$ in screws, drilling and countersinking holes in the plate, as shown in Fig. 6, in such positions that the screws may be in the centre of the width of each member. All this fitting up should be done with the limbs clamped up in a hand-screw; every part will then, of course, fit too tightly to work, but the subsequent glass-papering will make it right. Then turn the limb over, and screw on a similar plate on the other side. This limb may now be set aside, and the middle limb of the other legs similarly treated.

The top plates for the head, G (Fig. 1), may now be fixed. They should have one end rounded off to a semi-circle, as shown in side view, and should be screwed on at the ends of the top members, which should also be rounded off to coincide with the ends of the plates. The hole at the semi-circular end of the plate is for the pins in the head, and need not be drilled yet; the other two holes are to be drilled and countersunk for $\frac{3}{8}$ in. screws for fixing. When these plates are all fixed, the upper members may be laid in their places, in the position they will occupy when the leg is folded or closed up, and the hole for the clamping screw, D (Fig. 1), bored right through the upper and middle limbs. This should be at a distance of $\frac{3}{4}$ in. from the extreme ends of the members, which should all be clamped properly together in a hand-screw, and the holes bored very accurately and carefully, as—it will be seen—upon this depends the subsequent working of the joint, and any

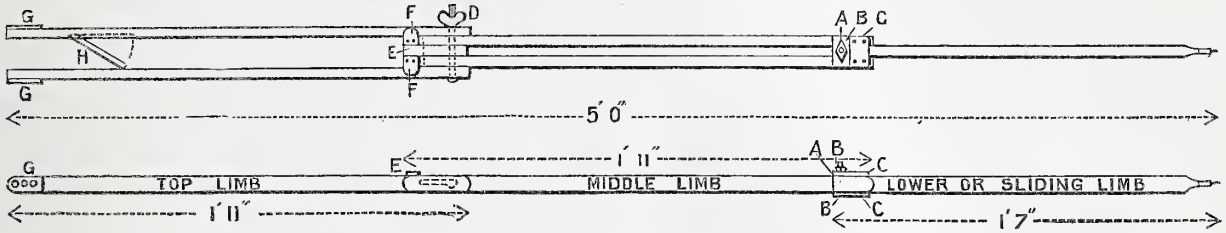
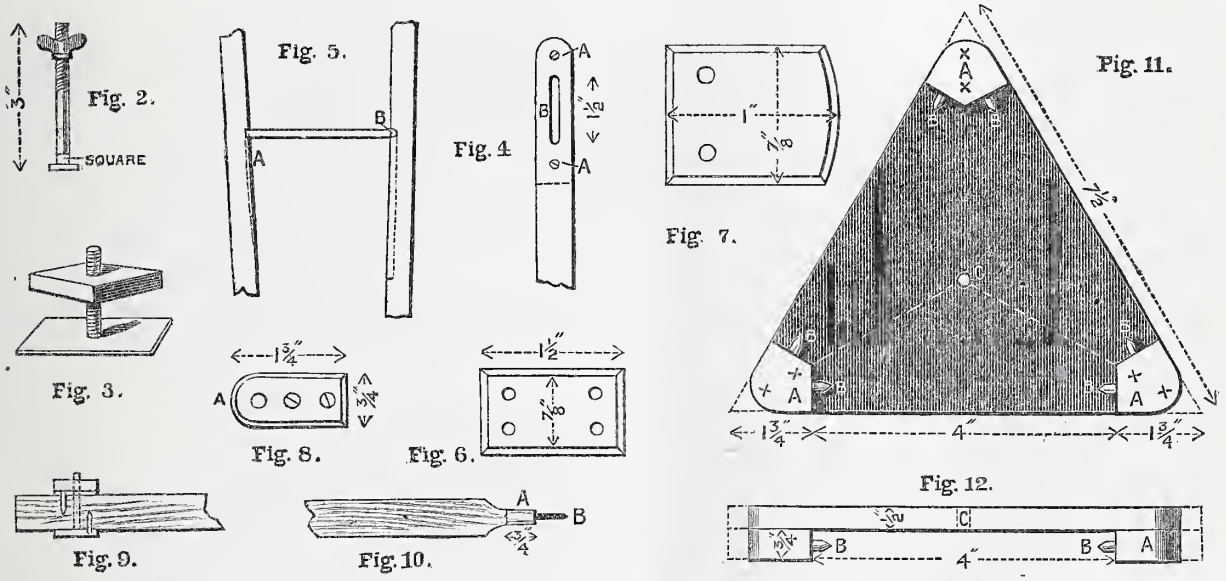


Fig. 1.



IMPROVED CAMERA STAND. Fig. 1.—Two Views of Stand opened out—A, Clamping Plate; B, Assiter Flange Bolt; C, Brass Plates holding Parts of Middle Limb together; D, 3 in. Brass Bolt and Fly-nut; E, Blocking Pieces; F, Abutment Pieces at Top of Middle Limb; G, Head Plates; H, Straining Piece. Fig. 2.—Brass Bolt for clamping Joint of Top and Middle Limbs. Fig. 3.—Assiter Flange Bolt for clamping Sliding Limb. Fig. 4.—Top of Middle Limb showing Slot—A, Screws for holding Blocking Piece and Top of Limb together; B, Slot. Fig. 5.—Portion of Upper Part of Top Limb, showing Straining Rod—A, Slot sloping from Surface and receiving free End of Rod; B, Steel Pin or centre on which Rod hinges. Fig. 6.—Brass Plates for holding Lower Ends of Middle Limbs together. Fig. 7.—Abutment Pieces for Top of Middle Limb. Fig. 8.—Head Plate—A, Hole for Pins in Head. Fig. 9.—Clamping Bolt and Plate of Sliding Limb, showing position of Retaining Screws. Fig. 10.—Toe of Sliding Limb—A, Brass Ferrule; B, Iron Screw with Head cut off. Figs. 11 and 12.—Views of Head—A, Blocks; B, Tapered Pins; C, Hole for Camera Screw.

departure from the true line will throw the limbs out when finished. The holes in the top of the middle limbs are to be converted into slots $1\frac{1}{2}$ in. long by another hole being bored in the leg through the block, and the intermediate piece cut out. This should be done carefully and kept central, or the working will be interfered with. It will be found that the clamping bolt has a square shank, which prevents the bolt turning when being tightened up; this must be let in on the side of the upper limb. When doing this, it will be well to open out each limb as if going to erect the stand, so as to ensure the heads of bolts being let in so that the screws shall be right-handed. The slots for the straining pieces in the top limbs should now be cut; these are shown in section at Fig. 5. They may be cut in the inside of either member. The opposite member should have a $\frac{3}{16}$ in. hole bored $\frac{1}{8}$ in. deep directly opposite the uppermost end of the slot in which the straining piece works, and a slot, commencing about 2 in. lower down the limb, should be cut with a $\frac{3}{16}$ in. chisel from the surface to the bottom of the hole, so that the straining piece may slide home when the stand is being erected (see A, Fig. 5). The plates F (Fig. 1), forming the abutments for the top limbs, are to be screwed on with $\frac{1}{2}$ in. screws. These plates have already been referred to, and will be 1 in. long, and fixed at the upper ends of the middle limbs, so as to project over $\frac{1}{2}$ in. (see Fig. 1), and the screws countersunk. The two upper limbs are now completed, with the exception of rounding off the ends, which may now be done, the limbs being folded down for the purpose. When the upper limbs of all the legs have been finished as described, the lower or sliding limbs are all that remain. These are to be placed in position in the middle limbs, and the brass clamping plates fitted. To prepare these, the diagonals should be drawn on the under-sides of the plates, and holes drilled in the centres large enough for the clamping bolts to go through; holes should be drilled in the plates and bases of the bolts for $\frac{1}{2}$ in. screws, for holding them in position and preventing them turning round. These holes should be drilled so that the screw from the base of the bolt is on the opposite side of the bolt to that which holds the upper plate in position (see Fig. 9). When the screws are turned in, the heads should be cut off, leaving a projecting pin the thickness of the plate, which, it will be seen, is all that is required to keep the bolts and plates from slipping round. When the plates and bolts are in position on the lower limb, it will be found that the leg can be clamped at any point. Nothing now remains to complete the legs but an iron toe on each. Brass ferrules, made of $\frac{3}{8}$ in. tube, $\frac{3}{4}$ in. long, should be fitted to the lower ends of each sliding limb, the leg being cut down as shown in Fig. 10; and a $1\frac{1}{2}$ in. iron screw (about No. 6 gauge) should be screwed up into the limb until only the plain shank remains to be seen, and the head cut off.

The head, or top, of stand will now occupy attention. This is shown in Fig. 11, which is a plan of the under-side, and also in Fig. 12, which is a view of one edge: A, A, A are three blocks screwed on and carrying the pins, B, B, B, on to which the upper members of the tripod are fixed, the camera screw passing through the hole C. The top can be made of oak or mahogany $\frac{1}{2}$ in. thick; a good close-grained piece should be selected, as, however it may be cut, one angle will be very much cross-grained. An equilateral triangle with $7\frac{1}{2}$ in. sides should be set out, and the piece cut to shape, a hole for camera screw being bored in the centre, which is found by bisecting two of the angles, which should be rounded off when finished, as shown, to $\frac{1}{2}$ in. radius. The blocks, A, A, A, are to be $\frac{3}{4}$ in. thick, and of the shape as indicated in Figs. 11 and 12. The pins, B, B, B, are $\frac{3}{4}$ in. screws, turned in until only the plain shank shows, and then the heads cut off with a metal saw, the projecting piece being left about $\frac{3}{8}$ in. long, which should be tapered down as shown, to ensure the legs fitting tightly. Holes for these pins must be drilled and bored in the plates and through the upper part of the legs; these holes should fit the pins in the head fairly tightly, so that there is no shake. The blocks are to be glued and screwed on from the upper side of the head, as shown, the screws being placed in the positions marked by crosses on the blocks, and the heads sunk. A piece of baize or cloth being glued on to the top, to protect the camera from scratches, completes it.

The stand may either be oiled throughout or French-polished; the latter, however, is sure to get scratched and worn by the working parts, and the former is to be preferred. The oil should be well rubbed in, and time given for it to go in and dry before the stand is used.

If the foregoing directions are rigidly followed, and care taken in fitting the joints, a convenient stand, which will be compact and portable when closed, and perfectly firm when in use, will be added to the constructor's possessions, and reward him for his labours. Badly-fitted joints mean a rickety stand, which is worse than useless, and no satisfaction to its maker; so good work must be put into it, or it is better left alone.

POKER WORK, AND HOW TO DO IT.

BY JULIE NÖRREGARD.

Many readers of Work are interested in poker work, or pyrography, which has become *the* favourite pursuit of the day; but few may know that this peculiar and interesting art is as old as historical times. Years and experience have greatly changed the way in which this work is executed, but the idea remains the same, and it is most interesting to go to the museums and study the various specimens, especially those of barbarian and uncivilised countries. Of course, very often amongst these collections, one only finds some clumsy attempt at poker work; but at the British Museum a great number of articles in burnt wood are to be found, which are charming examples of how much can be done out of very little, if the worker only possesses originality and an eye for form and colour. Particularly in the rooms containing industrial productions from Africa and Australia is to be found the etching with hot irons used to decorate articles in leather, ebony, and bamboo, such as boxes, spoons, and musical instruments. Some of them are only embellished with a few rough lines, which scarcely form any pattern at all; but others are beautifully finished in elaborate designs, which could not fail to astonish any modern artist. These specimens, which are especially interesting to study, are all to be found in the rooms of the Ethnographical galleries, the countries best represented in this style of work being New Zealand, New Guinea, and Borneo. In one of the cupboards one's attention is attracted by a whole row of splendid calabashes, the patterns of nearly all being very rich and effective. In cupboard No. 35, on the bottom shelf, there is an oval piece of wood, of which our sketch (Fig. 1) gives some idea; it is about 15 or 16 in. in length, and the natives used it as an instrument. A piece of string is attached to it, by which it is held, and, when swung rapidly round, it produces a whirring sound; the colour of the piece of wood is a beautiful warm brown, and the scrollic design somewhat reminds one of an old Celtic pattern. In cupboard No. 146 there are a large variety of beetle boxes, and also a very good example of a quiver, still filled with poisoned darts, for the blowpipe. Very close to this, in cupboard No. 147 and 148, are some exquisitely finished specimens of burnt bamboo, so finely done that one cannot help wondering how such work could possibly have been produced with the few and simple instruments that were known to these savages. A splendid effect is produced when the poker work is executed together with wood carving, and some large bowls in this style from West Africa are very attractive. I am sorry that the space in these columns will not permit me to dwell longer on the subject; but I would advise all "artists of the poker" to go to the Museum, and I feel sure that they will return home loaded with fresh ideas, which will enable them to do useful and artistic things for themselves.

That pyrography has been known in England years and years ago is very evident, for in some very old village churches large proofs of this work are still to be found on the altars, and in these cases the artists have traced the figures on the wood and then burnt away the background with large, hot pokers, thus leaving the figures in relief. But it was, indeed, a difficult task; for not only had the worker to attend to his picture, but, what was very necessary, he had to keep a large fire in which to heat the pokers and tools. But all these difficulties belong to a bygone age, and the artist of to-day can sit comfortably at his work table, surrounded by all the neat and practical little instruments which have been brought out by skilful inventors.

Of all these different makes of tools and necessary materials, not one has been admired as much as the small box called "Vulcan," manufactured by Messrs. Abbot Brothers. This box contains the materials sufficient for a beginner; it is practically arranged, and can be bought for a few shillings. It consists of the "poker," or pencil, the point of which is made of platinum, the only metal which can take up and absorb the benzoline gas by which the heat is obtained. This benzoline is kept in the bottle, to which is attached a piece of tubing and two indiarubber bellows. There is also a small spirit lamp and an extra bottle of benzoline, which must always be tightly stoppered to prevent evaporation. Every student must give great attention to the choice of the wood, this being one of the most important parts of the work; it should be well seasoned and free from knots. A great variety of woods can be used for pyrography, some of the best being lime, oak, and sycamore; but, as I am writing for beginners, I would recommend the American white wood, as it presents a fairly good surface for work, and one can buy it made up in useful and artistic fancy articles, such as boxes, frames, chairs, tables, etc., for very little money.

For the first attempt in burnt wood

etching it will be best to choose a piece of plain white deal, and on that to practise short and long strokes and dots, shading from a pale tint up to the deepest tone of brown; and so on. The wood is placed on a table, not fastened anywhere, so that it can be easily turned in different directions; the "poker" is then carefully attached to the benzoline bottle through the tube; the spirit lamp is lit, and the point of the poker is held in the flame while the indiarubber bellows are slightly pressed with the left hand. In a few seconds the platinum point will be red hot, and the lamp can be extinguished, and it will not be required again unless the point should get cold through any irregular movement of the bellows. This left-hand work is really the most important part of the whole process, and I have seen ladies, with plenty of perseverance and a strong desire to learn the work, let the poker drop and, with a most hopeless expression, declare that it was impossible to do. It is not, however, at all impossible, but requires some little practice in the beginning. It will seem very awkward to etch with the right hand and, at the same time, keep up a slight, regular movement with the left; but it must be remembered that, if the left hand gives up its task, the right must leave off too, because it is only the pressure of the bellows which forces the benzoline vapour down the tube, thus keeping the platinum point hot. When this difficulty is thoroughly mastered, a new one presents itself, which consists of doing the work evenly; but this, too, can easily be conquered with the aid of a little patience and practice, which are required for any sort of work.

In the beginning every stroke will be a failure. Just when you are admiring a nice smooth line, the poker will make a horrible deep and dark-coloured dot, and you are obliged to start afresh. Do not lose courage, however, but remember that no workman or artist, be he ever so clever and skilful, can master his tools or brushes at once. My advice is, Do not hurry to begin etching on a nice wooden article before you have absolute control over the hot point of the poker. Practise the strokes repeatedly on a plain piece of wood, and, when you feel yourself more at ease with the work, trace a small leaf, or conventional figure, on the wood in pencil, and try to follow the line carefully with the poker, etching the pattern in the wood. When this task has been successfully accomplished, a small stool, box, or frame might be attempted. It is not wise for a beginner to choose too small an article, for the patterns are generally very fine, which, of course, presents greater difficulty than figures, where large, bold lines can be introduced.

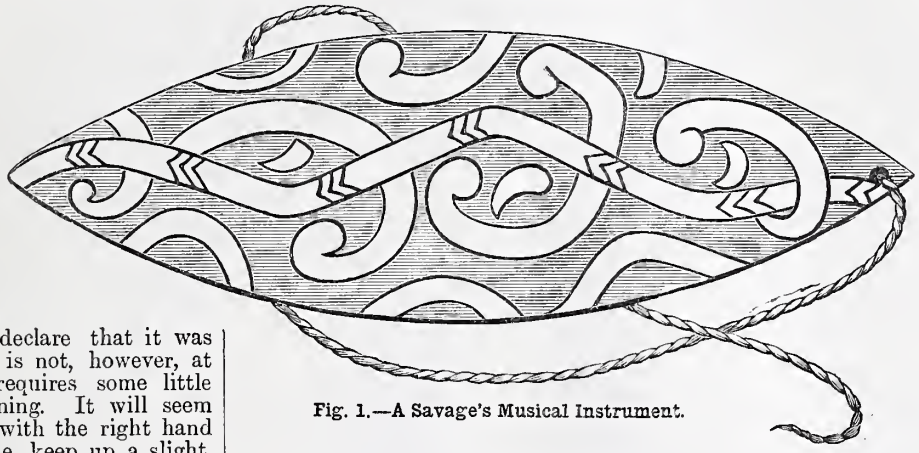


Fig. 1.—A Savage's Musical Instrument.

Choose, for instance, a small, square stool, about 20 inches high. It will come in very useful as a little stand near the fireplace, and, if made after an Eastern pattern, would go nicely with design No. 2 in the illustration, this striking Egyptian design, with its lotus flowers, being just the thing to commence with. When the pattern has been enlarged to the size wanted, trace it on to the stool, which should be first well rubbed with emery and glass-paper to make it perfectly clean and smooth. When the lines of the design stand out clearly and evenly on the wood, begin the etching by following all the outlines with the hot tool. Do not go on too fast, but try and direct the poker steadily along the lines, while blowing the bellows regularly with the left hand. It will look best to make the outline a deep brown, while the lines in the flowers should be done more softly. If you do not master the tool very well at first, I would advise you only to put a few lines on every single leaf of the lotus; but if, on the other hand, you feel that you are getting on pretty well, it would, of course, be better to shade the leaves in pale or darker shades of brown, thus giving richer colouring to the work. All the ground round the pattern will look best etched in rather coarse dots. It is the easiest part of the work, but, still, great care must be given when the ground near the edge of the figure is dotted, because this is easily spoiled.

Here I will leave the student, and in my next paper will complete the subject with some more advanced and original designs, which will be valuable to all art workers and designers.

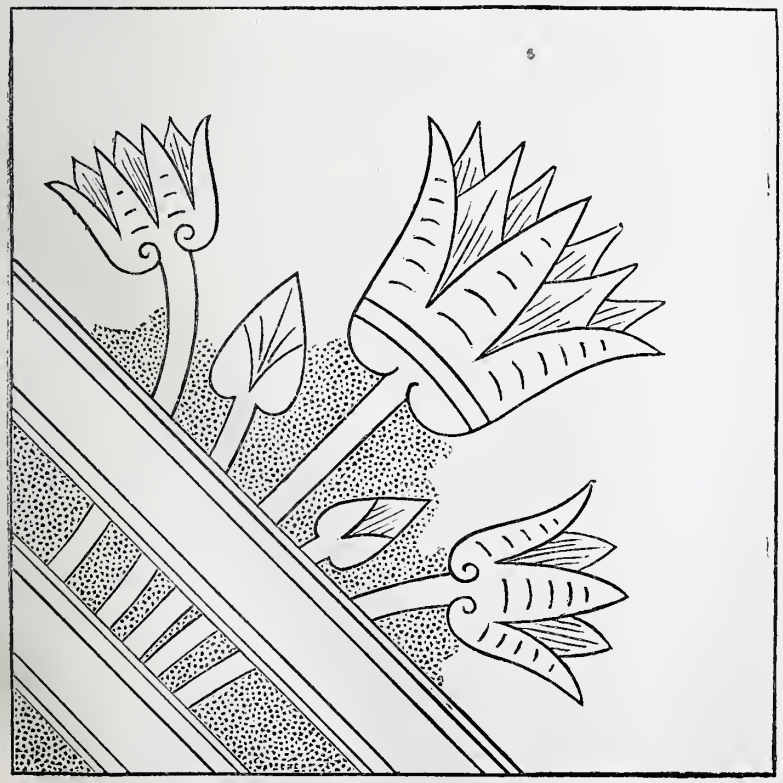


Fig. 2.—Pattern in Egyptian Style for Stool or Table.

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Pain has been described as a disagreeable sense of active vitality. We try to diminish it in many ways, as it is a serious strain on the nerves, often with dreadful results. Cold and heat deaden nervous pain. Blisters sharp and mild have their potency, but as they are disfiguring for a time, a harmless pain-killer is offered for notice and trial, as it has been found efficacious in many cases:—2 ozs. of spirits of hartshorn; ⅜ oz. of spirits of camphor mixed in a pint of filtered water, to which add a handful of salt; soak rags in it, and apply to part affected. Of course, the general health should be regulated by suitable harmless medicines, of which a change of air and diet stand foremost.

Iron and steel may be preserved by dissolving 2 parts of camphor and 60 parts of gum sandarach in half a pint of turpentine and half a pint of alcohol. Use as paint, but see that the iron or steel is thoroughly cleaned beforehand.

Foul sponges may be cleaned by putting the sponge in a basin and squeezing the juice of a citron on it. Cut the citron in small pieces and lay on the sponge; pour boiling water over the whole and leave it for a day. Then rinse the sponge well in the water, and afterwards let it dry.

Ink for writing upon glass or porcelain is made by dissolving 10 parts of bleached shellac and 5 parts of Venetian turpentine in 15 parts of oil of turpentine—the containing vessel being immersed in warm water. After the solution is effected, 5 parts of lamp black are incorporated.

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FREE TRAVEL.—Any idea for free travel—especially on a universal scale—will present itself to the minds of our readers as an extremely chimerical notion. Some may be bold enough to pronounce any movement with an object of securing free passage across the hemispheres as the issue of downright lunacy. All the same, the subject is beginning to attract public attention, and one of the most recent aspects of the matter is the admirable suggestion of Admiral Cochrane in a contemporary to establish a free ferry across the Irish Sea for passengers, and for certain classes of agricultural, fishery, and other goods between certain ports in Ireland and the West of England, the cost of such free ferry to be borne by the State. There is little that is really Utopian in the proposal. On the contrary, it is more rational, and if carried into effect is likely to be productive of greater good, than most of the schemes which have been propounded for remedying Irish matters. It has more to recommend it, for instance, than the plan of mopping up a part of the Atlantic and joining Great Britain and Ireland. The sister country has been so persistently sapped of its goodness that its resources now need replenishing. Recuperative processes are due to the people and country alike, and such a scheme as the free ferry for passengers and goods would mean an immediate influx of material wealth to the island, when the inevitable solution of the principles of supply and demand might reasonably, and soon, be expected to follow.

GOLF.—Again this year there is to be a Parliamentary Golf Handicap, when such knights of the "driver" and "putter" as Mr. John Penn, Mr. A. J. Balfour, the Marquis of Granby, and other M.P.'s will contest some knotty points in a better atmosphere than the St. Stephen's air. The final round has to be completed on May 28: long before which time our readers will be in possession of a novel design for a Golf Club Stand. Shall we be adjudged irreverent if we suggest the immediate tackling of this job in the event of some favourite politician winning this handicap, when it might be forwarded to him in recognition of his skill and as a token of admiration? Or the promoters of the handicap, possibly, would not object to accept the completed model as an excellent first prize!

FUEL.—How far we are removed from the time when the coal resources of this country will become exhausted, is a point which only an unwise man would hurriedly undertake to predict. The question is constantly cropping up soon to die out again, as the average mind can only be moved to look upon the supply aspect of the coal question in a somewhat complacent mood. Prices most affect the consumer, and if another element be wanting to disturb his equanimity, it is how best to deal with the dust or "small" which so largely obtains in the family coal cellar. Not a few of our readers are concerned on this score, and, having very wisely consulted our "Shop" columns, the fact has been elicited that an excellent slow-burning fuel can be made with the dust. One expedient is to water the same thoroughly and then mix it with gas coke. Another plan found to be a success is to mix the coal-dust with an equal quantity of sawdust, and well saturate the whole with water. These mixtures will not light a fire, but they will keep one going when fairly alight. With the poor this coal-dust is indeed a "burning" question; but we make public these useful methods for all our readers alike. Already the world has been told "What to do with the Cold Mutton," and now our correspondents seem to have afforded a solution to another domestic problem—How to treat the Coal-dust.

DANGER!—Not a small percentage of our readers are concerned with the many and various substances which, as imitations of, and substitutes for, ivory and bone now obtain a large market, especially since the cost of ivory has made it prohibitory for common uses. A thousand ways could be enumerated in which these imitation substances are dealt with by amateur and professional workers for ornamental and decorative purposes. Suddenly, however, comes an alarm. A learned professor tells us that these substances are, more or less, explosive; or, in other words, that we carry about with us equivalents to nitro-glycerine, and weapons as dangerous as the worst spirits of destruction could provide for us. The discovery is laudable indeed, but the information is startling—it being by no means reassuring to be informed that men and women are surrounding themselves with destructive agents quite Nihilistic in type. The mere act of warming one's coat-tails places the performer in danger of finding himself in flames; or a too heated indulgence in the latest Modern German concerto may abolish pianoforte, performer and all! There is no end to the calamitous possibilities which present themselves to the mind at the bare thought of this scientific "find." The moral of all this is, that ladies adopting the large buttons which obtain must have a care as to their security from this new danger, and workers using such substances as these imitation ivories and the like for inlay and decorative purposes should also take heed. Of course, the makers of these compounds are up in arms against the learned professor, but we prefer to encourage the value of the discovery. One thing is certain—the temporary scare will give the metal button workers another chance.

A HOPS PATTERN FOR BREAD-PLATTER OR OTHER ARTICLE.

BY FLORENCE HUDSON.

Among the many plants whose beauty of form or colour renders them valuable for decorative purposes the hop must ever take a foremost place. Every plant has some special beauty; it is not alone to the exotic or carefully-tended garden favourite that the "fatal gift" is given. The despised dandelion has its exquisite, feathery seed; the humble daisy, its "golden eye" and dainty touches of crimson underneath its long petals.

The hop lays claim to many beauties. The young vine pushes forward, feeling hither and thither for support; here, tightly clinging to whatever offers — often failing anything within reach, several stems will twist together round each other like a many stranded rope—there, hanging in long festoons from plant to plant in endless graceful curves.

The leaves, too, are most beautiful. A well-grown leaf is full of character, and will amply repay anyone for the time spent in making a careful study of it in sepia, for its form and surface modulations, and then afterwards in its natural green. Only a dull green apparently, and yet sorely taxing the artist's skill as it varies with the light from steely blue to vivid, almost yellow green.

The flowers, too, although individually so insignificant and colourless, have the charm of airy lightness, while the clustering hops are universal favourites, and well deserve their popularity.

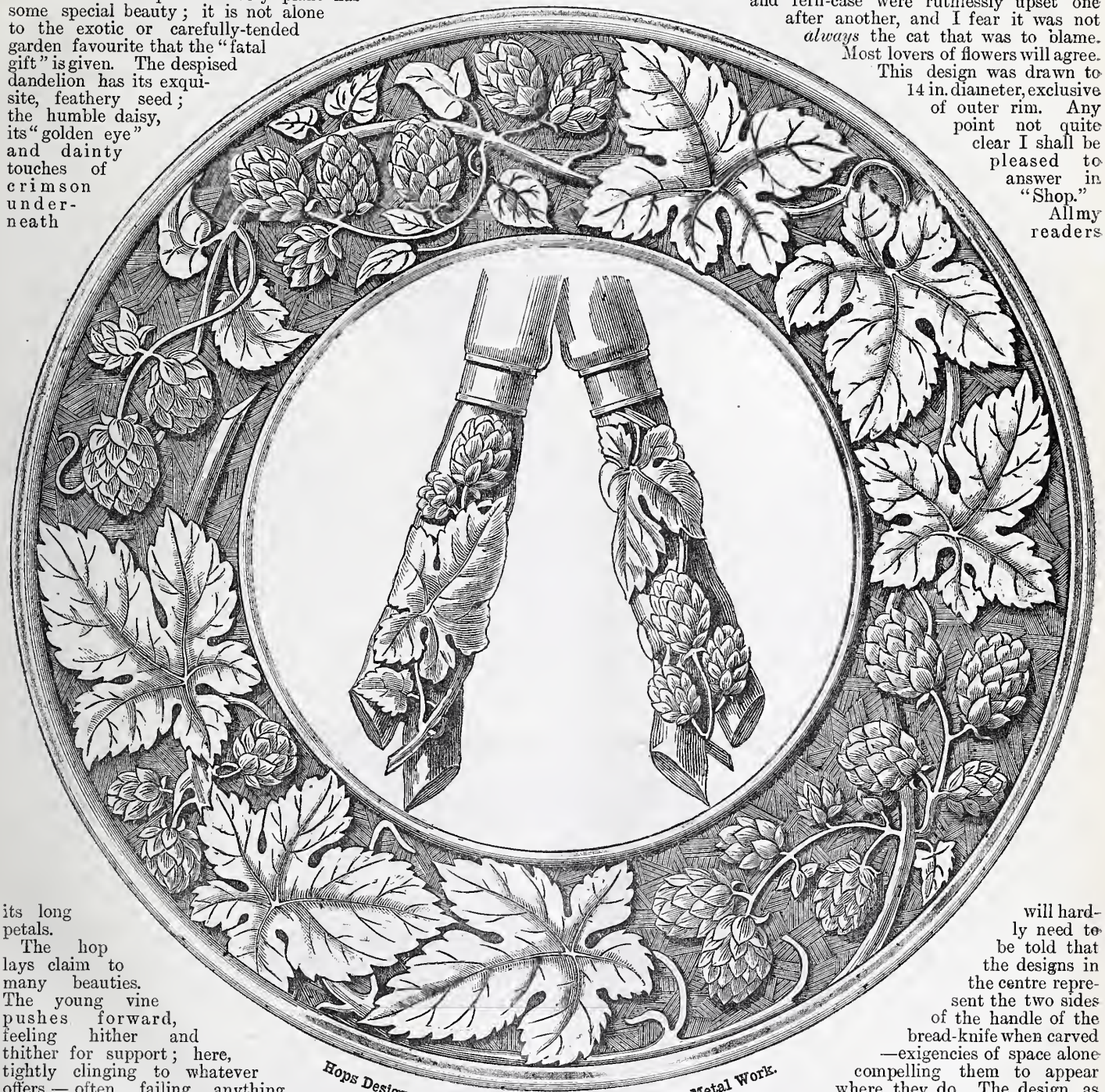
As I have already said, hops lend themselves well to decorative purposes, and I venture to hope that some reader of Work will find this design acceptable and an effective one when carved.

Although intended for a bread-platter, it would, I fancy, make an effective border for a brass tray in repoussé work, or would work out well in inlaid woods or stones. The ground might be done with tiny pieces to give a somewhat similar effect to that in the drawing—a patchwork ground, as one might call it.

A small tray is always handy, and invariably makes an acceptable present; and it is hard sometimes to find a gift that is at the same time useful and ornamental and yet within small means.

For a table top the design would be useful. A steady stone table, not easily to be upset, will save not only many a favourite plant, but also its owner's temper. I well remember how *my* treasured plants and fern-case were ruthlessly upset one after another, and I fear it was not *always* the cat that was to blame. Most lovers of flowers will agree.

This design was drawn to 14 in. diameter, exclusive of outer rim. Any point not quite clear I shall be pleased to answer in "Shop." All my readers will hardly need to be told that the designs in the centre represent the two sides of the handle of the bread-knife when carved —exigencies of space alone compelling them to appear where they do. The design, as produced, is very clear and bold, and will be amply sufficient to guide the student and worker in carrying out his purpose. The hop season, however, is approaching, and no harm would be done in working from a piece of the natural plant. No art can reproduce the full beauty of Nature, and for this reason a well-clustered string fresh from the hop-field will be the best of all guides towards securing a good rendering of the design here presented to our art workers. Later on I will submit another bread dish design that will be out of the ordinary corn pattern order.



Hops Design for Carved Wood Bread-Platter or for Metal Work.

SIMPLE CARPENTRY: PIPE-RACKS.

BY INGENIORUM AMATOR.

These two pipe-racks are simple in construction, and are very easily made at the expense of a little time and trouble. One is entirely constructed on the lathe, and the other is suitable for amateurs who go in for carpentering or fretwork.

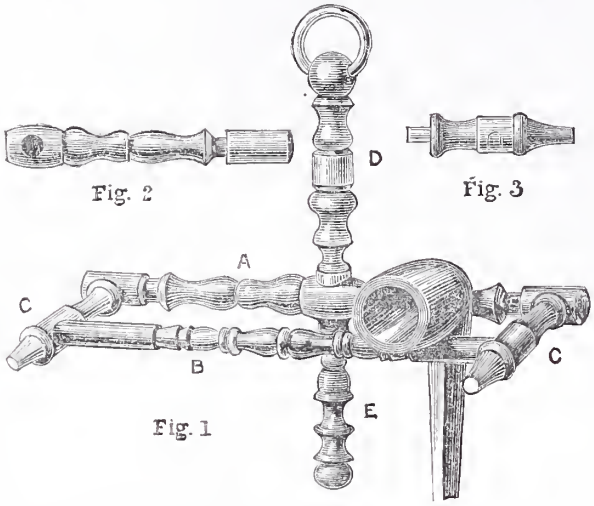
We will explain the construction of the turned pipe-rack first. This is shown in its completed form in Fig. 1. It consists, as may easily be seen, of six pieces, four of which form a sort of frame, in which the pipes rest, and the remaining two fastened into this frame support it against the wall to which the pipe-rack is fixed. A ring of wood, brass, or nickeled iron passes through the end of the upper of the two latter pieces and is placed over a brass-headed nail fixed into the wall or other place to which the pipe-rack is fixed. The length of the frame may vary from 8 in. to a foot or more, and the greatest diameter of the various pieces varies from ½ in. to ¾ in.

Having selected pieces of wood 1 in. in diameter, and of lengths suitable for the various parts, we will begin by constructing the piece A (see Fig. 1). The shape of this is shown in Fig. 2. It is turned in a cylindrical shape in the middle and at the ends, only one of which is shown, and the rest of it may be variously turned, but the pattern on each side of the centre should be the same. A hole ¼ in. in diameter, which is intended to receive the lower end of D (see Fig. 1), is bored half-way through the centre, as shown in Fig. 2, and a hole is bored half-way through each of the ends at right angles to the hole in the middle, as will be easily gathered from Fig. 2. When this has been done the piece may be polished and removed from the lathe.

We must now make the two side pieces, which are represented by C in Fig. 1, and by Fig. 3. One of the ends of each piece must be turned down small enough to fit into the holes which were bored at the ends of the piece represented by Fig. 2, and a hole of the same diameter must be bored half-way through near the other end. The piece B can be shaped something like Fig. 2, must have its ends turned down to fit into the hole at the ends of the pieces C, and its length, exclusive of the tenons, must be equal to the distance between the two pieces represented by Fig. 3 when they are fitted in their places. There is no need to say much about the pieces D and E. The former must be longer than the latter, and must have a hole bored through its upper end for the reception of the ring already mentioned, and the ends of both must be turned to fit into the holes which were bored through the centre of A.

It now remains to fit the various pieces together. This is best effected by first of all fitting together the four pieces which form the frame, letting them set thoroughly, and then gluing the two remaining pieces in their places. If the joints have been accurately fitted together, a very minute quantity of glue will be sufficient to make them fast, and it is always better to use as little glue as possible, since if much is used it is liable to ooze out and spoil the appearance of the work. The turned pipe-rack is now complete, so we will turn our attention to the construction of the other one. This is shown in Fig. 4. It is made in the shape of a gate, which is supported on an oblong piece of wood. A strip of wood, pierced with holes for the reception of the pipes, passes across the gate near its upper end. When thus constructed it is meant to stand on a table, but may easily be made to hang up by removing the piece of wood on which the gate rests, and fixing a ring or hook through the middle. The length of the pipe-rack may vary from 8 in. to 2 ft., according to the number of pipes which it is required to contain. First of all, prepare the piece of wood which forms the base, and cut a notch in the middle of each end for the reception of the posts of the gate. When you have done this proceed to make the gate. This is composed of two end posts, four cross-bars, and three other bars fixed across these. The posts are made of wood about 1 in. square, and have their tops cut into a pyramidal form. The cross-bars are mortised into the posts, and the three other bars are nailed across these with brass nails having rather large heads, which add rather to the appearance of the gate. If the ends of the nails project the other side when they have been driven in, they can easily be cut off with a pair of cutting nippers. The strip of wood which holds the pipes is about 1½ in. in width, and is pierced with holes ½ in. in diameter at equal distances apart. It is fixed near the top of the posts by cutting a notch wide enough for it to fit into, and then gluing it into the notch. If, when thus fixed, it is found not to be sufficiently strong, it can easily be strengthened by gluing small wooden brackets underneath its ends. The necessity of the somewhat troublesome operation of mortising the cross-bars into the posts of the gate can easily be obviated by simply nailing them on to the posts, care being taken that the latter are at such a distance apart that they will fit into the notches which have been cut for their reception at the ends of the base. When the gate is finished, it must be glued on to the base, when the whole pipe-rack will be complete.

In conclusion, I will add that the ingenious reader can easily devise a fret-worked base instead of the plain one, and other additional ornamentation, which will greatly add to the appearance of the pipe-rack.



Turned Pipe-Rack. Fig. 1.—Completed View. Fig. 2.—A Piece in Detail. Fig. 3.—C Side Piece.

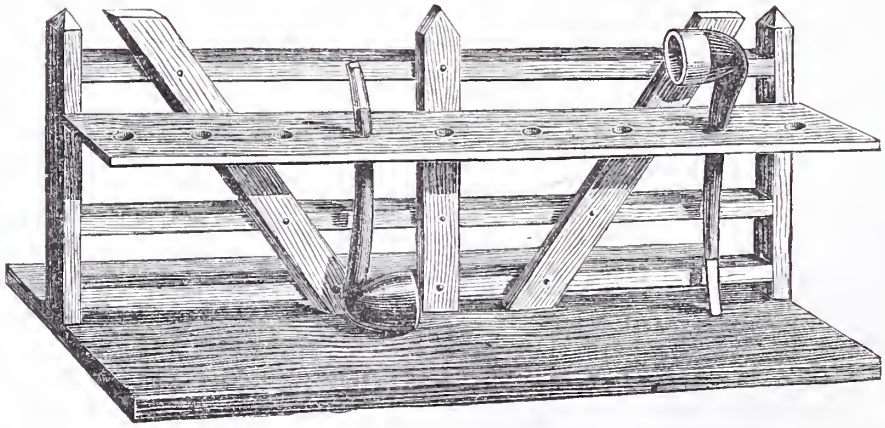


Fig. 4.—Plain Pipe-Rack.

NICK-NACKS.

Cement and Paint for Wood Joints and Mortises.—Mix powdered red lead and tub white lead with linseed oil; add a little gold size when mixed to the consistence of paint. Framings and mortises put together with this paint are cemented and impervious to water. It must be used as it is made, or a floating of water put in the pot to keep the air from it. Even then it will be found to thicken and dry up, so that more linseed oil is often needed to make it work. When as thick as putty in consistence, it may be used as such with a little whiting and linseed oil added thoroughly.

Mineral Rubber, Ebony, and Varnish.—The by-products of some manufactures are of more pecuniary worth than the leading manufactures. Mineral rubber asphalt is one, according to an American trade journal. It is produced during the process of refining tar by sulphuric acid, and forms a black material very much like ordinary asphalt, and elastic like india-rubber. When heated so that the slimy matter is reduced to about 60 per cent. of the former size, a substance is produced hard like ebony. It can be dissolved in naphtha, and is an excellent non-conductor of electricity, and therefore valuable for covering telegraph wires and for other non-conducting purposes. When liquefied, this mineral rubber serves as a good waterproof japan varnish. It is said its production pays the inventor or discoverer from 400 to 500 per cent. gain.

Transparent Paper for Copying.—Saturate a ball of floss cotton with pure benzine. Rub the paper lightly but regularly all over with the wad of cotton. The paper becomes transparent, so that a drawing under it may be seen and copied on to the benzined paper. With absolutely pure benzine it will evaporate from the paper without stain or smell.

Interesting Facts of Mile Records.—Various rates of speed of different forms of locomotion: Railway train, 40¼ sec.; horse galloping, 1 min. 25 sec.; horse trotting, 2 min. 8¼ sec.; torpedo boat, 1 min. 50 sec.; steam yacht, 2 min. 12½ sec.; bicycle, 2 min. 15 sec.; tricycle, 2 min. 28⅗ sec.; ocean steamship, 2 min. 20 sec.; man skating on ice, 2 min. 12⅗ sec.; man on snow-shoes, 5 min. 39¼ sec.; man running, 4 min. 12½ sec.; man rowing, 5 min. 1 sec.; man walking, 6 min. 23 sec.; man swimming, 26 min. 52 sec.; man canoe paddling, 9 min. 29 sec.; ice yacht, 1 min. 10 sec.

TRADE: PRESENT AND FUTURE.

**** Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

BRICKMAKING.—The Kent and Essex brickmakers have decided to continue the policy of limiting the output of bricks during the coming brickmaking season (which begins in April properly) by commencing the manufacture later, and by reducing the number of hands employed. They state that the condition of the market renders the step necessary, but workmen allege that the real object is, by restricting the supply, to force up the prices of bricks to a higher rate.

CYCLE TRADE.—In Birmingham, the St. George's Engineering Co. has had to run the works overtime to fill orders for the "New Rapid" machine. Many of the other Birmingham makers have had to extend their premises in order to meet the demands made upon them; and altogether the season 1892 bids fair to be a record one in the cycle trade. In Glasgow, the largest cycle factory in the world has been turning out "Safeties" during the winter at the rate of 200 a week. This factory is now under the care of a new company. The work turned out is of the best description. One notable feature of the Howe Works is that every part of a cycle, down to the balls and the minutest screw, pin, or nut, is made on the premises, as well as many ingenious tools and machines for quickly producing these parts. There are a number of makers of lesser magnitude than the Howe in Glasgow, all turning out their full share of machines. There are also numerous agents, dealers, and repairers, all over the vast city, who store the wares of most English as well as home makers. Many of these do a large hiring trade, notably the North British Machine Co., who last season, on a fine day, had on the road from 60 to 100 safeties and tricycles at one time. In Wolverhampton—a large cycle-producing centre—the ironmongers are adding machines to their wholesale and retail trade. This example has been set by Mr. Herbert, who by no means confines himself to the makers of his town.

ENGINEERING TRADE.—In the Lancashire district no improvement has taken place in the condition of the engineering industries, and the trade outlook is of a decidedly discouraging character. Boiler makers are still fairly well employed, and an average amount of new work is being secured, but otherwise the general tendency is unquestionably in the direction of diminishing activity. Several firms of machine-tool makers and many locomotive and stationary engine builders are complaining of a marked scarcity of new work, and, generally, the prospect is anything but satisfactory. The depressed state of the iron trade continues, and but little business is being done. The miners' holiday has already had a marked effect upon many Lancashire industries, the Bolton district suffering conspicuously. Several of the leading iron works have been closed—in one or two cases for an indefinite period—and some of the cotton-spinning concerns in the neighbourhood have also ceased working. About 5,000 hands have thus been deprived of employment, and it is exceedingly probable that the number will be largely augmented before very long in consequence of the closing of several other works in the district.

TIMBER TRADE.—The delivery from the London docks still shows a decrease, and the trade generally is exceedingly quiet. Prices are very low, and buyers of timber can get what they require almost at their own figure. The following quotations are based upon the Public Auction prices, and can be relied upon as a fair price to give: 3 by 9 prime pitch pine, £12 per std.; 3 by 9 1st yellow, £18 per std.; 3 by 9 2nd yellow, £14 10s. per std.; 3 by 9 3rd yellow, £13 per std.; 3 by 9 4th yellow, £10 per std.; 3 by 9 yellow, £6 10s. to £9 10s. per std.; 2½ by 7 yellow, £7 10s. to £9 per std.; 2 by 4 yellow (unsorted), £8 10s. per std.; 1 in. yellow flooring, 8s. to 12s. per sq.; ⅞ in. yellow flooring, 7s. to 9s. 6d. per sq.; ¾ in. yellow matchlining, 6s. to 8s. 6d. per sq.; ⅝ in. matchlining, 4s. to 6s. per sq. The carpenters do not seem to have got over the late strike yet, and there are rumours that another is likely to take place.

HARDWARE TRADE.—The heavy engineering and boiler-making trades in Sheffield have good prospects for the season of 1892. New orders for armour plates are confirmed by the Government for three battleships of an improved design. The file trade is still depressed, and only scanty wages are earned by the workmen. There is plenty of common cutlery work, but with a corresponding deficiency in wages.

WEAVING TRADE.—In Rochdale and district the principal topic of interest is the crisis in the coal trade, though the colliers have not yet begun to "play them" (the Lancashire term for ceasing work). Unless the crisis is soon over, the mills will be stopped, and a great number of hands thrown out of employment, which will cause misery and, in many cases, actual want. There is also a danger of the supply of gas being cut off, as, owing to the quantity required (about 300,000,000 ft. being used in twelve months), it is impossible to hold any in reserve, the supply just about keeping pace with the demand.

SCIENCE TO DATE.

New Compound of Lead, Sodium, and Ammonia.—M. Joannis has been studying the action of various metals on sodammonium. Sodammonium is a deep blue solution obtained by dissolving metallic sodium in liquefied ammonia. It has no action on aluminium, silver, zinc, and copper, but is decomposed by lead, mercury, and antimony. When lead is placed in a solution of sodammonium in water, which is reddish-brown in colour, the liquid becomes blue and then green. From this liquid an indigo-blue coloured compound can be obtained, which has the formula Pb_4Na2NH_3. It dissolves in liquefied ammonia, giving a solution of a bottle-green colour. Water converts it into metallic lead.

Combination of Nitrogen with Metals.—M. Maquenne has succeeded in preparing nitrides of the alkaline earth metals by heating an amalgam of the metal in question in an atmosphere of nitrogen. The barium compound is the most easy to prepare. They are brown powders which are decomposed by water with the production of ammonia. Magnesium nitride, Mg_3N_2, also has been obtained by Merz, in Germany, by simply heating magnesium in a combustion tube in a current of nitrogen gas. Almost the whole of the magnesium is by this means converted into nitride, a small portion reacting with the glass producing free silicon in the form of a black mirror. Magnesium nitride is a yellowish-grey substance, decomposed by water, with great rise of temperature and a hissing noise, into ammonia and magnesium hydrate.

Limits of Taste.—The following table gives the least quantity of the substances named which, placed on the tongue, will enable one to distinguish the taste: Sugar, ·0028 gramme; salt, ·0009 gramme; tannic acid, ·00008 gramme; hydrochloric acid, ·00009 gramme; saccharine, ·0000048 gramme; strychnine, ·00000048 gramme.

Bread from Sawdust.—A Bavarian chemist has patented a process for converting the cellulose of sawdust into a glucose. When the latter is mixed with corn, etc., and baked, the bread or biscuit thus obtained is easily assimilable and possesses highly nutritive properties. The inventor still further adds to the value of the bread as a nutritive material by introducing small quantities of phosphates as are necessary for the formation of bone.

Connecting Metals with Glass.—An alloy of 5 parts copper and 95 parts tin, prepared by adding the copper to the molten tin, stirring with a wooden rod, cooling, and re-melting, is stated to adhere strongly to clean glass surfaces, and to have, moreover, nearly the same rate of expansion as glass.

High Pressures by Electrolysis in a Closed Space.—M. Chabry has been making experiments on the electrolytic generation of gas in a closed space, and has succeeded in getting as high pressures as 12,000 lbs. or 18,000 lbs. to the square inch. The electrolysed liquid was a 25 per cent. soda solution. The electrodes were made of iron, one being a hollow sphere in which the gas was collected. A constant current of 1½ ampères was employed.

Constitution of Flames.—Prof. Smithells and Mr. Ingle have devised an ingenious and simple apparatus by which the inner bright cone of a Bunsen burner can be separated from the outer non-luminous cone to a distance of several inches. By drawing off the gases between the two cones thus separated, and analysing them, considerable additions to our knowledge of what goes on in a gas flame may be expected. This work is in progress.

Minerals of Vanadium.—The discovery is announced of considerable quantities of minerals containing vanadium in the Argentine Republic. One of the present applications of vanadium is that in which, in the form of vanadate of ammonium, it is combined with aniline to give a black dye. No doubt, if this substance could be found in larger quantities other applications could be found for it, but at present its price is about 6s. per grain.

NOTES FOR WORKERS.

THE intensity of the light of Eddystone Lighthouse is nominally equal to that of 5,000,000 candles, and that of St. Catherine's to 6,000,000.

ALL lighthouses are arranged so as to send out their light horizontally. Experiments were made at the Naval Exhibition of the effect of sending up the light vertically. For these the light used was of 6,500 candle-power, and was visible at Frant, thirty-four miles away, although set at an angle of 15°. If it had been quite vertical, the light would have been visible fifty miles away at the least.

THE Liverpool Electric Overhead Railway will be six and a half miles long, and will have thirteen stations, including the termini. It consists of two lines of rails, carried on pillars and girders at a height of 16 ft. above the roadway beneath.

DURING last year Victoria, Australia, produced 597,629 oz. of gold.

THE *Algerine*, 3, second-class gun-vessel, 835 tons, has been sold out of the Navy, as it is too slow. It is one of the few vessels built for the Navy in Ireland.

IT is said that severe blows on the head, causing inflammation of the brain, can be cured by lubricating all the internal membranes of the nose with glycerine. This results in an abundant flow of water from the nose and throat, and thus the brain is relieved and the headache removed.

PARIS has just produced the largest driving-belt in the world. It is 120 ft. long, 7 ft. wide, nearly 1 in. thick, and weighs 1½ tons. It will put a fly-wheel 22½ ft. in diameter in communication with a pulley over 8 ft. in diameter, transmitting 1,000 horse-power at an ordinary speed of 67 ft. per second.

THERE are to be fifty separate contracts for lighting the buildings and grounds of the Chicago Exhibition. This will give a good variety of illumination, as so many different firms will be able to exhibit their special methods.

THERE are about 63,500 electric lamps—incandescent and arc—in use in Paris.

TO solder together two pieces of aluminium, use silver chloride as a fuse. Put the pieces together in position, spread finely powdered chloride of silver along the line of junction, and then melt the powder with a blow-pipe.

THE total output of anthracite coal during last year from the Pennsylvania mines (U.S.A.) was 40,448,336 tons.

ANTHRACITE is less easily combustible than other coals, and burns with very little flame or smoke. It is not suitable for ordinary grates, but is valuable for furnaces, as it gives off more heat on combustion than any other coal.

NEXT to camphor, sugar is the chief product of Formosa, an island off the coast of China.

PLANETS can be, and have been, discovered by taking two photographs of the same region of the heavens at different times. Upon comparison, a planet will betray itself by the movement with regard to the fixed stars it has made during the interval.

BORAX-CARMINE is a good general stain for microscopic preparations. It is prepared by dissolving 2 parts carmine and 4 parts borax in 100 parts of water, adding an equal volume of 70 per cent. alcohol, allowing to stand two or three days, and filtering.

ELECTRIC lighting is being adopted in flour mills, for the absence of naked flames makes it much safer than gas. It has long been known that anything in the state of very fine powder is explosive when mixed with air.

BY the aid of a telephone, singers at four different towns, twenty or thirty miles apart, were able to rehearse together the music they intended performing at a concert to follow some days later. Everything was distinctly heard.

PAPIER-MACHÉ is made by boiling paper cuttings in water, beating them in a mortar until reduced to a paste, boiling with gum or size, and then pouring the resultant mass into oiled moulds. It is then pressed, and when dry, varnished and polished.

CUNSEY BECK, a little stream running into Windermere, is the first that has been ever employed as the prime motor of electric boats. The power generated by its fall over a rocky ledge to the level of Windermere turns a turbine, which directly works a dynamo. The current thus produced is carried on telegraph poles to the lake side, and charges the storage cells which propel the boats.

SHOP:

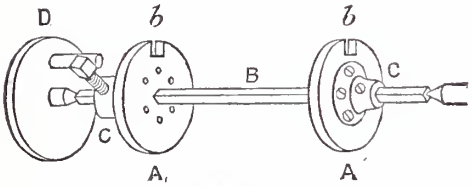
A Corner for Those who Want to Talk It.

**** *In consequence of the great pressure upon the "Shop" columns of* Work, *contributors are requested to be brief and concise in all future questions and replies.*

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of Work *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given.*

I.—Letters from Correspondents.

Quasi-Square Turning.—F. A. M. (*Eastbourne*) writes:—"A friend to whom I applied for information writes: 'I have never seen any means employed to prevent the edge breaking out; sharp tools, high speed, and great practice are required, especially in the last cut; also, as a rule, suitable wood is chosen for the purpose.' No doubt 'suitable wood' will be that kind of wood which has least grain, such as pear-tree. A very simple appliance for doing this work is described in the Britannia Co.'s book, 'Turning Lathes,' which need not cost more than three shillings, or may be home made. This consists of a square bar of iron (say ¾ in. square) carefully centred to run in the lathe. On this slide two iron flanges, each with its boss and set-screw to fix it on the bar, the flanges to be, say,



Lathe Parts.

4 in. diameter and ¼ in. thick, and drilled for wood screws. On these would be screwed discs of wood as large as the lathe will swing over the sole of the rest; these are then fixed on the bar and turned true. In Fig. 1, A, A, are the wooden discs; B is the square bar; C, C, are the iron flanges fixed by set-screws; and D is the catch-plate, or driver chuck. In the discs square or triangular notches are formed, as *b*, *b*, according as the work is to be of square or triangular section; they must be exactly opposite to one another, and there may be a dozen or more, according to the size of the discs. The work will be planed up square or triangular, to fit the notches, and secured by a ring, or by wood screws or other means. Now, as to the second question. Your hot-air engine burnt through in a fortnight, and you wish to know how long they ought to last, but you do not say whether yours is only a model, or whether you over-heated it. A properly-made heater ought to last three years. Of course, everything depends on the make, the thickness of metal, the method of heating, and the degree of heat required; with gas heating it will probably last longer than with a coke or coal fire."

Testing Accuracy of Framework.—F. C. (*Leytonstone*) writes:—"With regard to J. S.'s paper in Work, No. 125, and subsequent letters on the above subject, it may interest some of your readers to know that the method of testing frames by measuring the diagonals is the one used by railway-carriage, tramcar, and waggon builders for setting their axle-guards and framing true; and it will be seen, on referring to the two sketches, that it is by far the simplest method, and may be used where the 3, 4, 5 method could not. Take, for instance, Fig. 1—an outline of the end of a carriage. When the diagonals are of equal length, it is said to

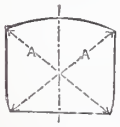


Fig. 1.

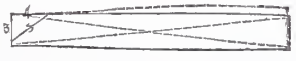


Fig. 2

Framework Tests.

be square; but whether the term square should be applied to a frame in which none of the angles are right angles might be made the subject of a long and profitless debate. Again, take the case of a bottom, Fig. 2, a frame about 7 ft. 6 in. wide, and varying in length from 14 ft. to 50 ft. When you are dealing with long pieces of timber, it is very seldom that you get them straight; so if you set one corner by the 3, 4, 5 method, it would throw the others out, as shown by the dotted line; and a number of other instances might be noted. Of course, the frames are tested for being out of winding, and to see that the sides are of equal length, before trying the diagonals. You could not get a frame square by any method without first taking this precaution. I do not question the accuracy of the method given by J. C. K. (p. 427), as it may be easily proved by Euclid I., 47—a principle said to have been discovered by Pythagoras, so undoubtedly of great antiquity, and very useful if you are dealing with straight lines; but when you are dealing with frames, the simplest plan is to test by measuring the diagonals, and in a great many cases it is the only one you can use."

Bicycles.—P. B. H. (*Southport*) writes:—"A reference is made in 'Bicycle Patent' (see p. 717, No. 149, 'Shop'), telling C. M. (*Liverpool*) something which the original answer of mine gave, and A. S. P. certainly adds nothing new. My answer to F. S. appeared on p. 524, not 394, No. 137, Vol. III. of Work. The drawings may be right or wrong, as A. S. P. states; they were traced, however, from the specification drawings."

Sash Making.—G. le B. writes to B. R. H. (*Cardiff*):—"In my papers on 'Sash Making,' I did not say that the forms given were the *only* forms in which windows were made, but I distinctly stated that 'every locality, and, in fact, every builder, has different ways of doing the work.' As to the sizes I have given for the sills, I am very well aware that they vary, and have made them myself 4 in. thick at the front edge; but I can tell you where to see tens of thousands of soles of the sizes I gave, and not one of them warped—in fact, in the particular city I have in view it would be extremely difficult to find a sole of heavier dimensions. As to my calling the head of the sash a 'lintel,' it is a common term in many parts of the country. If I had called it a 'head,' some other critic would have probably inquired why I had not termed it a 'lintel.' The lead casing, I may say, is also very often omitted, and the window can be made as shown. As to the meeting bars, I think that, if you read my paper *carefully*, you will see that I do explain the 'difficulty,' as you term it; and also that I say that a little *thought* on the beginner's part ought to enable him to comprehend the instructions given. As to your statement about the half-tenon of the lower meeting bar, I can only imagine that you can have seen very little good work, or else must not have travelled far from one locality, or you could not have failed to have seen this mode of construction. I do not say that your way is wrong; I have seen so many ways of doing things that I would be very chary to tell anyone his way was not the right one. As to your last objection—the size of the mouldings in Figs. 12 and 13—it is apparent to the merest novice who looks at the drawings that they are not drawn to scale, but are simply intended to convey to the student the mode of construction. This, I think, sufficiently explains the discrepancy in size, which is, in reality, of not the slightest account, as the various sizes are correctly given in the matter. I did not know before that Work was 'intended for the amateur'; I fondly imagined it was for both *amateur and professional*, as stated on the front page every week. As for myself, I scarcely come under the designation 'amateur.' I have worked on sashes in all parts of the country, from the Island of Harris, in the far Hebrides, to the coast of Cornwall. I regret that, instead of carping criticism, you did not give us the benefit of *your* method. We are all willing—nay, anxious—to learn from everyone; so hurry up, and tell us your way. And next time do not write anonymously: give us your name and address, 'not necessarily for publication, but merely as a guarantee of good faith.'"

II.—Questions Answered by Editor and Staff.

Soldering Gongs.—Tinsmith.—It is very little use soldering gongs, the vibration of them very soon loosens the solder. You might manage to braze them, however, if you have a good powerful gas blow-pipe. I would not advise you to try to braze them on a forge fire, or you might very possibly spoil them, as the metal of which they are composed melts very quickly, so that to make a good job you will want to get some quick-running spelter.—R. A.

Wheelwrighting.—Cymro.—I am glad that Work has proved so useful to you and others. I will bear in mind with regard to articles on wheelwrighting, but I cannot promise until my articles on cart and carriage wheel making are finished—subject to the Editor's approval—on which at present I am engaged. In the meantime, I shall be pleased to answer any query about same in "Shop."—W. P.

Peroxide of Manganese.—One in a Fix.—This is the chief ore of manganese, being a compound of that metal and oxygen. It is also called pyrolusite (from Greek "pur," fire, and "luein," to wash), in allusion to its use in "correcting" the green and brown tints of glass. It occurs in massive black lumps, and is sold either as powder or granulated. For a Leclanché battery it is better to use the granular, which you can obtain from all chemists and dealers in electrical apparatus for from 3d. to 6d. per lb. Ask for "granular manganese dioxide."—F. B. C.

Formulæ Collection.—E. H. B. (*Manchester*).—Purchase a well-bound pocket-book of any stationer. Let it have an alphabet cut for index purposes. Then collect your formulæ under subjects, page the book, and index it yourself accordingly.—Ed.

Cost of Model Electric Light.—Young Reader.—A 5 c.-p. incandescent lamp will cost 5s. The holders cost from 1s. upwards, according to material and workmanship. Round double cells with porous compartment, zinc and carbon elements, and binding screws complete, will cost about 3s. each, and you will require four such cells to light an 8-volt lamp. If you make the battery yourself, following the hints and instructions given in my article on the subject, under the head of "Model Electric Lights," in No. 89, Vol. II. of Work, the materials will probably cost less than the above-named sum. I cannot tell you "the best place to buy the requirements, lamp, etc.," but I know that Mr. Bottone will supply all these or any other electrical fittings required by amateur electricians. Mr. G. Bowron, Praed Street, Paddington, will also supply them, but there are few other dealers who care for such small orders. Consult also the advertisements in Work.—G. E. B.

Electric Bell Fitting.—M. D. (*Blackburn*).—You will do well to learn how to fit electric bells and electric lights. The knowledge will be useful to you in your trade, for you can as well combine electric bell and electric light fitting with plumbing as many do gas-fitting. I know a first-class plumber who is equally good at electric bell fitting. Some of those who are now in practice at this work picked up the knowledge in little bits at a time from such periodicals as Work, in which the subject has been treated, and used those little bits as occasion offered. Four hand-books on electric bells and their fittings are now on sale. These are: "Electric Bell Construction" and "Practical Electric Bell Fitting," by F. C. Allsop, price 3s. 6d. each; "Electric Bells, and all about Them," by S. R. Bottone, price 3s.; and "The Bell-hanger's Handbook," by F. B. Badt, price 4s. 6d. These will be useful to you. At present there are only two cheap hand-books published on electric light fitting: one by F. B. Badt, price 4s. 6d., and one by J. W. Urquhart, price 5s. F. C. Allsop and S. R. Bottone have books on the subject in course of preparation, and you should learn much thereon from the articles published in Work. Purchase the indexes, and then get the back numbers.—G. E. B.

Technical Magazine.—F. S. (*Exeter*).—We know of no such magazine as you refer to.

Jobbing Sheet-Metal Work.—W. L. R. (*Rochdale*).—Sympathising with your misfortune, and being desirous to help you all that I can, I have carefully thought out a list of tools that I think will be the least that you will require for the above. You will, I suppose, utilise the fire in the room you work in to solder with; if not, a fire pot will be wanted; next, two soldering irons or copper bits of a medium and a light weight; a strong pair of snips (12 in. or 14 in.); a mallet; two hammers, ordinary shape, one small for riveting, etc., and the other considerably heavier; a block and two block hammers. A paning hammer and a stud hollowing hammer will also be necessary; two rivet sets; two groovers, several punches of various sizes, a chisel or two, a square, a pair of compasses, a scoring or brad-awl, a pair of round and a pair of flat-nosed pliers. With regard to heavy tools, such as stakes, etc., you will want a crease-iron, a hatchet stake, and half-moon stake; and a funnel stake would be very useful, but that is a side stake you could get later if you found you got on at it. As you have all the numbers of Work, I must refer you to them for price and description of tools named. You will find these on pp. 240 and 301, Vol. II.; and if you take the trouble to look up my other articles, you will find there a lot of information that will be useful to you. I might say that second-hand tools may often be bought cheaply. Try the ironmongers' shops in your town. I know from experience that there are often surplus tools that have been thrown aside that would do very well for your purpose, though, perhaps, not thought good enough for a regular tinsmith. Do not be persuaded to buy a lot of antiquated stakes and tools. If you cannot pick up what I have mentioned in your town, try an advertisement in Work, and failing that, you must perforce buy new ones. I think you will find all about materials, solder, etc., in my articles, so I need not go into that; but if there is any point I have not made clear, or any further information required, I shall be pleased to give it. For china and glass riveting, see p. 4, Vol. II. of Work.—R. A.

Enlarging Camera.—Ilford.—Of course; read it in the singular. The size of the enlargement is dependent on the distance of the lens from the negative. The *nearer* the negative to the lens, the greater the extension of camera required, and the larger the image, and *vice versâ*. It is quite necessary that the *surface* of the ground glass should occupy *exactly* the same position as the sensitive surface in order to obtain definition. Ascertain that both the ground glass and sensitive surface do so by actual measurement. Both the apparatus and plates mentioned are excellent. You cannot do better.—D.

Incandescent Lamp.—Kallitype.—The marks on your incandescent lamp are to be interpreted as follows: "Swan," made by the Swan Electric Lamp Company; "16," the lamp is of 16 candle-power; "100," it takes a current with a pressure of 100 volts to light the lamp; "J.K.," the reference letters used in grouping lamps in an installation of electric lights. The lamp will be of no use to you unless you have a dynamo capable of giving a current of electricity at a pressure of 100 volts. It is altogether unsuitable to a small installation worked with current from a battery.—G. E. B.

Cycle Enamel.—W. A. J. (*Tamworth*).—The best enamel for cycles is stoving enamel, baked in by the heat of a stove, or even at a temperature of 300 degrees. The next best is put on with a brush. Any good hard drying enamel will do. If three or

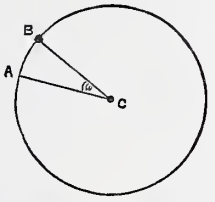
four coats are put on, every part alike getting the same number of coats, it will resist damp. It is not the enamel that rusts by exposure to damp, but the want of it—that is, only the parts of the machine where the enamel is chipped or worn off are affected by damp. So a stove-enamelled machine, even of the very best, gets chipped or rubbed, and these parts are affected by rust immediately. The reason the stoved machine is best is that the enamel so treated stands more knocking about without chipping than that painted on with a brush. A stove-enamelled machine, if it gets but one coat (and cheap machines usually get no more), is not much, if any, better than one well done with the brush. If you do not wish to send the machine to a stoving works, get the "Club" hard drying black enamel: it is a spirit varnish; give three coats carefully. Keep some of the enamel for future use, and give any worn or chipped parts a touching-up, and you will not be much troubled with damp. You will get the "Club" enamel in most of the cycle shops, or of the makers, the Silico Enamel Company.—A. S. P.

Magnetic Field of Dynamo.—C. F. C. (*Lincoln*).—The relative position of the poles in the magnetic fields of the Gramme and Manchester dynamos has often been a puzzle to students of electricity. Many, like yourself, hold pre-conceived ideas of the position of magnetic poles, based on their knowledge of the position of the two poles in ordinary permanent horseshoe magnets, where the magnetism is self-contained and the poles are only surrounded by air. But the arrangement of the electro-magnets to form the magnetic fields of the Gramme and the Manchester dynamos does not resemble a horseshoe magnet. In the Siemens and Simplex machines the arrangement is that of a horseshoe with the magnetic field between the two poles; but in the Gramme the arrangement is that of four bar magnets in pairs—one pair at the top with their like poles touching each other, and one pair at the bottom similarly arranged. The block of curved iron on top is therefore one pole of the upper pair of magnets—that is, the two like poles united—and the block beneath is the pole of the other pair. The direction of the electric current flowing through the wire wound over the cores determines the poles of an electro-magnet. In the Manchester dynamo there are two vertical electro-magnets parallel to each other, with like poles at the tops and like poles at the bottoms of the magnets. The pole-pieces in this machine are merely iron bridges, and as each bridge spans two like poles of the magnet, the bridges become magnetised with the same magnetism—N or S—as that of the poles which they span. Hence there is a strong magnetic field in the space between the two bridges, and each bridge has the same magnetism as that of the poles of the cores to which it is attached. I hope you will now clearly understand the position of the poles in these machines.—G. E. B.

Flat Brass Tube.—W. C. (*London*).—The section of tube that you send is rather unusual—in fact, I have never seen any like it—but if it is to be procured, I think you would most likely get it at Messrs. Tonks, Limited, brass founders, Birmingham; or Townsbend & Co., Ernest Street, Birmingham.—R. A.

Casting in Plaster.—PLASTER PARIS.—You ask (1), Can anything be mixed with plaster to harden it? Nothing is needed if the plaster is fresh and properly mixed. If your casts do not harden, it is owing either to stale plaster or to the proportion of water being too large. (2) What is best to make a piece of mould leave? Hog's lard, used sparingly; this has more body than oil, and does not discolour. (3) What is used for polishing the figure when finished? Many things have been used to take off the chalky look of plaster and to give it something of the creamy softness of ivory, that most in favour having been white wax. This must not be applied till the cast is perfectly dry. Melt the wax in a vessel big enough to hold the cast. Heat the cast, and lay it in the bath. The wax should not be high enough to cover it. Watch till the wax rises to the surface, which will show that the plaster is saturated; then remove the cast. PLASTER PARIS should by all means get Vol. II. of WORK: he will find articles on "Casting in Plaster" at pp. 349, 398, 500, 578, 659 (Nos. 74, 77, 83, 88, 93).—M. M.

Gravitation.—H. R. (*Colne*).—If you draw a circle on a sheet of paper, and then cut a piece of string the exact length of the diameter of that circle, you will find, on measuring, that the circumference of the circle is a little over three times (really 3·014,159,265 . . . etc.) the length of your string: *i.e.*, of the diameter. This is universally true, that whatever may be the size of a circle, its circumference is 3·1416 (this is near enough for practical purposes) times the length of the diameter of that particular circle. Now, if this figure were a simple one (as 3 or 4), then it would be easy to use and speak about; but as it is not so, and yet is a factor which is continually used in every branch of work and science, for convenience it is written π (the Greek letter "pai"). Thus the circumference (c) of a circle is π (or 3·1416) times the diameter (d): *i.e.*, $c=\pi d$. For many reasons it is always preferable to use the radius (r) of a circle, and not its diameter. The radius (r) is any line drawn from the centre of a circle to its circumference, and is consequently half the length of the diameter, or $d=2r$. Thus, our formula becomes $c=2\pi r$. By higher mathematics it is also known that the area of a circle (*i.e.*, the amount of space enclosed by its circumference) is $\pi r \times r$ or πr^2. Now, if we come to a solid circle or a sphere, it is found that the size of its whole surface is given by the formula ($2\pi r \times \pi 2r$) or $4\pi r^2$, and its solid contents by ($\frac{2}{3} \times 2r \times \pi r^2$) or $\frac{4}{3}\pi r^3$. Now, the radius of the sun is about 426,450 miles, and therefore the solid contents of the sun amount to $\left\{\frac{4}{3} \times 3{\cdot}1416 \times (426{,}450)^3\right\}$, which equals in round numbers 325,725,000,000,000,000 cubic miles. One cubic mile of the sun weighs 5,769,230,769 tons, and therefore the weight and mass of 325,725,000,000,000,000 tons will be in round numbers 200,000,000,000,000,000,000 tons. I do not understand what you mean by "the mass of the sun or planet = $4\pi^2$ (or 39·48)." Besides, the mass of one planet differs from the mass of another planet, and from that of the sun. As regards the second part of your query, a body (B) set in rotation will describe a circle; and if we imagine a line (B C) joining that body to the centre of the circle, then the angular velocity of B is the angle B C A that B C makes in one second with any chosen radius (such as A C) of that circle. This angle is not expressed in degrees, but in circular measure. If the rotation is uniform, then the distance moved through in one second will always be the same wherever B may be: *i.e.*, B will move a distance = to A B in each second. But all lines drawn from the centre to the circumference are radii of that circle, and therefore equal to one another. Thus the ratio $\frac{A\,B}{A\,C}$ is always the same for that circle, and this ratio $\frac{A\,B}{A\,C}$ is the circular measure of the angle B C A, and is often represented by the Greek letter ω (omega). Now, the linear velocity (*i.e.*, the velocity in a line in one second) of the body, B, is A B. If we call the linear velocity v and the radius r, then $v = A\,P$ and $\omega = \frac{A\,P}{A\,C} = \frac{v}{r}$ and therefore $v = \omega\, r$.



Gravitation. Fig. to show Angular Velocity — C, Centre of Circle; B, Position of Rotating Body one second after leaving A; A C, Any chosen Radius of Circle; B C A, Angle of Rotation represented by ω.

This explains some of the symbols, although I do not at all understand your figures, or what they are intended to prove. If you require further explanations, write again, and state clearly what you wish to find out.—F. B. C.

Timber for Yawl.—G. H. (*Stoke-on-Trent*).—Any timber merchant can supply the wood for building a canoe or canoe yawl. If of spruce or white pine, it should be selected very carefully, so as to be free from knots and shakes, and is usually cut into six cuts or planks from a 3 in. deal, but the scantling will depend on the size of the boat to be built, and the work she may have to do. If she is to be built of cedar, then the planks, when finished, should be from ¼ in. to $\frac{5}{16}$ in. thick, and about the same if of spruce; but if of oak, then somewhat thinner: but oak is rather heavy, though very strong and almost indestructible. As your correspondent lives in the country, his best course will be to get his "grown trees" from wood he can purchase at any cart and waggon builder's, where it will be well seasoned. It may be of either oak, Spanish chestnut, or ash. He will find the branches so shaped as to admit of the knee, or timber, being cut out of it, the grain following the curve or shape of the required part, as shown in Figs. 1 and 2. A good way of proceeding is to work the branch into a 3 in. plank, and then cut it into three planks, from which the knees for the stem and stern can be cut, and any other of the larger knees. For the timbers, as light a plank as possible should be cut—say, ¼ in. to ⅜ in.—and the grain being in a correct curve suitable for the timber required, the template or mould should be laid on it and pencilled out; then it should be cut out with the compass-saw, the planing being done next. Any other questions on the above subject will at once be answered with pleasure. Timber for canoe yawl and fittings, and kinds wanted: Keel, red pine, free from knots and shakes; stem and stern-posts, knees and timbers, oak, carefully cut with the grain; deck of ⅛ in. cedar, the water-ways thicker; inside gunwale of white pine or spruce; planking of cedar or spruce; upper strake of mahogany; carlines and inside fittings, white pine or spruce; coaming of well, oak or ash; breast-hook of oak; decks to be screwed with brass screws firmly to the inner gunwale. The firms in London from whom cedar, etc., can be obtained: Messrs. Joseph Sandell & Co., Waterloo Road, S.E.; Messrs. Wm. Bloore, Bond Street, South Lambeth, S.W.; Messrs. B. J. Hudson and Sons, Millbank Saw Mills, Grosvenor Road, S.W.—L. Y.

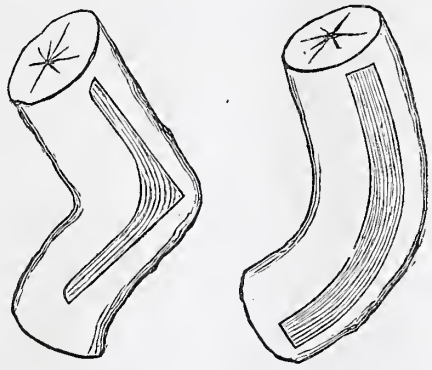


Fig. 1. Fig. 2.

Yawl. Fig. 1.—Shape of Tree for Knees, so that the Grain will follow the Curves. Fig. 2.—Shape of Tree for Timbers, so as to have the Grain follow the Curves.

Combination Patent.—IGNORAMUS II.—Our correspondent sends us a question to which we can give him no satisfactory reply on the scant data afforded. He may rest assured that the *grant* of a patent is not the *slightest* proof of its *validity*, and in the case of a *combination* patent its validity depends on the following points: Is the combination novel? Is there sufficient invention? Is it the subject matter of a patent? Is the application of any part of the combination an "analogous use" of the parts which have been employed for the purpose? And, lastly, how the claims are set out. It would take up too much space in "Shop" to go into the details relating to patents—of which the public, as a rule, are too generally ignorant—to make all the points clear; but if our correspondent will refer to the celebrated trials in the case of the "fish-plates" on railways (Heardor Wilde *v.* G.N.R.) and the case of Bamlett *v.* Picksley, he will there learn more on the subject of combination patents than can at present be acquired in any other way. If he visits the Patent Office Library, the obliging librarian will put him in the way to refer to them. Without examining and studying the specification, we cannot give any opinion or advice calculated to be of any use to our correspondent.—C. E.

Elephant Tusk.—W. F. Z. (*Liverpool*).—In few places can such a choice of tusks be seen as at the docks of your own port—nowhere else do we remember seeing such piles of ivory. As you are particular in the one you want, why not go there? Of course there would be difficulties in getting a single tusk from an importer, but should you fail in obtaining this as a matter of favour, you could surely learn from an *employé* the name of a customer through whom you could buy the tusk selected.—M. M.

Half-Plate Camera.—KODAK.—It is out of the question to reply to your request in these columns. In the first volume of WORK, several articles of some length were given, and fully illustrated with working drawings, which were carefully made out in all details, so that anybody with constructive ability could make the apparatus. It was for whole-plate size, but by reducing the principal measurements to half-plate dimensions, they would be equally useful for that size. Why not advertise your wants? The probability is somebody would have a first volume of WORK to part with.—D.

Striking Clock.—A. R. R. (*Yarmouth*).—New winding squares cannot be purchased so far as I know, and the only way to get them would be to make them yourself, or get a clock-jobber to do it; and the latter I should think would cost you nearly as much as a new clock, from the description you give of it; but I see no reason why you could not do it yourself if you have a few tools. Carefully take your clock to pieces, letting the springs all the way down before taking the plates or frame apart; now get a piece of rod-iron, a trifle larger than the old broken arbor or square, and turn in a lathe, or file up by hand if you have not got a lathe, and fit it up, using the old pieces as a guide. The arbor is fixed to the winding ratchet by simply driving it through, having previously tapered it by filing or turning. Having knocked the old one out, it should be a simple and easy job to put a new one in, as it does not matter much if the fit is not exactly, as these American clocks allow a little for being out of truth.—A. B. C.

Gas.—A. D. (*Blackburn*).—Coal consists chiefly of carbon, and when burnt, this carbon combines with the oxygen of the air to form carbonic acid gas. But as in an ordinary fire there is not sufficient air to properly burn all the carbon, the carbonic acid gas and heated air carry off some of this unburnt carbon with them in the form of smoke, which is carbonic acid gas and air so heavily ladened with solid carbon in a very fine powder that, on meeting a cool surface, this carbon is deposited as a black layer. Supposing you have a bright red fire, and you put coal on to it, the air entering at the bottom of the grate is deprived of much of its oxygen whilst passing the red-hot portion of the fire, and thus cannot properly burn the fresh coal, and yet, being hot, it can burn the coal sufficiently to carry off some of its carbon as smoke. Coal, too, often has gases enclosed in it, and these gases, when they escape, take fire, and burn with a smoky flame, because they contain more carbon than the air can properly burn as the gas rushes out.—F. B. C.

Bending Lead Pipe.—W. H. C. (*Homerton*).—You state in your query that you want to bend the pipe to an angle of 45°, but your sketch shows the pipe bent square, which is an angle of 90°—a great difference. Try this way; Place a strong piece of ash stick in each end of the piece of pipe, place the pipe in a vice with just enough pressure to hold it, get someone to take one stick and you the other, and both lift up. Bend up about half what you want, then take out and work it a bit with a round stick; then put in vice again, and bend to correct angle required.—R. A.

Dry Batteries.—C. B. (*Keighley*).—(1) Of course, the term "dry battery" is slightly aside the mark. There must be some moisture in the cells, but there is not enough to be noticed. If you were to break a cell of a dry battery, you would not find any liquid. The battery is, therefore, safe to use wherever there is any danger to be apprehended from spilling the liquids employed in the general run of batteries. It is eminently suitable as a generator of electric current for a bedroom electric night-light. (2) I cannot tell you the exact composition employed in any of the dry batteries, as they are the subjects of unexpired patents, and their makers keep the relative quantities of the ingredients or their method of mixing them a profound secret. (3) I am not able to furnish you with a statement comparing the relative value of the Gassner and the E. C. C. dry cells as electric light batteries. I have tried the Gassner and the E. S. dry cells for this purpose, and am inclined to think the latter superior in point of constancy; but none of these dry batteries are suitable to continuous electric lights. They do very well indeed for portable electric night-lights. I have had an E. S. portable lighting set in use as an occasional night-light for nearly three months, and find it very useful when I wish to see the time by my watch. I have only to press a button under my pillow to light the lamp and illumine the face of the watch, besides lighting a room 12 ft. by 12 ft. by 10 ft. I think this very good.—G. E. B.

Leclanché Battery.—C. B. (*Keighley*).—(1) The inside cell of a Leclanché battery contains a mixture of peroxide of manganese and carbon, both broken to the size of peas and sifted free from dust. This mixture is packed closely around a carbon plate, which forms the negative element of the battery. The peroxide of manganese furnishes oxygen to combine with the hydrogen formed by the electric current, and thus prevents the negative element from being coated with a film of hydrogen. (2) The agglomerate Leclanché battery has the above-named mixture combined with a cement, and compressed into blocks. A block of the agglomerate mixture is placed on each side of the carbon plate, and kept in contact with it by a rubber band. This does away with the necessity of having a porous cell, and consequently lowers the internal resistance of the cells. (3) The Leclanché cell can only be employed in electric lighting where small incandescent lamps of low candle-power are required to be kept glowing for a few minutes at a time, with long intervals of rest between. When used continuously, the store of oxygen gets used up, and the cells are then said to be run down. The same may be said of "dry cells;" but these have their peculiar properties and advantages apart from those of the Leclanché series. The six-block agglomerate Leclanché is the most durable cell of the series. In this there are six blocks of agglomerate arranged around a fluted carbon rod, which forms the negative element of the cell.—G. E. B.

Electric Subjects in Work.—C. B. (*Keighley*).—We are always pleased when rendering assistance, by means of advice, to all our readers, and generally manage to answer all questions of a reasonable character; but your last exceeds the bounds of reason. We have repeatedly given notice in "Shop" that we *cannot answer questions in our next issue* from the date of correspondents' letters. We have several times printed a list of the numbers you inquire for. When you ask us to give you a list, in our next issue, of "all the numbers of Work that treat on electric lights, dynamos, accumulators, electro-motors, and batteries," we must refer you to the three indices of Work, which cost one penny each.—G. E. B.

Tailoring, Cutting, Fitting, etc.—S. W. (*Ashton-under-Lyne*).—These subjects shall receive proper treatment as soon as a competent, practical man can be arranged with to write a series of papers.

Induction Coils.—A. B. (*Leytonstone*).—An excellent series of papers have been commenced in the fourth volume of Work. Purchase No. 157.

Electric Lamps.—C. B. (*Keighley*).—You are in error in supposing that it takes sixty-five times more current to light one 5 c.-p. lamp than it does another of the same candle-power. It may, and does frequently, require sixty-five times more pressure to force the requisite current through the resistance of a lamp's filament, but the quantity of measured current expressed by the unit of current measurement denominated the watt is nearly the same for all lamps of the same candle-power. This quantity ranges from $3\frac{1}{2}$ to 4 watts per candle-power. A 5 c.-p. lamp, for instance, will take, say, 20 watts of current to bring out its full light. If it is an 8 volt lamp—that is, if its filament can be made to glow with a 5 c.-p. light under a pressure of 8 volts—it will take a current volume of $2\frac{1}{2}$ ampères, since $2\frac{1}{2} \times 8 = 20$. But if the filament is very long and very thin, so as to offer a high resistance, it may take 65 volts of pressure to make it glow; but the capacity of the filament will only allow of $\frac{5}{13}$ths of an ampère of current to be forced through it, and $\frac{5}{13} \times 65 = 19\frac{1}{2}$, or nearly 20 watts, as before.—G. E. B.

III.—Questions Submitted to Readers.

*** *The attention and co-operation of readers of* Work *are invited for this section of "Shop."*

Kiln for Burning Lime.—J. McJ. (*Capetown*) writes:—"(1) Would some reader kindly give me, through 'Shop,' the rough drawing of a lime-kiln, known as a running kiln; and what is the best lining, as fire-bricks are very expensive out here? (2) How long will the stone require to remain in the kiln to be burnt? (3) What is the best simple test to know a good limestone? (4) I should like to know also any good work on this subject."

Damp Ceiling.—J. W. S. (*Guernsey*) writes:—"I have a boarded ceiling, which is damp through the sweating of the tiles. Would Willesden paper—the one-ply brown—be suitable for tacking to it, and then paper over it in the usual way?"

IV.—Questions Answered by Correspondents.

Model Ship Building.—Thornhill writes, in reply to Cutter (see No. 150, p. 733):—"Cutter will find all the information he wants in 'Model Yacht Building and Sailing,' by E. Biddle, published by Norie & Wilson, Minories, London, E.C., the best work on the subject that has come under the eyes of an amateur of 1822 down to date."

Fret Inlaying.—J. B. (*Carrick-on-Suir*) writes, in reply to J. T. S. (*Sheffield*) (see No. 149, page 718):—"I enclose rough sketch showing how to manage holes. As you see, they come through waste wood only. I suppose you understand how to get correct angle for table. I used to try a few waste pieces first until I got it right. I can recommend 'Fret-sawing for Pleasure and Profit,' which you can get at any dealer's. I think it costs 2s. 6d. In inlaying, you must be careful not to go back on the cut, else the saw will cut bevels on both sides, and destroy the stuff. Personally, I don't think fretwork worth the trouble. In veneer inlaying, a fine saw is used, quite upright, and the burr of saw on under-side, on being pressed into the cut, quite hides it. The under-side must be the right side when finished."

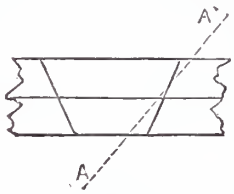


Diagram showing Line of Awl.

Paper Making.—F. G. (*Gravesend*) writes, in reply to J. W. (*Plumstead*) (see No. 148, p. 702):—"There are several directories published annually giving the addresses of the various paper mills in the United Kingdom. A very reliable one is that published by Marchant, Singer & Co., St. Mary Axe, E.C. The selection of site is a very important matter in building a paper mill, as it is necessary to have a good water supply, and also to have such advantages as to keep carriage of raw material, etc., as low as possible. The price of rags depends upon their grade. New white cuttings are quoted at 23s. per cwt., whilst light prints sell at 6s. In the manufacture of paper, esparto has superseded rags to a very large extent. It may be mentioned that there is a paper mill on the Wandle, at Wandsworth, for many years worked by Mr. Wm. McMurray. Here large quantities of esparto are used, and doubtless J. W. has noticed the water-mark 'McMurray' on the *Times* newspaper. Another fibre which is fast growing in use is that made from wood, treated by various chemical and mechanical processes, and known as sulphite, soda, and mechanical wood pulps. The chemical pulps average in price from £10 to £16 per ton, and mechanical pulps from £1 17s. 6d. to £7 10s."

Lathe Work.—Brum writes:—"On page 798, No. 154, Vol. III. of Work, Lathe asks for the name of a good book on screw-cutting. I can confidently recommend him to study Shedden's 'Mechanical Rules and Tables,' price 1s. 6d., and when he has mastered that, to get 'Screws and Screw-cutting,' price 3s., both from Calvert, of Manchester. On same page, Young Turner asks for information as to kit, etc., for outfit, but does not say whether he means taking up iron or wood turning, or whether he can afford a good outfit or not; but if he will be a little more explicit, I will try to help him. But either way, I would advise him to go to some good library and study (not read) 'Holtzapffel's 'Mechanical Manipulation'; also Northcott's 'Lathes and Turning,' which are the best books on the lathe."

Overshot Water-Wheel.—G. E. C. L. (*Ipswich*) writes, in reference to F. T. C. (*Finchley*) (see No. 149, page 718):—"I should advise a small hydraulic ram in preference to an overshot water-wheel. The efficiency of a wheel is seldom more than 25 per cent., while the ram is frequently 80."

Blowing Fan.—G. E. C. L. (*Ipswich*) writes, in reference to Warehouseman (see No. 151, page 750):—"The Blackman air propeller is the best thing on the market, which can be obtained from the Blackman Ventilating Co., Limited, 63, Fore Street, E.C."

Maguay Electric Lamp.—G. E. C. L. (*Ipswich*) writes, in reference to electric lamp (see No. 150, page 733):—"These can be purchased, and lists can be obtained free, from the Maguay Electric Light Co., 9, Frith Street, Soho, W.C."

Coal Dust.—J. H. B. (*Pendleton*) writes, in answer to Householder (see No. 151, page 750), *re* coal dust:—"If he will water the same thoroughly and mix it with gas coke, he will find it an excellent slow-burning fuel."

Glass Cement.—R. W. (*Liscard*) writes to A. S. (see No. 154, page 798):—"For an adhesive for glass to stand continued wet, I do not think he can use anything better than the fluid waterproof glue manufactured by the Waterproof Glue Company, Dale Street, Liverpool, which will stand any amount of wet. I presume the dark colour of this glue would be no detriment to its use; if so, he might try the same company's 'Glu-Krystal,' which is a strong adhesive for glass, but as to whether it will stand continued wet I cannot say."

Qualification for C.E.—Civil Engineer writes to Young Engineer (see No. 154, page 798):—"There is no 'examination' or 'competition' which qualifies a person to become a C.E. To become one, it is necessary that he should serve a three to five years' articled apprenticeship to a qualified engineer, either in an engineering factory or works, and when out of his time, and been in charge of, or superintended, the carrying out of such works, he may apply for admission as an Assoc. Ins. C.E., or a member, if of suitable age, and his credentials are satisfactory. There is no 'royal road' to position in this profession."

V.—Letters Received.

Questions have been received from the following correspondents, and answers only await space in Shop, upon which there is great pressure:—A. M. (*Hastings*); E. P. (*Southampton*); H. E. (*Glazebrook*); Canary; G. E. C. L. (*Ipswich*); M. F. (*York*); Poor Tinker; Brum; G. H. (*Oldham*); J. W. (*West Brighton*); J. H. L. (*Newport, Mon.*); L. C. (*Maidstone*); Snap; Never Satisfied; Junior Engineer; W. D. (*St. Helens*); Dynamo; F. T. (*Stoke Newington*); A. J. W. (*Battersea*); J. M. (*Leith*); A. E. G. (*Leicester*); Constant Current; B. H. B. (*Newport, Mon.*); T. L. (*Leicester*); J. W. (*Collessie*); J. M. P. (*Nottingham*); W. J. D. (*Montgomery*); A. W. (*Manchester*); J. G. L. (*Sheffield*); J. S. (*Holcombe*); T. W. (*Harpurhey*); D. (*Portsmouth*); S. J. C. (*Swinnoon*); W. B. H. (*New Delph*); E. B. (*Southsea*); W. C. M. (*Stanningley*) Nitrate; J. H. M. (*Longsight*); C. H. L. (*Falmouth*); J. McD. R. (*Leith*); G. S. W. (*Dewsbury*); D. B. (*Glasgow*); T. A. (*York*); Miller; F. J. H. (*Tufnell Park*); W. M. (*Stechford*); W. R. (*Clitheroe*); W. S. (*Woodbridge*); Thrums; J. C. (*Stratford New Town*); W. H. (*London, E.C.*); B. A. T. (*Burnham*); S. P. (*Durris*); G. J. M. (*Liverpool*); W. B. (*Wirksworth*); H. A. W. (*Holt*); G. M. (*Brighouse*); A. P. (*New Ross*); D. J. K. (*Roscommon*); J. P. (*Hull*); C. P. (*Old Trafford*); T. M. (*Birmingham*); Guilielmus; F. F. (*Deptford*); H. W. H. (*Bath*); Electric Lamp; R. W. (*Perry Barr*); E. C. R.; White Wood; C. E. C. C. (*Chesterfield*); A. C. C. (*Rochford*); A. C. (*London, W.C.*); A. H. D. (*Marylebone*); Raw Material; W. T. (*Northwich*); Indiarubber; J. T. V. (*Bournemouth*); J. C. L. (*Greenwich*); C. J. F. (*Eastbourne*); H. J. (*Nottingham*); J. T. (*Blantyre*); J. H. M. (*Beau Parc*); Mac; A. O. (*Tetteuhall Wood*); Emarf; J. W. (*Birstall*); A. B. (*York*); Young Pattern Maker; A. B. W. R. (*Normanton*); F. W. R. (*Harting*); W. St. J. (*Castlefield*); Young Electrician; J. J. (*Everton*); Shears; Auto.; A. G. P. (*London, N.W.*); Nimrod; W. J. G. (*Holloway*); J. U. (*Bournemouth*); W. F. C. (*Coventry*); W. E. R. (*East Grinstead*); N. W. A. (*Durham*); J. J. (*Bristol*); A. F. (*New Ross*); W. C. L. (*Owens College*); J. L. (*Hull*); W. R. (*Manchester*); W. H. (*Kirkdale*); J. J. (*City Road*); R. S. C. (*Newcastle-on-Tyne*); J. H. (*West Leigh*).

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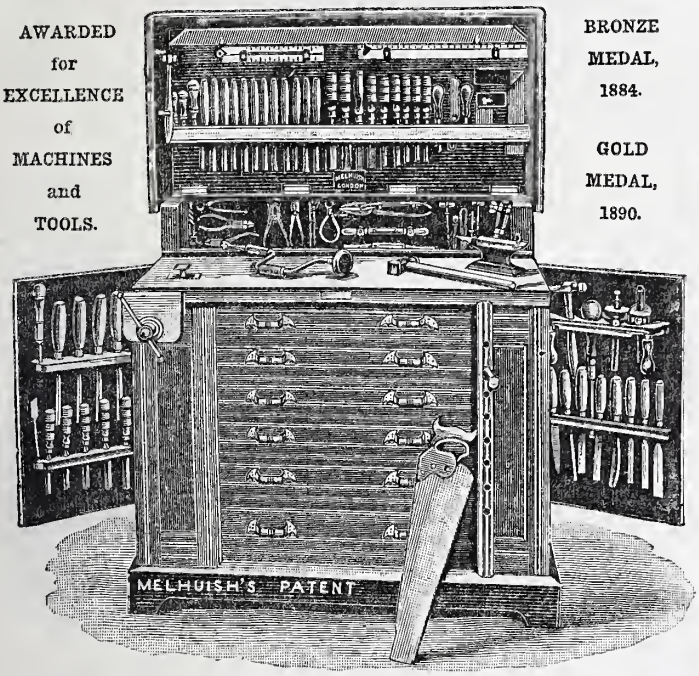

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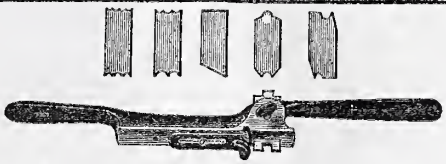

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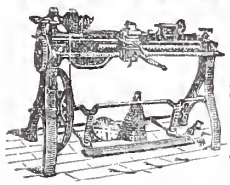

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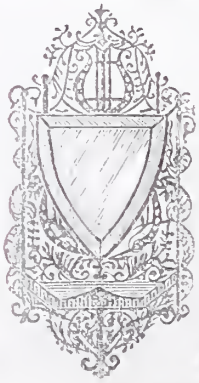

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WORK

An Illustrated Journal of Practice and Theory

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Vol. IV.—No. 159.] SATURDAY, APRIL 2, 1892. [Price One Penny.

WORK WORLD.

Over 150,000 Safety bicycles were made in Great Britain during 1891, and it is computed that there are more than three-quarters of a million cyclists at present in the United Kingdom. This is at least a third more than in 1890, so much has the present form of cycle taken with the public.

* *

Dynamite in Cornwall is not in an unsuitable quarter. This will account for the factory which has been recently started at Perran for the manufacture of dynamite. "It's an ill wind"—and a neighbouring saw-mill will benefit, as the proprietor has an order from the company for 2,000 boxes in which to pack the dynamite.

* *

The Liverpool authorities are not keen on electric lighting for their city. The Council have decided not at present to adopt it. The cost for lighting the business portion of the city would be about £9,800 per annum, as against £3,800 for gas. Nevertheless, a number of business premises and private houses are lighted by electricity supplied by a local company.

* *

An egg, measuring 8½ in. in girth the long way, 6½ in. in girth the other way, and 3½ in. long from end to end, and weighing 4 ozs., was produced recently by a barndoor hen at the smithy croft of Roslinfield, Kincardine. A quarter pound of egg in one shell! This should induce dissatisfied capitalists to "catch on" at egg and poultry culture.

* *

The latest samples of timber imported into England by a Pahang Company comprise mahogany, teak, rosewood, oak, ebony, cedar, walnut, and satinwood. The wood comes from Pahang, about forty miles from Singapore, and is floated or carried down by the steamers to the mouth of the River Pahang, and carried thence by steamers to Singapore, and shipped from there to England. The estates comprise about eleven million acres, or about 10,000 miles, and are mostly wooded. As the supply of teak is reported to be limited, this importation from Pahang will be of great assistance to the trade. The wood is very easy to work, but is, in some cases, heavy. The Company has shipped here about 2,180 loads of a London market value of upwards of £18,700, in addition to the local sales.

* *

A Newcastle firm of iron merchants have hit upon something of a new idea. In buying up scrap steel and iron they often come upon large forgings that require to be broken up before they can be made marketable again. To break them up, as a general rule, holes some 2 ft. deep are drilled by hand, and filled with dynamite cartridges, the forgings then being blown to pieces. The firm in question, having lately come into possession of several hundreds of tons of large steel forgings, the engineer resolved to get out a multiple drilling machine with six or more drills to operate at one time together, with the necessary plant for works where large forgings, etc., could be broken up. This has proved a success.

* *

It appears that the local steeple-jack is to be entrusted to erect a temporary chimney to take the place of the one which fell with such disastrous results at Cleckheaton, near Bradford, a few weeks ago. From all accounts, the job could not have been put in better hands, this "jack" having had great experience for many miles round. "I do not think there is a man in England," writes our correspondent, "who is more at home than he is on the top of a chimney from eighty to a hundred yards high, and the few accidents he has experienced during his career testify to his ability as well as to his care in the selection of material and scaffolding." *Terra firma* folks will not be enviable of such a reputation—the maintenance of which, in the present instance, will, no doubt, occupy the attention of the Government inspectors.

* *

At the recent meeting of the Birmingham Technical Schools Committee, a return was made showing a membership roll of 1,187 students. The bronzing and electro-plating class had proved very successful, but, strange to say, it is resolved to advertise for a competent teacher for this class; and as the subject was one that has hitherto received little study in this country, it has been suggested to go to France or Germany for a teacher. Such a proceeding is scarcely creditable to the metropolis of the Midlands, when its jewellers and silversmiths can easily set London an example in the matter of technical instruction. A town which can claim the home and works of such famous electro-platers and silversmiths as the Elkingtons, ought to look elsewhere than a foreign conntry for its technical tutors and professors. Where are the South Kensington authorities, and what are they about?

* *

A new cold galvanising process has been introduced. It is stated to be superior to the old plan of hot galvanising, which has many defects, the chief of which are—waste of zinc, reduction of strength in small wires, and a tendency to make small section iron and steel brittle. By this system the coating affords a better protection than an equal thickness put on by the hot process, and the coating is much more adhesive. That the galvanising put on by the old system was, and is, very fanlty in this respect, is well known by all who have had to work galvanised sheet iron or steel, and any improvement in this respect will be of great utility. It is also claimed for the process that fine mesh wire, small screws, and so on, can be coated without clogging up, and the coat is said not to exceed that of the old system.

* *

A square hole drilling machine is being more and more perfected. Now a great variety of holes can be drilled with the utmost accuracy with the same cutter, or drill. The machine resembles an ordinary hollow-frame drilling machine, being arranged on a massive frame, giving the necessary stability to stand the side strains of angular drilling. The essential difference is, that whereas an ordinary drilling spindle revolves on its own fixed axis only, in the machine in question there is a side or lateral play of the point of the drill, regulated by the guide templates provided at the top of the spindle, the spindle being held about half-way up its length by a ball socket bearing. It will drill holes of almost any shape: regular, angular, or irregular, and semi-circular; and also drills round holes, without alteration, by the simple adjustment of a screw. For our information an hexagonal hole was drilled about ¼ in. deep in a piece of brass, and inside this a square hole with its angles just touching the sides of the hexagon, and inside the square hole a round hole just touching the sides of the square, each sinking being about ¼ in. deep, and to the greatest nicety.

The latest application of the Slide Rule is to the calculation of the discharge of water pipes, including these three problems: (1) Given head, and length, and diameter of pipe, to find the discharge; (2) given discharge, head, and length, to find diameter; (3) given length, diameter, and discharge, to find head.

* *

Those who see in the nationalisation of existing industries the Ideal of Labour would doubtless ponder over these figures. In 1870 Government acquired the telegraph system of the country at a cost of rather over £10,000,000. It has worked that system for twenty years, and has lost £4,000,000 by the transaction. Only in the first two years has there been any surplus; ever since there has been an annual heavy loss.

* *

Work on the Manchester Ship Canal is being pushed on vigorously, particularly the construction of the iron viaducts and bridges. The swing bridge at the Salford Docks is well in hand: it is the heaviest of its kind in England, containing eighteen hundred tons of steel and iron. The remarkable swing aqueduct which is to carry the Bridgewater Canal over the Ship Canal at Barton is also well advanced.

* *

The electric-lighting arrangements at Lambton Castle, the seat of the Earl of Durham, have just been reorganised. Two new engines of the latest type steam turbines have just been fixed, and are coupled direct to the dynamo, and their combined power is 100 horse. The dynamo runs at a speed of from 4,000 to 5,000 revolutions per minute, the flow of steam being in a radial direction, instead of being parallel to the axis, as in the old form of Parson's machines. Each is fitted with a novel and special governor, designed to maintain a constant electrical pressure at all loads. The governors are electrical in action, and work by admitting the steam in puffs of longer or shorter duration, as required for the load, producing an equivalent of alternate expansion, which greatly increases the economy of the engines when running below full load. A fly-wheel is also fitted, which prevents the intermittent action of the steam from causing a fluctuation in the lights. Steam is supplied by two Cornish boilers at a pressure of 100 pounds per square inch; and a battery of accumulators capable of supplying 220 lights for nine hours is fixed. Many new fittings have been added, and the total number of lamps is about 600. The installation is now amongst the most extensive private electric light plants in the country.

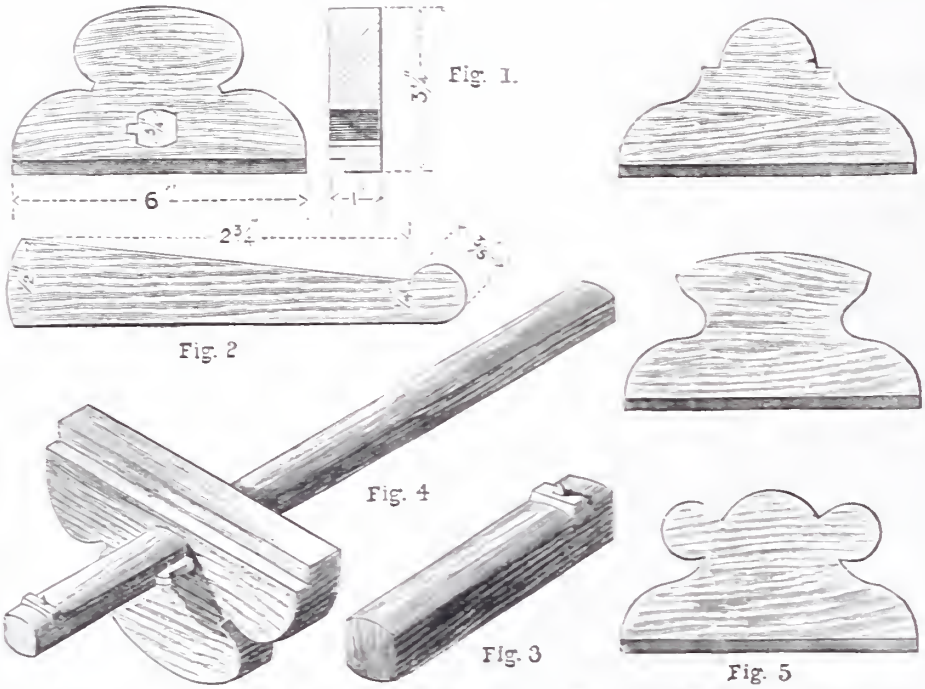
THE WAY TO MAKE A PANEL GAUGE.

BY F. CROCKER.

THE STOCK—THE WEDGE—THE STEM.

IN WORK, No. 142, a correspondent asks to be supplied with a drawing of a panel gauge, and as this is a tool that may be useful to a good many of our readers who do not possess one, a short paper is here devoted to the construction of one.

A panel gauge is used to mark a line parallel to the true edge of a panel, or any piece of wood that would be too wide for the ordinary gauge to take in.



Panel Gauge. Fig. 1.—The Stock. Fig. 2.—The Wedge. Fig. 3.—The Stem. Fig. 4.—The Panel Gauge. Fig. 5.—Patterns for the Stock.

The *Stock* is shown in Fig. 1, drawn to a scale of 3 in. to 1 ft. This is made of maple, beech, or any other suitable wood. As may be seen by the drawing, it is 1 in. thick, and has a ⅝ in. by ¼ in. rebate at the bottom. A mortise is made for the stem to pass through, and another one at the side for the wedge. The first may be cleaned out with an inside ground gouge, and is ⅜ in. wide. The bottom of the mortise is a full ¼ in. above the rebate. The edge is shown square, but it is an improvement to have it rounded.

The *Wedge* is shown in Fig. 2. It should be made of box-wood or ebony if possible, and is a bare ¼ in. thick. The other dimensions may be gathered from the drawing. The taper of the mortise in the stock must be made to correspond with it.

The *Stem* (Fig. 3) should be about 2 ft. 6 in. long, and may be made of a piece of straight-grained mahogany. It should fit the mortise, not too tightly, but so that it can be moved with the hands without tapping, and is held in position by the wedge when set. A piece is dovetailed in the end, as shown, to bring the marking point level with the bottom of the rebate. The stem may be made square if preferred or if the rounded mortise presents a difficulty.

Fig. 4 is a sketch of the gauge when finished, and in Fig. 5 three other patterns are given for the stock, but which is the nicest shape is purely a matter of opinion; either will give satisfaction if well finished and nicely polished.

HOW TO WORK CORK PICTURE FRAMES.

BY ARTHUR YORKE.

CORK FRAMES—THE MATERIAL—TOOLS—CUTTING OUT—THE WOODEN FOUNDATIONS—FASTENING ON—FINISHING—DESCRIPTION OF THE DESIGNS.

Cork Frames.—The devices of ingenious amateurs for framing pictures ornamentally without going to the cost of regular professionally made frames have been many in number, and the range of materials pressed into the service has been a wide one. One of these ingenious makeshifts is the cork frame. It has decided points in its favour. The material costs little or nothing. Expensive tools and appliances, like those needed for wood carving or leather work, can be dispensed with; far less skill is required than in those arts; yet much of the richness of effect gained by them may be attained through it. Patience is, perhaps, the first quality essential to the successful cork worker. His work will not have the sterling qualities of wood carving, but it will look and be more solid than leather work; and, as is shown by the designs before us, scraps of the material, cut to a few and simple shapes, may be so combined as to give an unlimited variety of pleasing patterns.

The *material* is too well known to need much comment. Cork, as we are most of us aware, is the outer bark of the *Quercus suber*, a kind of oak which grows in Spain and Portugal. Its uses in the arts are numberless. The form in which we are most familiar with it is that to which it is cut as bottle stoppers: and if our intending cork worker proposes to go upon the most economical lines, he will probably content himself with disused bottle corks. In the designs given there is nothing that cannot be carried out with such very humble materials. The difficulty which rises from working with old corks is that they are often sadly damaged by the screw.

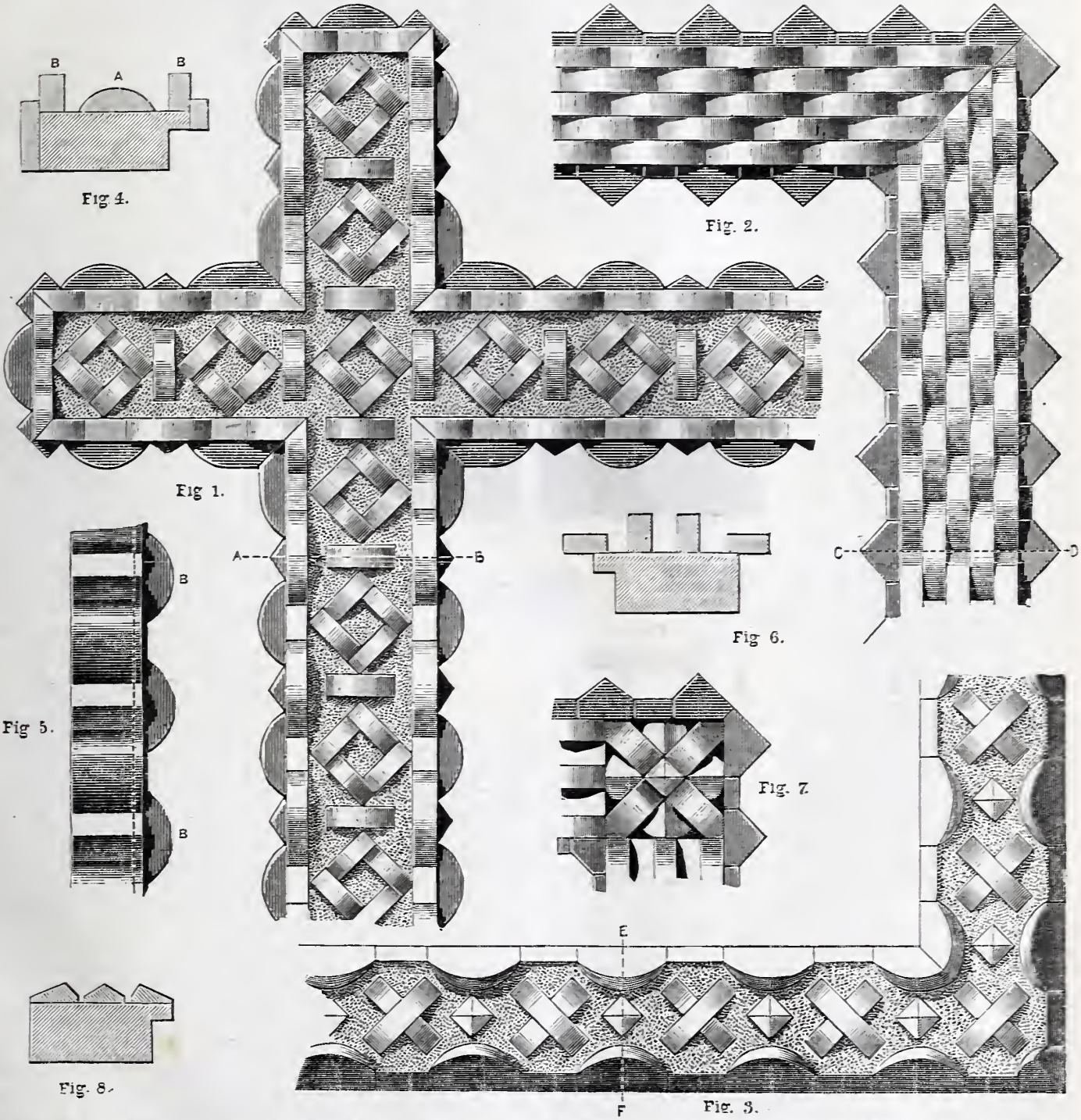
It may, however, be supposed that anyone intending to work with used corks will not only have them saved in his own house, but will ask his friends to save for him likewise; and if he does this he will soon have such a store on his hands that he may well afford to throw aside all unsuitable ones. It may be hinted that all sorts and sizes should be saved, the small ones from

phials, etc., often coming in useful as well as the larger ones.

Or, if he indulges in the luxury of new cork, he will not find it costly. In this case he will choose such as has a close, firm grain. In the shape of bottle corks those sold as "wine corks" are the best. But a cork cutter will provide him with the material in many other forms. It is to be bought in sheets of regular thickness, and these, if elaborate work is engaged in, may be found useful. Some sheets, for the use of hatters and others, are cut as thin as paper; others, for shoemakers, naturalists, etc., of greater thickness. There are purposes, to be more fully spoken of hereafter, for which sheet cork may be found handy.

Tools.—This section of the subject might be made almost as concise as the famous chapter on Irish Snakes. Tools are not needed, except that tool which everybody has in his pocket—namely, a knife. The knife for cork cutting should be thin, and kept exceedingly sharp. To make that good, clean cut which is essential, it should be used with a drawing motion, somewhat as a razor in shaving, and not with a direct downward action.

Cutting out.—In the designs given it will be seen that most of the pieces employed in forming the patterns are made by cutting the ordinary bottle cork into transverse sections. To produce good work it is essential that the pieces to each given pattern should be of equal thickness. Practice will soon accustom a person to cut them with regularity, but till that knack has been acquired it will be well to have a gauge, made of card, or better, of sheet metal, with which to test them before using—all that do not agree with it being laid aside for other purposes.



Cork Picture Frames. Figs. 1, 2, 3.—Designs for Cork Frames. Fig. 4.—Section of Fig. 1 on Line A B. Fig. 5.—Elevation of Side of Fig. 1. Fig. 6.—Section of Fig. 2 on Line C D. Fig. 7.—Alternative Corner for Fig. 2. Fig. 8.—Section of Fig. 3 on Line E F.

The Wooden Foundation.—This is generally made of deal, and as it is scarcely, if at all, seen in the finished article, no great neatness is necessary. An indifferent amateur carpenter can make it sufficiently well. The foundation or actual frame is shown in the different sections. There are various ways of dealing with those parts of the foundation not hidden by the pattern, as will be explained in due course. Or, instead of

deal, the foundation may be made of some wood which, like teak or cedar, will match the cork in colour, and which may be left as it is.

Fastening on.—The pattern being arranged, and the pieces of cork ready, the latter have simply to be glued to the foundation. The glue should be moderately thin, but strong. In these days, when Le Page's and other excellent liquid glues are in the market, it is scarcely likely that the cork worker will resort to the orthodox glue-pot; indeed, to those who follow this art, liquid glue is an especial boon.

Finishing.—To do this a couple of coats of varnish should be given. Coachmakers' body varnish is that usually employed.

Description of the Designs.—It will be seen that in Fig. 1 the Oxford form of frame has been given; the simple pattern upon it might, however, as well be placed on a frame of the simpler shape. In the section of it (Fig. 4), the form of the slices of bottle cork which make the ornaments of its centre may be seen at A. The alternate pieces of the projecting border, B B (Fig. 5), are much the same, but a trifle larger; these last also appear in section at B B (Fig. 4). It will be seen from the elevation (Fig. 5) that the sides of this frame are entirely covered and hidden by pieces of cork, which are not only glued to the sides, but also to the lower parts of the pieces which form the projecting border. These pieces, with alternate curved and triangular outlines, show their upper ends in Fig. 1.

The projecting ornament in Fig. 2, though of a kind which does not appear to advantage on paper, is highly effective when actually worked out in relief, recalling some of the beautiful ornament of high-class turning. It is, as will be seen, simplicity itself. The pieces forming it are all similar, and in shape like A (Fig. 4).

To make this pattern look well, however, requires that there should be exactitude in the size of the pieces and in sticking on. It will be observed that in this design the flat border is not formed, as in the last, by pieces glued to the sides, but by thin pieces glued to the face of the foundation. Thus the sides of the frame are not covered as in Fig. 1. The section (Fig. 6) illustrates this. Fig. 7 is an alternative corner for this frame. If preferred, it can be used in any case, but it has been introduced with a view to the possible employment of this pattern on an Oxford frame, when the original pattern could not well be continued through the intersections. A square of cork, from $\frac{1}{16}$ in. to $\frac{1}{8}$ in. thick, should first be glued over the corner, and the flower built up upon it, so that a little more projection may be gained than in the other work.

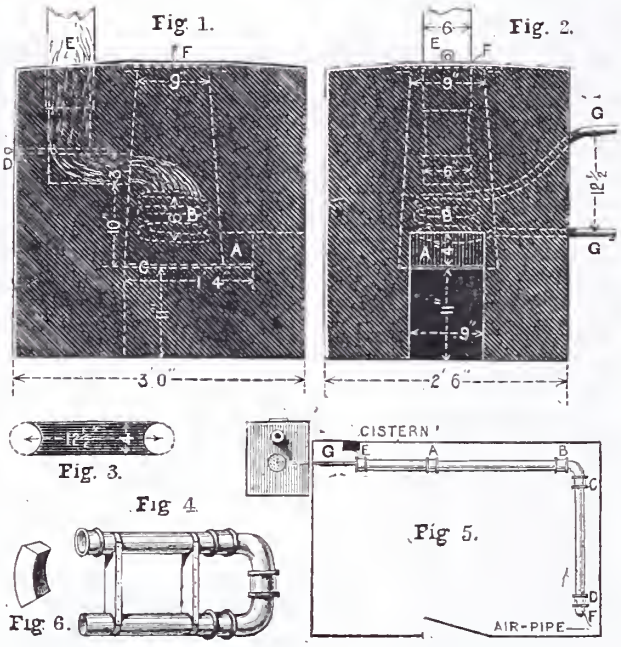
The frame (Fig. 3) is, owing to the sloping form of the border, rather more difficult, but with a card gauge of the exact angle the novice may cut the pieces accurately.

I shall have something further to say on this subject, but my remaining remarks must be reserved for my second and concluding sheet of designs. Meanwhile, my readers will find much to occupy their patience, taste, and ingenuity in the ideas already set before them. In view of the coming bright days, the subject of cork frame making is one which will be found to offer a particularly pleasing pastime.

HOW I HEATED MY GREENHOUSE.

BY SAINT MUNGO.

Having erected a small greenhouse in the spring of last year, when the cold weather came with the autumn I began to think of putting in some kind of heating apparatus to preserve my plants during winter, and bring forward seeds and cuttings in spring. After consulting catalogues and price-lists innumerable, I came to the conclusion that I could not afford to get hot water fitted up in the regular way. Gas was out of the question, and the disastrous nature of a friend's experience with paraffin warned me to steer clear of it, as it proved to be neither cheap nor efficient. I next thought of a flue, and found that some neighbours succeeded fairly well with flues, but all advised me against them and in favour of hot water. So to it I turned my attention again, and, after examining one or two different methods, set about the construction of a heating apparatus which has proved both cheap and efficient, and which I shall proceed to describe.



Greenhouse Heater. Fig. 1.—Side Elevation of Furnace. Fig. 2—Front Elevation of Furnace (Figs. 1, 2)—A, Removable Firebrick closing Opening of Furnace; B, Coil of Iron Pipe; C, Grating at Bottom of Fire (Cast Iron); D, Damper in Chimney at Back; E, Chimney; F, Cast-Iron Lid of Furnace; G, Ends of Coil for connecting to Circulating Pipes. Fig. 3.—Pieces of Wood for connecting Pipes as shown at Fig. 4. Fig. 4.—Method of connecting and supporting Circulating Pipes. Fig. 5.—General Ground Plan of whole Apparatus. Fig. 6.—Shape of Firebricks used in building Furnace (called "Pups" in the trade).

My first proceeding was to consider how much piping, and of what diameter, it would take to keep up the desired temperature. My greenhouse measures 12 ft. by 8 ft., and is 6 ft. high at the eave, with a shed roof, and the door is in the middle of the front, which is also the 6 ft. side; so I decided to run the pipes along the back and one end, putting the furnace outside, as shown on the ground-plan. My intention was not to be able to keep stove plants, but simply to preserve my plants during frost and to dry the air during spells of cold, damp weather, and I find that this length and disposition of pipes is ample for my purpose. If more heat were required, I would add pipes along the other end, and put the stove at the front corner. There are pipes specially made for hot water, but I found that rain-water pipes were cheaper, and with care would do equally as well; so, through my plumber, I procured four 6 ft. lengths, and two 3 ft. lengths of 4 in. rain-water pipes, and four corner bends to suit, for all of which I paid 15s. 2d. The reason for my getting four corner bends will be obvious on looking at the illustrations, as single return bends are not made to suit rain-water pipes, hence I had to use two corner bends, as shown at Fig. 4. As rain pipes are made much thinner than hot-water pipes, and flaws are by no means rare, I was careful in selecting mine to see that they were sound.

I was fortunate in my selection, and have had no trouble from this cause. My next step was to get a maker of malleable iron tubing to make a coil (as shown at Figs. 1 and 2). The distance between centres of the 4 in. pipes when connected I found would be $12\frac{1}{2}$ in., but, as I did not wish my coil to be so deep, I had it made as shown in the sketch, which also gives the sizes and the correct number of turns. This coil, made of $1\frac{1}{4}$ in. (outside diameter) pipe and screwed to fit the plugs presently to be mentioned, cost me 12s.

The plugs were simply pieces of cast iron made to fit the ends of the 4 in. pipes, one to fit inside of the faucet, and the other to fit inside of the narrow end, each being about 4 in. long, and fitting slackly enough to allow for packing the joint. They were screwed to fit the ends of the coil, and cost sixpence each. Before commencing to join up the pipes I bored a $\frac{1}{4}$ in. hole at E in the upper side of the bottom pipe, and another at F in the top bend, and screwed them with a $\frac{1}{4}$ in. tap. The use of these holes will be explained presently.

A small stop-cock screwed into the bottom pipe at E is also a great convenience for obtaining a little hot water to temper the water for watering plants on a frosty day, or for running off the water should it be thought necessary. The distance between the centres being, as already stated, $12\frac{1}{2}$ in., I cut out of $\frac{7}{8}$ in. yellow pine six pieces, shown in sketch (Fig. 3). By means of hoop iron and wire nails I bound the pipes together in pairs into the hollows in the ends of these pieces (see Fig. 4), being careful to keep the ends reversed so that they would connect properly with the bends at the return end F.

Of the many ways of making joints I chose red lead, as it does not set too quickly, and when one cannot be working continuously that is a consideration; then it is more easily taken asunder if needed for removal than a rust joint or Portland cement, both of which are often used. I made the red lead into a stiffish paste with linseed oil, soaked pieces of teased rope in it, and rammed them tightly into the joints with an old table knife broken at the point. As I did not wish to disturb my staging and plants, I put the joints marked D, C, and A together outside where they were also more easily got at, then the pipes were put in position and temporarily supported on bricks when the joints at B were made; finally, the arms of the coil were inserted from the outside through holes cut in the wood lining, the plugs screwed on with a little red lead, and the remaining joints between them and the pipes made.

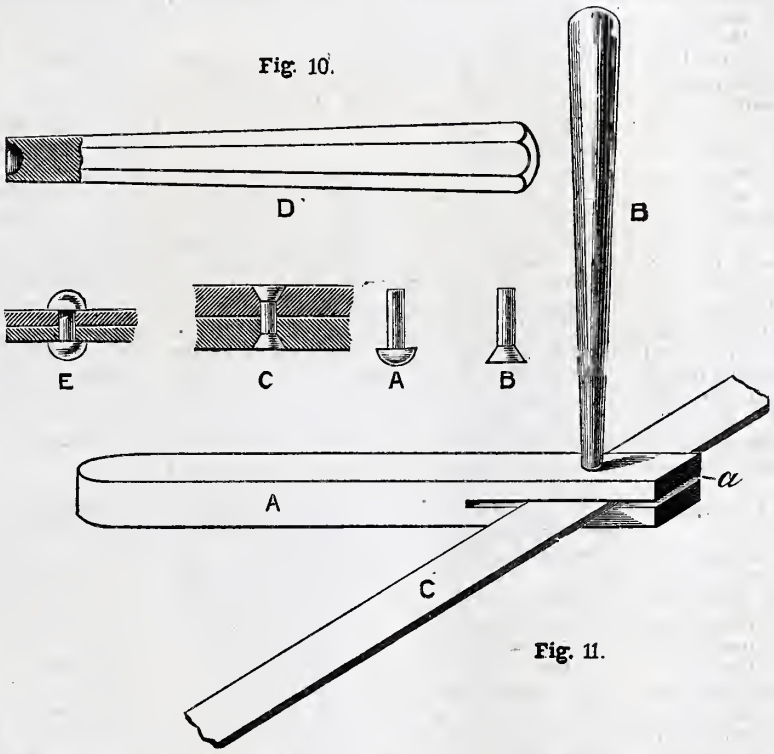
As they were as yet only temporarily placed as to level, although in proper position otherwise, I proceeded to give them the necessary slope. To secure this I planed a piece of wood with a slight taper on it; on placing this on the top of the pipes, with a level on the top of it, and packing up below the pipes with bricks and slates till the bubble was in the centre at any part, taking care to keep the thick end of the bevelled piece towards the coil, a gradual slope was obtained, making the end at F about 2 in. higher than that at G. This allows the water after being heated in the coil to ascend and promote a steady circulation.

Then I took an old meat tin, and to a hole in the middle of it soldered a piece of ¼ in. gaspipe, with a nipple soldered on the end of it, screwed to fit the hole already mentioned at E. At F I screwed in a similar nipple, with a short length of gaspipe, leaving the upper end open, and a little above the level of the tin can at E. E is the filler and reservoir, and if placed so that the surface of it is only a few inches above the top of the 4 in. pipe at its highest part it will do. The lower it is kept the better, as every inch added in height increases the pressure on the joints, which is quite as great communicated through a ¼ in. pipe as through a 2 in.

The pipe at F is an air pipe; without it the pipes would not let in the water at all. After giving the joints a few days to set I filled the pipes with water, and finding that they were all tight, proceeded to build the furnace round the coil. As it was my first attempt at brick-building, I did not manage to go straight ahead and get everything right at first, but had to feel my way cautiously, and eventually got it as I will describe. The sketch shows a cross and a longitudinal section on which the sizes are marked. It took about 150 bricks, and about 1 cwt. of lime. The centre immediately round the coil is built with the circular firebricks used for building brass-melting furnaces, adopted as shown at Fig. 6. It took six of them to go round the circle, and there are eight such circles. One brick is left loose at A (Figs. 1 and 2) for kindling and cleaning out ashes, and a flat piece of iron put in to support the bricks above the opening. There is just about 1 in. between the coil and brickwork all round, and towards the top the circle is gradually contracted. The reason for this is that if the sides were straight the coke would be apt to jam and allow the fire to burn out underneath it. The taper, although very slight, has the effect of making it drop down as the fire burns away beneath and keeping up a regular supply of fuel. The opening to the chimney goes out just clear of the coil, and the damper is put in from the back, as shown. The chimney consists of two lengths of 6 in. rain pipe, in all about 10 ft. long, and gives a splendid draught. To close the opening at the top of the furnace, I procured a cast-iron cover fitting into a checked ring which I fixed to the brick on the top, and after fitting a firebrick to close the opening at, I was ready to light the fire. The fuel I use is unriddled coke, which I get from the gasworks at about 4s. 6d. per ton including cartage, but dross would burn in it as well.

I generally keep a bag of nuts for kindling, as they light up quicker than coke. Closing the brick door in front, the fire is kindled inside from above, and after it is quite red it may be filled right up to the top with coke, the damper behind almost closed, and left to itself for twenty-four hours, when it will be found to be still warm.

When the draught is extra strong, as it sometimes is on a clear, frosty night, or with the wind in the right direction, I damp it further by putting a piece of sheet-iron against the front, covering up the whole opening. Sufficient air leaks in to keep up combustion, which, however, is very slow and equal. An occasional canful of water to make up for the slight evaporation is all the attention it needs, a glance at the reservoir showing when this is required. The whole cost in my case did not exceed 30s., and one ton of coke lasted through last winter, and gave me an equable temperature with very little trouble. If in trying to follow my example any reader should have a difficulty, I will be glad to help him further through "Shop."



Bent Iron Work. Fig. 10.—Riveting Appliances. Fig. 11.—Method of Punching Holes.

BENT IRON WORK, AND HOW TO DO IT.

BY J. H.

The Framings—Methods of Union—Soldering—Soldering with the Copper-bit—Soldering by Sweating-on—Brazing—Riveting—Punching Holes—Drilling Rivets—How to Rivet.

I shall write in this article of some of the principal elementary operations involved in the construction of the heavier portions of bent iron work.

The Framings.—Bent iron work consists of two portions, the framing or skeleton, and the ornamental parts. It is usual for amateurs, and especially lady amateurs, to purchase the framings, and only do the ornamental work themselves. This is expensive, and not satisfactory, and I do not see why the entire work should not be done by the amateur himself, for the sections of iron are never really heavy. There is very little indeed over about ⅛ in. and $\frac{3}{16}$ in. square, and about ⅜ in. in width by ⅛ in. in thickness; and all this can be easily heated to redness in a kitchen fire, and bent over an amateur's anvil or in the vice. There is no welding at all ever necessary in bent iron work; so that we may say that the forge operations on the larger sections are simply those of bending, and occasional tapering or thinning down of a section. How these are done I intend to show in the articles which I propose to devote to practical examples.

Methods of Union.—Then, further, in reference to the union of parts, there are three methods of uniting the heavier framings upon which the bent iron work is built; they are—soldering, brazing, and riveting. These are named in their order of relative increasing strength.

Soldering.—Soldering, or soft soldering, is employed, first in positions into which it would be difficult—in some cases impossible—to introduce the clips and the nose of the pliers for pinching them tightly.

Plenty of such instances occur in the smaller curves. The fastenings of larger curves are always easily got at; not so, many of those of minute dimensions. In such places a spot of solder will effect a perfect fastening, and there is no area so small that solder will not reach. If solder is not used in these cases, then the parts must needs be left in mere contact only, without any fastening. This is very undesirable, because the bent iron is so very slight that all the support available should be afforded to it, in order to compensate, as far as possible, for its own lack of rigidity.

There are two principal methods of soft soldering employed—that, namely, effected with the copper-bit, and that by the process of sweating-on; and each of these has its uses in bent iron work.

Soldering with the Copper-bit.—If work is to be united by the use of the copper-bit, then, before the ends are actually secured in place, just the surfaces which are to be united with solder must be filed clean and bright. They are tied together, either with soft iron wire, or with brass binding wire, or pinched with clamps or pincers, or by any other suitable means. After they are thus bound together, run in between the bright faces a little spirits of salts, in which zinc has been dissolved until effervescence ceases. Then take in the right hand the copper-bit, properly tinned and at a low red heat, and a stick of solder in the left; melt a portion of the solder with the bit, letting it run between the surfaces which are in apposition. The solder will follow the spirits of salts, and set firm in an

instant. This is a method well suited to a number of small points of contact.

Soldering by Sweating-on. — For large surfaces the method of sweating-on is preferable. The surfaces to be soldered are cleaned with a file, are moistened with killed spirits of salts, and a thin layer of solder is melted and worked over each surface smooth and level with one of the flat bevelled faces of the copper-bit. The two surfaces are then brought into contact, pinched together, and heated up to the fusing-point of the solder, when amalgamation and union of the two soldered surfaces will take place. The requisite heat may be obtained from a clear fire, or from a Bunsen flame, or from a pair of red-hot tongs, used for pinching the parts together.

Brazing.—Brazing is accomplished either with the blowpipe, or in a clear fire. The surfaces to be united are cleaned by filing. The portions are then tied together with iron binding wire, or with soft brass wire. If the latter is used, it supplies the soldering material. If soft iron wire is used for binding, then spelter is employed for cementing. This is sold in various qualities in the shops—different grades fusing at different temperatures, to suit different metals and alloys. Any spelter will do for uniting iron. The spelter is powdered and mixed with borax as a flux, and with water, and strewn over the edges of the work. The borax should properly be fused first, to drive off its water of crystallisation. If this precaution is not taken, the borax will swell upon the work and displace the spelter. The mixed spelter, borax, and water are taken up with a spoon, and placed upon the edge of the joint; and when the temperature has been raised sufficiently with blast, the spelter and borax will fuse and run between the joints. Now the work must be removed from the fire. The edges will afterwards have to be filed smooth, as brazing leaves them very rough.

Riveting.—The making of joints with small rivets is a very simple matter. Even ladies taking up the bent iron work need find little difficulty in these elementary operations, and so become independent of the smith in the construction of frames.

There are two kinds of rivets—the cup or snap (Fig. 10, A), and the flat or countersunk head (Fig. 10, B). Either and each of these may be used in the construction of the frames for bent iron work. For thin iron the cup-head is best, for these reasons—the hole has not to be countersunk, which is objectionable in thin iron, weakening it much; and, unless it is countersunk, the flat head, standing up above the iron, keen and jagged, looks very unsightly. But the cup-head requires no countersinking, and forms a neat finish on the work. In some instances where it is desirable that the surfaces shall be perfectly level, then the holes must be countersunk, and the best job possible made of it. In the heavier framings — say, of $\frac{1}{16}$ in. thick and over—this is readily done.

The holes for the rivets are either punched or drilled. In the thinnest iron they are more quickly punched; in that of over about $\frac{1}{16}$ in. thickness they must be drilled.

Punching Holes.—To punch a hole, the iron may be laid upon the end grain of a block of hard wood, as shown in Fig. 5, page 6, No. 157. A steel punch, blunt at the end, but made keen at the edges, which is accomplished by touching the end on the grindstone, is then driven through with a single blow of a hammer. The disc which is punched out will become embedded in the wood, and the support afforded by the hard wood will prevent the formation of much burr. What there is will be filed off or hammered back, and the hole rymered out with the rymer shown in Fig. 6, page 6.

Another and better way of punching holes is shown in Fig. 11. A is a bit of steel bar having a slit, *a*, cut down at one end with a hack-saw. The steel punch, B, passes through a hole drilled through the bar. The iron strip, C, is passed through the slit and adjusted, and a single blow of the punch upon it forms the hole, and the burr passes through the bottom hole in the bar, A. This makes a keen, clean hole, and there is no need to use file or rymer for finishing it, because the strip, C, has a better bedding upon the iron than upon a wood block.

Drilling.—For drilling holes in a thicker iron any form of drill may be employed. One of the common archimedean drills is as useful as any for general work, and it has this great advantage—that it can be used on work which is in course of construction, in any position, and at any angle.

Rivets.—It is seldom or never that rivets of over $\frac{1}{8}$ in. in diameter are required for framings. For most work those of $\frac{1}{16}$ in. are large enough. Rivets of iron or of copper may be used.

How to Rivet.—The length of the rivet should be such that, when it is inserted through the holes in the two strips which it has to connect, the tail shall project through to a distance equal to about one and a quarter times its own diameter. A firm bedding is obtained, such as that afforded by a small anvil or similar block of iron, or even by the top of the vice-jaw; and upon this the head of the rivet is laid while the tail is hammered over. When hammering the tail, the cross-pane of the hammer is used; and for this work it must be narrow, and the hammer light—say, of about half a pound in weight. The aim of the blows is to spread the metal; therefore they are delivered, not only vertically, but also diagonally, in order to drive the metal outwards. This must be done equally and gradually, so that the spreading-out shall not become one-sided, nor the metal split, nor simply bent over. Several dozen blows will have to be delivered on a small rivet.

For countersunk rivets (Fig. 10, B) the battered end is simply filed off flush with the surface of the strips, as at C; with snap-head rivets a special tool, called a snap, is used for finishing. This (Fig. 10, D) consists merely of a bit of steel rod bored out at one end to a semi-circular form, and hardened. Two or three blows upon this, on the end of the rivet, will finish it neatly, so that nothing more need be done to it.

HOW TO MAKE AND WORK THE SPECTROSCOPE.

BY CHARLES A. PARKER.

PREFATORY REMARKS—REFRANGIBILITY OF LIGHT—NATURE OF PRISMS — SOLAR SPECTRUM — COMPOSITION OF SPECTRUM—FRAUNHOFER'S LINES—POSITION OCCUPIED BY PRINCIPAL LINES — USE OF SPECTRUM ANALYSIS—ABSORPTION BANDS — EXTREME DELICACY OF SPECTRUM ANALYSIS—VALUE OF THE SPECTROSCOPE TO THE ANALYTICAL CHEMIST AND THE ASTRONOMER — DESCRIPTION OF SPECTROSCOPE.

THE spectroscope may truly be said to be one of the few instruments which, during the past quarter of a century, have done so much for science—so marvellous, indeed, being its powers, that the minutest speck discernible by the microscope, or the faintest orb that the telescope can reach, may be subjected to a searching analysis which will reveal their inmost element, thus teaching the student the constitution of the sun and stars, besides placing in the hands of the analyst the means of recognising substances in quantities so minute as to escape all other methods of analysis. Nor is this all; for the spectroscope has been the means of revealing the presence of elements which would otherwise have remained entirely unknown. In short, spectrum analysis affords a means of testing various substances so delicate that its value to the analytical chemist can scarcely be overrated.

The cost of a good student's spectroscope, as usually constructed, places the instrument beyond the reach of the average student or amateur experimentalist; but, as it is not necessarily of elaborate construction, it can generally be successfully made by any amateur workman of ordinary ability. Before, however, turning to the constructive details, it will be advisable to explain as much of the theory of the instrument as may be necessary for the full comprehension of the subject.

Spectrum analysis may be said to be mainly dependent upon what is called the refrangibility of light, or property by which light, in passing out of one transparent medium into another of different density, becomes bent out of its direct course and suffers deviation, transparent media bounded by non-parallel planes, and called prisms, possessing this property in the highest degree. A prism for optical purposes requires but two refracting surfaces—that is to say, two perfectly plane surfaces which are not parallel, but brought together at one edge in the form of a V, the apex where the two refracting surfaces meet being called the refracting edge and the angle between them the refracting angle.

Most of my readers are doubtless aware that, when a ray of white light is passed through a circular hole in the shutter of a darkened room, and is received upon a white screen, we get a brilliantly illuminated disc of white light; but if a piece of triangular glass—or prism, as it is technically called—is placed over the aperture in the shutter, and in the path of the rays of light, the latter will be split up into its component portions, as it were, and we shall no longer get the round spot of light, but an oblong band composed of seven different colours disposed in the following order: At that portion of the band which is opposed to the apex or refracting edge of the prism, a vivid red will appear, which merges into a bright orange and then yellow as it approaches nearer to the base of the prism, the yellow in turn melting into green and then fading to an exquisite blue, which deepens into indigo and then violet as it nears the end of the band of coloured light, which, by the way, is called the solar spectrum.

A pure spectrum—that is to say, one in which the bands of colour do not overlap as in the above experiment—is obtained by passing a ray of sunlight through a very narrow slit, as in the spectroscope; but in doing this the spectrum will be found to be intersected by a number of dark vertical lines, four of which were first seen by Dr. Wollaston at the beginning of the present century; and in 1814 these lines were mapped out in a masterly manner by the celebrated German optician Fraunhofer, who employed a much finer slit as the source of light, and marked the position of the principal lines by the letters of the alphabet, and in recognition of his services these lines in the solar spectrum are now universally known by his name.

The student will do well to acquaint himself with the position of these lettered lines in the spectrum, as they are now repeatedly referred to in works upon spectroscopy. By reference to Fig. 1, it will be understood that the A, B, and C lines occupy the red portion of the spectrum, whilst the D line is in the orange-yellow, E in the yellow, F in the green-blue, G in the indigo, H in the violet, and I at the extreme end of the spectrum. Fraunhofer discovered in the course of his investigations that these lines were present in every form of sunlight, either direct or reflected, and with prisms of every form and substance. After having carefully mapped out some six hundred lines or so, he directed his attention to the stars, and found that starlight also contained lines, but they did not quite correspond with the lines in the spectrum of the sun; and, after a somewhat lengthy series of experiments, he came to the conclusion that the shadowy lines must be caused by something existing beyond our atmosphere, and entirely independent of our earth.

As a result of subsequent experiments, it was shown that every substance or metal, when raised to a high degree of heat, will give its own particular lines of colour, by which it is readily distinguished, no two substances producing similar coloured bands in the same portion of the spectrum; so that, supposing a mixture of two metals is submitted to analysis, each one will be found to exhibit the coloured lines or spectra peculiar to itself.

When we view the spectrum of a solid body—for example, a bar of iron—which is heated to a red glow, it appears first as a red spot, which gradually increases to the orange and then yellow and green tints as the heat becomes slowly raised until the metal reaches a white heat, at which stage we obtain the complete spectrum. This phenomenon, which was found by Dr. Draper to be general with all liquids and solids, is considered to prove that light comes from an incandescent solid or liquid. Supposing, however, that the temperature is still further raised, so that the body flashes into vapour or gas, the spectrum will be found to vanish, its place being taken by disconnected bands of colour and darkness, the bands of colour differing in number and position according to the variation in the composition of the luminous flame; and as every compound or element, the vapour of which can be heated to incandescence without being decomposed, presents a spectrum peculiar to itself, we have a ready means of immediately distinguishing a glowing solid or liquid from an incandescent vapour or gas. Then, again, supposing the light-rays from a luminous body to be passed through the incandescent vapour of a similar substance, the latter will absorb precisely those rays which it would itself emit if it were incandescent, causing a series of dark bands to appear in the spectrum which precisely coincide with the bright lines characteristic of the luminous vapour of the element through which the rays have been passed.

As an example of the extreme delicacy of this method of analysis, it may be stated the Chevalier Bunsen, in one of his earliest experiments in spectrum analysis in 1860, had been examining some of the evaporated residue of Dürkheim spring water, when he was surprised to find that the spectrum contained a number of unfamiliar lines, evidently due to some new substance. He therefore evaporated *forty-four tons* of the mineral water, and after having separated

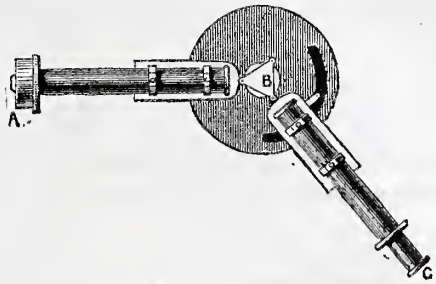


Fig. 3.—Plan of Table-top of Spectroscope.

Fig. 1.—The Solar Spectrum, showing the Position of the Principal Fraunhofer Lines.

every known substance, found some *two hundred grains* or so of a mixture which proved to be the salts of two hitherto undiscovered metals, the first of which he named cæsium, from the greyish-blue of the lines in its spectrum, and the second rubidium, from its two intensely red lines. Since this period two other elements, thallium and indium, have also been discovered by the aid of the spectroscope, the former by an English chemist, Mr. Crookes, who named it after the splendid blue tint of its spectrum, and the second by German chemists, who also called their new discovery after its characteristic line, which in this case was indigo.

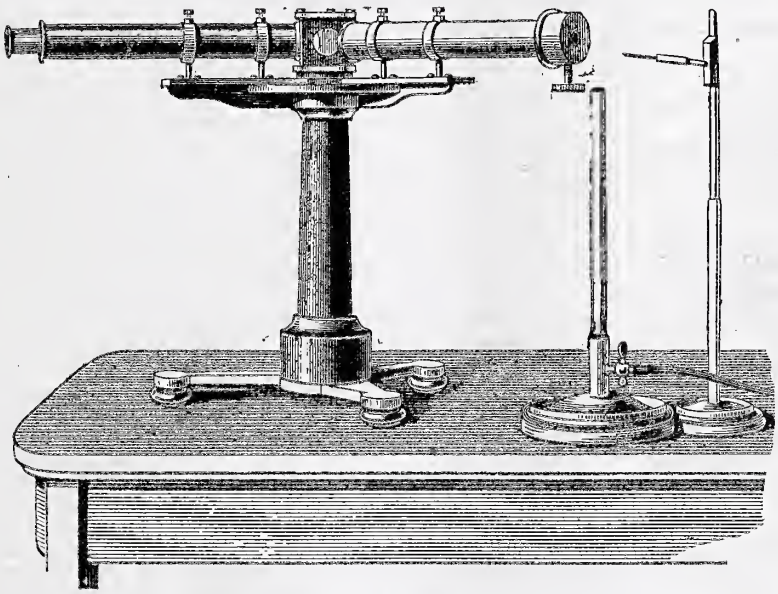


Fig. 2.—Spectroscope arranged ready for use.

Every known metal has its own particular characteristic band of colour, and in no case are the bands of any two metals alike in refrangibility, so that the analytical chemist has a sure test for the presence of any particular salt. Then, again, with the alloys we find the same unmistakable bands of colour belonging to each metal: thus, with copper we have green bands; zinc, blue and red; and brass, which is an alloy of copper and zinc, gives the bands of both these metals, unaltered either in position or character.

As before stated, however, the spectroscope is not solely employed by the chemist for the detection of substances in minute quantities, but it is also of great service to the astronomer in investigating the constitution of the sun and stars; but for further explanation of this branch of the subject, and fuller particulars of Professor Kircher's discovery of the absorption bands, the reader must be referred to one or other of the many excellent works devoted to spectrum analysis, as the matter would occupy too much space in this journal, and, moreover, it is fully time to turn to the practical portion of the subject and describe the construction of the instrument by which these great agencies of Nature may be brought to light.

The spectroscope illustrated in Fig. 2 consists of a turned wooden pedestal mounted on a triangular base of the same material, supporting a circular table-top, to the upper side of which a couple of wooden arms are attached, one of these arms being made to move round the table on a pivot, carrying the observing telescope adjusted for a near focus, whilst the other arm, which is made a fixture to the table, supports a tube of similar length called the collimator tube, the outer end of this tube being provided with a vertical slit enclosed in a cap or hood, and made adjustable to any width by means of a milled screw on the outside.

By reason of the light entering solely through this slit, this latter forms the source of light so far as the optical arrangements are concerned; but as the light-rays would, in its present condition, radiate in all directions and fall upon the prism at different angles, it becomes necessary to employ a collimator, which consists of an ordinary convex lens placed at the other end of the tube at the distance of its principal focus from the slit, a small stop or diaphragm being located in the tube between the slit and the lens, in order to cut off all rays which proceed at too great an angle.

The prism is placed upon a slightly raised platform situated between the two metal tubes, so that the parallel rays from the collimator fall upon one of the sides of the prism, and are deflected according to their refrangibility, after which they enter the telescope, where they may be observed by the student, in the form of a long, narrow band of colour.

Fig. 3, which is a plan of the table-top of the spectroscope, shows more clearly the disposition of the various parts, and will doubtless aid the above description. The rays of light entering the spectroscope from the slit, A, of the collimator tube fall upon the prism, B, and in passing through this they become bent out of their course towards the base, and, being picked up by the telescope, are observed by the student at C in the form of a brilliant band of colour.

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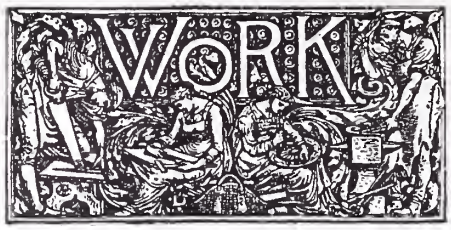

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COINAGE.—We should have to revert to a rather remote period in the history of the country to find an epoch when the coinage, in design, if not in shape, was in a more discreditable condition from an artistic point of view than it is now. The last issued figure of the reigning monarch is the least satisfactory that has appeared upon the currency during the present reign—the set of the crown upon the head being particularly ungraceful, and seemingly insecure. It is not surprising that the question is again receiving attention at the hands of the authorities now that circumstances have arisen to permit of another alteration in the coinage being considered. All will rejoice if the new designs which are being proceeded with prove to be of a character worthy of the subject they are intended to emblemise. If this be not the case, then the designs should be made a matter of public competition, with a suitable money grant for life to the designer of the selected work. So far as the present coinage is concerned, the only artistic part of it worth retaining is Petrucci's excellent representation of St. George and the Dragon.

COAL.—400,000 men at work is no mean matter when the reflective mind turns to the results aspect of such labour; but when such a vast number of men turn from their industrious pursuits, and take to what they are pleased to term "play," the situation becomes a grave one indeed, since the issue of such a course must prove disastrous to all concerned. This state of things has been characterising the coal trade during the past few weeks. An exodus has taken place from the under world—horses have been brought up; tens of thousands of men who are better employed when dissecting the earth's strata than in any other occupation have emerged to its surface; and earnest measures have been carried on for a great trade struggle. At the opening of the winter such a campaign would have been fraught with gloomy prospects for society at large. As it is, our fitful climate has favoured us with some warm weather, which will have done more than all the trade delegates to bring the crisis to an end. The situation, however, brings with it its lesson. Inventive minds will have to turn their attention to compounds which will serve as substitutes for coal. There probably exist ample materials for a new kind of fuel, and in these days of advanced chemical science and business enterprise, there is little to stop the way to almost untold wealth, and at least one whole nation's gratitude, for the fortunate discoverer of the right compound. Certain properties it would need to possess. It should be slow burning, heat giving, and gaseous, and if it could be smokeless—well, the inventor of such a coal substitute would deserve a place in the calendar of the world's greatest benefactors.

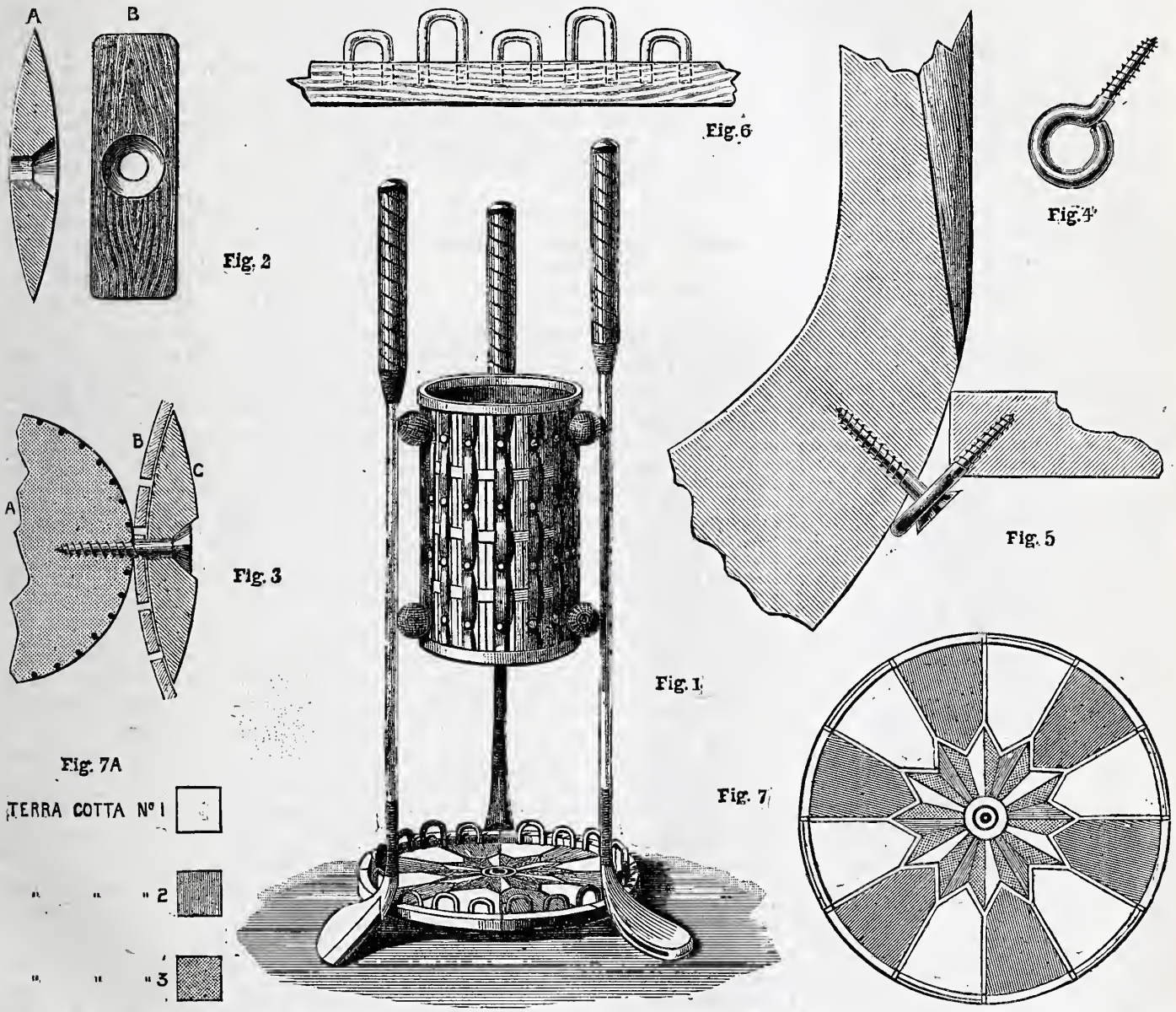
WORKERS' HOLIDAYS.—After a season as cheerless, inclement, and erratic as our winters are wont to be, the thoughts of those who share in what are known as "holidays" are naturally beginning to turn in that direction. This break is always a comfortable reflection for a large section of the community who readily accept the recognition of some temporary cessation from their toil, mainly because they claim to belong to, and are content to be ranked among, that not always distinguishable body of toilers known as "brain-workers." A less favoured community are the factory hands, the men at the bench, in brief, the weekly wage men who, year after year, toil and spin without cessation. Workers' holidays constitute a quantity which has not, so far, been taken into consideration in the great problem of capital and labour, etc. The mere suggestion of such a thing as workers' holidays will strike terror into the minds of those burdened with the responsibility of converting labour into profitable financial results, as forming yet one more element in the vexatious struggle in which the capitalist has to engage. Nevertheless, the subject is one which ought to be urged and considered. In this advanced age, and with all our progress schemes and ameliorative processes, it is lamentable that throughout the country a recognised principle obtains by which toilers labour on year by year with only such remission from their task of daily toil as the Bank Holiday Act affords. We submit the suggestion of workers' holidays as one worth the attention of all employers having long-service workmen. A week's holiday in the summer—at, of course, the worker's own expense—would probably serve him better than any shortened hours of daily labour. It might suit the employer equally well. Such a scheme would give workers time and opportunity to improve physically and mentally, and there is little doubt that the occasion would be turned to good account by every reasonable man—and there are such, even in the factory and workroom. If organised workmen's summer holiday and pleasure trips, especially to the Continent, could be arranged between men, masters, and the unions, this would spell not a little in the emancipation of the workers of this great country. It is impossible to estimate the salutary effect which an acquaintance with some of the art treasures of, say, such a city as Paris would have upon intelligent craftsmen who could participate in such a scheme as the one briefly indicated. The wealthy man can summon his yacht or "special" and go whither he will; while the rich middle-class can enjoy their personally conducted tours. Why should not some Cook or Gaze come to the rescue with plans for operatives' holidays?

NOVEL STAND FOR GOLF CLUB.

BY J. W. HODGE.

INTRODUCTION — BASKET — STEADYING BLOCKS—BALLS—CLUBS, SHAFTS, AND HEADS—TRAY—ORNAMENTAL EDGING—PAINTING — ALTERNATIVE TRAY.

Introduction.—Among the devotees of golf there must be a large number possessed of a practical turn of mind, or others, again, who may be desirous of "killing time" profitably, and to either class this paper will prove interesting. An article which is ornamental as well as useful, and easily manufactured by the golfer himself, at a trifling cost, from materials within his grasp, is certain to be appreciated. What golfer is there who has not lying about him relics of his muscular powers, in the shape of broken shafts, cracked club heads, or beautifully hacked balls—all or any reviving memories, pleasant or melancholy, or even humorous, of the splendid victories or regrettable defeats of a bygone season? With old friends the golfer is loth to part. These remnants of his dear old implements are clung to with wonderful tenacity, and are kept knocking about, it may be, in the corner of a room or lobby, where they prove a source of endless worry and anxiety to the tidy housewife. But this chaotic state of affairs need not exist, when a handy contrivance can be made which is sure to preserve order. When finished the stand will be to the possessor (and all the more so if he himself has made it) "a thing of beauty" and "a joy for ever," for he will never tire of dilating on the historical points of this or that club or ball.



Novel Stand for Golf Club. Fig. 1.—Stand complete. Fig. 2.—Cross Section and Front View of Clamp (full size). Fig. 3.—Cross Section, showing how Ball, Basket, and Clamp are fitted together. Fig. 4.—Eyelet through which Tray is fixed to Club Head. Fig. 5.—Method of joining Tray to Club. Fig. 6.—Showing how Hoops are erected. Fig. 7.—Design for Tray with Explanatory Note (Fig. 7 A) as to Colour.

The sketch produced (see Fig. 1) gives a general idea of what is more fully described below. The dimensions are taken from one made by the writer—an enthusiastic novice—but should these not suit the requirements of his more experienced brother, whose stock-in-trade is much more extensive and complicated, it will at least provide him with a plan to work upon.

Basket.—Procure from any fancy stationer a small wicker basket (circular), commonly used for waste paper, measuring 12 in. long and 7 in. in diameter. Carefully remove the bottom, and see that the bands at the extremities are properly secured. Down the sides, with a pencil, mark three lines equal distances apart; on each of these lines, $2\frac{1}{2}$ in. from the one edge and 1 in. from the other, bore holes sufficiently wide to take in a $\frac{3}{4}$ in. screw nail.

Steadying Blocks.—Get a piece of hard wood, fully $1\frac{1}{2}$ in. broad and about $\frac{1}{2}$ in. thick; taper off with small plane on both sides to edge until the end assumes the shape of A in Fig. 2. Cut off six pieces to pattern B, and bore in centre of each a hole which will give easy access to $\frac{3}{4}$ in. screw, taking away at same time from one side enough wood to allow for sinking of head. These clamps, which are inserted from inside of basket, will be found inestimable in answering the twofold purpose of preventing the cane from splitting and—what is perhaps even more essential—steadying the whole structure.

Balls.—These (six in number) may be old, useless "gutties," heated and re-grooved according to the ingenuity of the operator; but should he not be inclined to go to so much trouble—for undoubtedly the process *is* a troublesome one—he might purchase the requisite number of common

"sixpennies" or "re-makes" from any club-maker, and the result will be much more satisfactory to the eye. Through the holes made in the basket, and with the aid of the clamps already mentioned, the balls can now be fixed in position, and the method will, perhaps, be better understood by a glance at Fig. 3, which shows how ball (A), basket (B), and clamp (C) are united.

Clubs.—Select from the "incapacitated" the shafts most easily "doctored," and with fine cord and a little putty do all the necessary splicing and filling of holes or cracks. Pick out the three shafts having the tidiest "leatherings," and to each of these, for the time being, loosely fix one of the selected heads. Stand the clubs in a perpendicular position with the toe on the ground, and measure for the sizes required —viz., 2 ft. 10 in., 3 ft., and 3 ft. 2 in., and should any of the shafts require shortening, remove head and cut surplus from lower end. Let the angle be exactly the same as before cutting, else the height aimed at will be altered. By gluing and warping, the heads can now be firmly secured to shaft, and the result will be a club resembling, in nearly every respect, one for ordinary use. Rest the clubs in an upright position once more, and from ground, 15 in. up shafts, bore a hole and fasten with inch screw nails to balls attached to basket, 1 in. from edge. Find the distance from the centres of two balls on one line of basket (which should be about 9 in.), mark off on upper portion of shafts from last hole, bore, and fix as before to balls, 2½ in. from upper edge. Care must be taken to make exact measurements, otherwise the stand will present a twisted appearance. See, likewise, that all screws are well sunk and the holes obliterated, either with putty or a mixture of glue and sawdust.

Tray.—All that now remains to be done, to complete the structural effect, is the tray for the clubs to rest upon. Cut from a ½ in. board, with a bow-saw, a circular piece fully a foot in diameter, and smooth with plane and sand-paper. On lower edge, at regular distances apart, screw three strong eylets (Fig. 4) right up to ring. Through each of these, with a strong ¾ in. screw nail, attach tray to club heads, allowing a space of about 2½ in. between tray and ground. A reference to Fig. 5 will indicate how this is done.

Ornamental Edging for Tray.—The introduction of some simple ornamentation to take away the plainness, and prevent the clubs slipping off, is advisable. This may consist of a series of miniature hoops (eighteen in all), made from thick cage-wire, cut into two lengths of 4 in. and 6 in. The regularity of the curve may be ensured by bending each piece, from the middle, round the handle of a long kitchen broom—an article which is surely within the reach of all. Fix these, large and small alternately, on upper surface of tray, in an upright position (see Fig. 6) at regular intervals from one another, and about half an inch from edge, into holes pierced half-through with a small bradawl, suitable to the thickness of the wire used.

Painting.—Here will be found great scope for artistic taste. Taking as a guide the stand which is responsible for these details, the shafts might be painted with terra-cotta enamel, No. 2 (Aspinall's was used all over); the warping at junction of head and shaft with terra-cotta, No. 3; the head black, with a white facing; the bone and lead grey; and the balls, of course, white. The painting of the tray could be made a special feature; and the sketch (Fig. 7), besides giving the design, will show how the writer went to work with three shades of terra-cotta. When these are dry, the outline of the star should be gone round with a fine line of white, and from each point to edge of board a line of the same will enhance the effect.

Alternative Tray.—Those who do not care to go to so much trouble in making and painting the tray will find a simple substitute by using an ordinary Japanese tray with inch rim. The mode of attaching to shafts, however, would be somewhat different; the eyelet screw would require to be secured to upper edge of rim, and bent slightly in to meet the slope on back of clubs.

Should anyone be induced to carry out in a practical way these instructions, he will find that for a lobby or hall ornament the golf club stand will take a lot of beating. His efforts, too, will be amply compensated for by the complimentary remarks of admiring friends and visitors.

BOYS' CARPENTRY—RABBIT HUTCHES.

BY LAUNCELOT GUBBINS.

The writer has been through that wonderful institution known as the People's Palace, London, and was greatly struck with the extraordinary opportunities that are afforded there for lads to obtain that practical acquaintance with the various trades that will enable them to take a bold stand at the start of their apprenticeship, that was quite impossible hitherto. I only wish that such schools could be established all over the kingdom, but of course it is not possible to have them everywhere, and it is such boys that cannot avail themselves of such facilities that the Editor hopes to reach in these elementary papers on "Carpentry for Boys," for there is no reason why Work should not be in every house in the land; and I hope that this chapter on rabbit hutches, which boys may make, may lead some of them to start what I hope will prove hereafter a stock of lasting information in the carpentry line.

The first thing to be considered is, of course, the capabilities of boys generally, then the tools they shall require, and next such work as would be most suited to them. As regards the tools, I think a list had better be given here of what we shall require: A hammer, and what is known as a pruning saw, pincers, one or two awls, a jack knife, a rule, a chisel or two—say a half-inch and an inch one—a spokeshave, a brace and a few bits, a light axe known as a gardener's axe, the peculiarity of which is its lightness and a long, narrow-shaped blade (this to be used always with great caution), a square—a wooden one will do very well until we become more proficient—and after a time a light jack plane.

In writing this article I shall not go to any pedagogue-like means of explaining what the tools are for in each case. I shall premise that our boys at least know what the tools are for before they buy them. Nor shall I go into a long dissertation on the fibre and peculiarities of the various sorts of timber. I shall, I am sure, be better thanked by "skipping" all that, and—our impatient boys will think—a good deal of the introduction as well.

How to make a Rabbit Hutch.—Well, I shall take it that we know the names of all the elementary tools and their uses, and I shall now describe how to make a few articles indispensable to boys, and I shall begin with a rabbit box or hutch. The first thing to do is to find out how much wood we require and obtain it; and as we are only commencers we shall fall back on old packing-cases and boxes of that sort for timber to experiment on. A very good form of rabbit box is made plain square with two divisions, one for the animals to sleep in, and the other for them to feed in, with what is known as a lean-to roof, which may be covered with felt and tarred, if it is to be exposed to the weather, but which is most likely to be kept in the back house, and which, in this event, will not require any waterproof roofing. The size for a hutch to hold, say, a pair of rabbits will be about 24 in. long, 24 in. deep, and 18 in. high in the front, sloping down to 12 in. high at the back. The first things to get are two sides 24 in. long and 18 in. high at one end, and 12 in. high at the other, and about ¾ in. thick. But as timber 18 in. wide is not to be had, as a rule, we shall have to put the pieces together to make up the required thickness. This may be done in several ways, but about the easiest way is to lay the narrow boards edge to edge and to nail narrow strips, technically called cleats, down to them at right angles, so that the whole is firmly held together (see Fig. 1, and observe the position of the nail-holes). After the nails are driven through they are clenched at the other side—that is, they are bent over so that they will tighten the wood together and not come out again except by the use of very considerable force. A glance at the old packing case will show us how this is done; the points of the nails will, by this operation, be turned in so as not to do any damage. The top edge will now be cut to the required slope, and when the sides are finished they are nailed to the edge of the piece forming the back, which will, of course, be 24 in. long and 12 in. high. The partition (Fig. 3) is next to be made in the same way and fitted into its place; it has two small doors for the exit and ingress of the "bunnies," cut out with a pad saw if we have one; if we have not, with an ordinary saw as far as we can go, and the rounded top with a strong jack knife. This partition is put into its place, leaving a foot deep for sleeping space and a foot for feeding space, not counting the thickness of the partition, and will be kept in position with nails driven through the sides. We will, in putting the sides together, and in all cases, keep the cleats as much out of sight as possible.

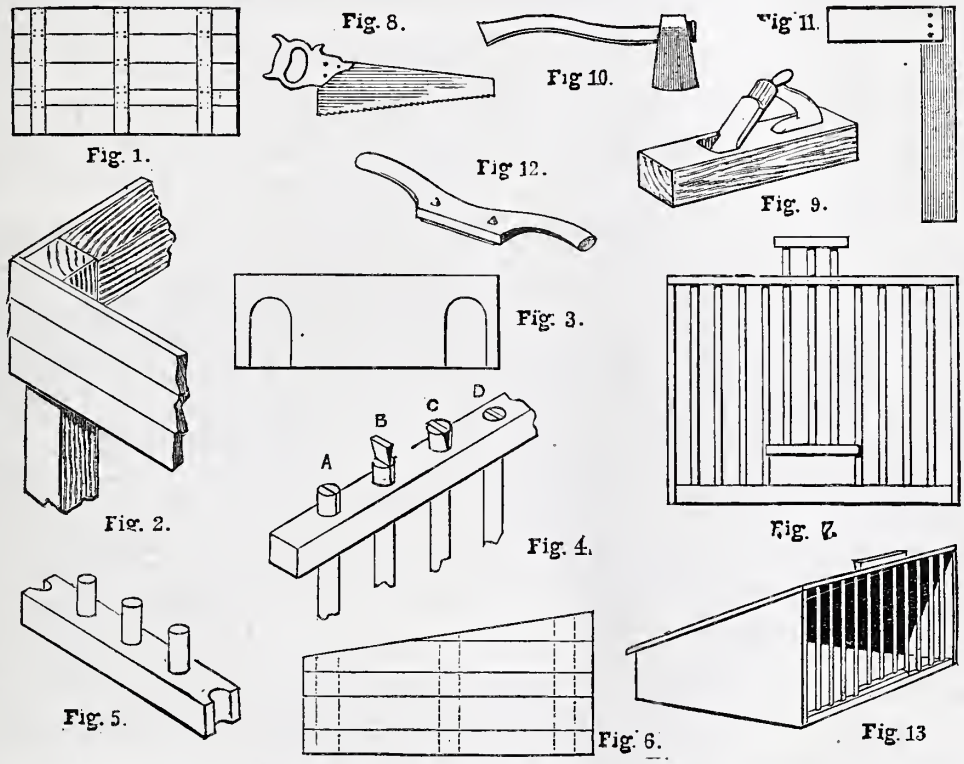
That disposes of the sides, back, and partition. The roof is then put on, which consists simply of the thin pieces laid on to the sides and nailed into position one after the other. We will try with our square to ascertain whether the edges are true before nailing the parts together, as if they were not quite square the resulting house would be lop-sided. Next comes the front. This will require a little patience, and consists of narrow rails, which will be made from pieces of timber of, say, 1 in. square; they are neatly rounded, first with the axe or chisel and then with the spokeshave, which is one of the most useful tools in our kit. These rails are cut to the proper lengths and fitted into holes bored in the top or roof along the edge, and also along the edge of the bar which runs across the front at the bottom, in the case of a hutch having no floor, but bored into the floor itself, if a fixed one. The holes will be about 1½ in. apart. The rails will be made to protrude through the holes in the edge of the top, and cut down the centre with the saw, and a wedge will be

driven down to keep them tight in position, and the surplus wood cut off with the saw and nicely trimmed with the chisel or knife (see Fig. 4). The holes will be bored with a brace and bit; a useful size bit is $\frac{5}{8}$ in. If we can afford it we shall get Jennings' double spur bits; they are far and away the best, but being beginners we shall require to take great care of them. They do not require any force to drive them; the taper screw on the end works its own way into the wood, and we must be careful of this screw, as it is very delicate, and if broken off the bit will cease to be of any service. Ordinary centre-bits are infinitely cheaper, and perhaps will be good enough to commence with. The door of the house is made, it will be seen, of three of these bars, which go up right through the roof (they will, of course, be cut a little longer than the others), and are let into a piece of wood with holes bored in it also, and wedged into the piece of wood instead; this bit of wood forms a handle to the door. The bars at the lower end of the door are secured by a bit of wood similar to the last, only made a little longer, and shaped with half a hole at each end, so as to fit up against the rails at each side of it, and thus keeps the door straight and steady (see Fig. 5). In the case of hutches with no floors, a long, narrow piece of wood about $1\frac{1}{2}$ in. square will be nailed to the front bottom corners of the sides, and forms, after the holes have been bored in it, the bar into which the rails fit.

Another mode of putting the box together would be to get square scantlings of timber of, say, $1\frac{1}{2}$ in. square, and nail the boards on to these as required (see Fig. 2); the scantlings give extra strength as corner pieces, and do away with the necessity of cleats. Rabbit boxes, as a rule, have no bottoms, but if any reader thinks his would be better with one, it can easily be made in the same manner as the sides, and when made can be fitted to the bottom and left loose in order to be cleaned from time to time, or nailed into position from the sides down at the bottom edge.

From these instructions in working up rough wood the beginner can easily see what other things not requiring great skill can be constructed on the same lines. Small chicken coops and dog kennels, wall pigeon dovecotes, and such like necessary and useful articles can all be made in this manner with scarcely any labour or outlay.

In my next paper I shall take it that we are getting a bit proficient with the tools, and will explain how to construct a few small articles, such as brackets, salt-boxes, knife-trays, and such like out of odd pieces of timber that we may have left over, and how to make ordinary picture frames. In the meanwhile, if there is anything which any boy does not understand, he has only to write to me through the Editor of WORK and I will explain anything respecting dealers for tools, wood, etc., through the always welcome pages of "Shop."



Rabbit Hutches. Fig. 1.—Manner of laying Boards to be cleated. Fig. 2.—Another way of building up Boards. Fig. 3.—Partition. Fig. 4.—Manner of securing Rails by Wedges—A, Rail with Saw-cut; B, Wedge ready to be driven; C, Wedge driven home; D, Wedge and End cut and cleaned off. Fig. 5.—Bottom of Door. Fig. 6.—View of Side. Fig. 7.—View of Front (Door partly open). Figs. 8, 9, 10, 11, 12.—Various Tools. Fig. 13.—General View of Rabbit Hutch.

CRAFTSMEN'S PRECEPTS.

BY P. B. H.

REMEMBER:—That wooden surfaces cemented by glue *newly made*, and in dry weather, will hold much better than when done in wet weather, and with glue several times re-heated.

That saltpetre and sulphur may explode if pounded in an iron mortar.

That sugar mixed with ordinary ink forms a good copying ink.

That quinine will preserve paste, etc.

That in mixing acids and water, the acid must be poured into the water, and not the water into the acid.

That carbolic acid is combustible.

That 31 grammes make 1 oz. troy.

That 175 lbs. troy = 144 lbs. avoirdupois.

That lbs. avoirdupois × 1·2153 = lbs. troy.

That lbs. troy × ·82286 = lbs. avoirdupois.

That the diameter of a circle × 3·1416 = the circumference.

That the square of the diameter × ·7854 = the area.

That the side of a square × 1·128 = the diameter of a circle of equal area.

That one metre = 3 ft. $3\frac{3}{8}$ in. English.

That one cubic foot of pure water = 62·425 lbs.

NOTES FOR WORKERS.

AN improved form of casing for the protection of electric cables has been brought out. It is made of the toughest steel, carefully galvanised to resist corrosion, and is very strong, flexible, waterproof, and is lighter than iron wire armour.

THE necessary machinery for furnishing power at the Chicago Exhibition will be secured nearly free of cost, as the exhibiting manufacturers of engines, pumps, etc., will supply power gratuitously.

A NEW magnesium lamp has been devised, which burns without attention for periods of 24 hours. It takes about 100 hours to burn 1 lb. of magnesium, and the light produced has an intensity equal to that of 130 candles.

THE artesian well at Springfield, South Dakota, U.S.A., is one of the largest in the State, has a pressure of 200 lbs., and throws up a stream 30 ft. high. Lately it has been throwing up soft coal and slate, and there are already $1\frac{1}{2}$ tons of soft coal scattered round the well.

THE Institution of Civil Engineers consists of 1,760 members, 3,095 associate members, 413 associates, 17 honorary members, and 854 students.

WATER constitutes more than two-thirds of the weight of the human body.

A NEW hand camera, called the Photomnibus, has been brought out. It has no lens, but a pinhole in front answers the purpose.

ALUMINIUM gold is an alloy of nine parts of copper and one part of aluminium. It is much harder and lighter than gold, but becomes tarnished in course of time.

PROF. KAUFMAN, of the Veterinary College at Atfort, has discovered that chromic acid, used hypodermatically, will destroy the poison of snakes. A one per cent. solution is cautiously used with an ordinary hypodermatic syringe.

ELECTROLYTIC copper is coming more into general use, owing to its great purity. The first electrolytic factory was established at Hamburg, where a powerful Gramme machine (3,000 ampères) was constructed in 1872 for galvanoplastic operations.

THE daily output of electrolytic copper at the Hamburg works during 1891 was $25\frac{1}{2}$ tons. The strength of the current used was 25 to 30 ampères per square metre of cathode surface.

THE velocity of light is 186,700 miles per second, and it only takes $16\frac{1}{2}$ minutes for light to travel across the earth's orbit, which is about 185,000,000 miles.

ALL bodies expand on heating, the few exceptions to this rule being silver iodide, stretched caoutchouc, water below 4° Cent., and some alloys, which contract when heated and expand on cooling.

A HARD cement, which resists the action of acids, may be made by mixing a strong solution of zinc chloride with zinc oxide to form a thick paste.

THE largest electric light plant in the world is to be erected in Chicago by the Edison Co. at the cost of $2,000,000.

To make lime-water, add 2 ozs. of slaked lime to a gallon of water and stir well. After standing several hours, the clear lime-water can be drawn off the deposited excess of lime.

EMIGRANT FIELDS AND PROSPECTS.

OTTAWA. — Time for Emigrating — Building Trade Unpromising—Good Prospects for Electricians.

ACTING upon the promise contained in the prospectus of the present volume of WORK, we have now the pleasure to present to our readers the first of a series of letters bearing upon the all-important subject of emigration—a matter involving such momentous issues to those directly concerned that only such information as that emanating from special and direct sources—from those, in fact, who have tried the various districts for themselves—can be really valuable. Such personal experience is given in the following letter; and we trust that, while it will encourage some to act upon the advice offered, it will also deter others from trying a spot, the latest information in respect to which is not favourable to one section of workers—the building trades. **J. J.** (**Ottawa, Canada**) writes :—

"The present time is a good one to come to Canada, and I believe that any man who is willing to strive, and is of sober habits, can get a living here better than in England. I came out from London some twenty years ago, and have never regretted doing so, as I have always been able to earn enough to keep me comfortably. Although I have not made a fortune, I have established myself in a good business, and can always put my hand on a few dollars when I need them. Living is better and cheaper than in England, but I would advise anyone coming out to make way to Ottawa, or go even farther west, rather than stop east, as the western towns and cities are more English, and the climate milder. The summers here are as relatively hot as the winters are cold. Being always sheltered where I am, I prefer the winter. The building trade will not be very brisk in Ottawa this coming summer; but anyone understanding electricity or any of its branches would be sure of employment. We have three electric light and power companies here in full blast, the city being nearly wholly lighted by electricity; while street cars, printing offices, machine shops, baking machinery, and flour mills are run by it. We have an immense water-power here, and there is every appearance of this being one of the centres for electric light work in America. There is very little demand for good finished bench carpenters here, as all the house work is made in the mills."

SCIENCE TO DATE.

Artificial Bitumen.—On warming resin with sulphur to 250°, sulphuretted hydrogen is given off, and a nearly black substance is obtained, which possesses most of the properties of bitumen. It is insoluble in alcohol, but dissolves in chloroform and benzine. It is also sensible to light, and can replace bitumen in photography.

Flame Coloration.—The colour given to a non-luminous flame by certain metals and their salts—as for example, the yellow coloration produced by sodium salts, green by copper, etc.—has hitherto been considered a physical effect due to the incandescent vapour of the metal. Prof. Smithells has, however, noticed, by means of his flame-separating apparatus (described last week), that a copper salt brought into the inner cone does not produce any coloration, but only a feeble luminosity, while the outer cone is tinged green in the usual manner. Hence it seems that the green coloration is due to a process of oxidation, and is not due to the mere incandescence of the vapour of the metal.

Rust from Nickel-plated Articles.—According to *La Nature*, the following method may be used for this purpose. The rusted surface is first greased, and a few days later it is rubbed with a rag soaked in ammonia. If there are any stains left, a little dilute hydrochloric acid is applied and then rubbed off. The article is then washed in water, dried, and polished with tripoli.

Luminosity of a Coal Gas Flame.—Prof. V. B. Lewes, after a long series of experiments, has come to the conclusion that the formation and decomposition of the hydrocarbon acetylene is the main cause of luminosity in a coal gas flame.

TRADE: PRESENT AND FUTURE.

*** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

OIL TRADE.—In palm-oil the Liverpool market is rather quiet—Lagos at £21 15s. transit, and Benin £20 5s. ex-quay. Paraffin is in limited demand—American at 5¼d. to 6½d., and Russian 4⅜d. to 4½d., per gallon. Rosin quiet but steady at 4s. 1½d. to 4s. 3d. per cwt. for common ex-quay.

COTTON TRADE.—In Manchester and district, the cotton trade remains in an unsatisfactory condition. Some mills in the Pendlebury district have been closed, owing to the miners' "holiday." In Liverpool, from the large crop of cotton this year, the price has already fallen to the lowest it has ever been, but there is now a rising tendency.

SILVER TRADES.—Here, in Sheffield, there is, speaking generally, a condition of stagnation in the silver and allied trades; some few houses who trade with Australia are, however, better employed than their neighbours.

HARDWARE TRADES.—In Manchester and district trade still continues in the same depressed state. The locomotive-engine builders are very slack, and this causes, to some extent, a corresponding dulness amongst machine-tool makers. Most of the latter are working with a reduced number of hands—some, indeed, with only about half their usual staff. There are very few contracts on hand, with an almost complete absence of new ones, except one or two small orders for abroad. The coal crisis has not, as yet, caused any disturbance in the district iron trade, so there is nothing fresh to chronicle. Very little business is being done, and the outlook is anything but cheerful. Prices remain about the same, and an advance in the price of fuel would probably cause many makers to close their works for a time. The same may be said of the finished iron makers. In Sheffield, Bessemer steel billets of special carbons are quoted at 117s. 6d. per ton, and hematites delivered in the district at from 57s. 6d. upwards. Business is improving in agricultural implements, especially spades and forks. The firms who do business with Spain and Portugal have been busier than they have been for years, owing to the new and higher tariff coming into operation on the 30th June next, and, in consequence, goods are being sent into these countries in immense quantities; but in the meantime great efforts are being made to escape a duty which threatens to make itself severely felt. Very little is now doing in shipbuilders' tools, this branch being less active than formerly.

CYCLE TRADE.—The few days of fine weather have given a great impetus to the cycle trade in and around Glasgow. Private buyers are on the lookout for a suitable mount for the season, which may be said to have fairly opened, the hiring dépôts being overwhelmed with business. The racing fraternity are also going in for their new mounts, and long since many of them have placed their orders with agents for the very best "racers" that money can procure, some going in for three or four different makes, all of high repute. In Leicester, orders are flowing in in a very gratifying manner. The Leicester Cycle Co. is a young concern, established in 1890. It has grown apace, and the company is now employing some 300 workmen, and the output of cycles has reached something like 270 per week. There is a cycle factory in the North which may be said to locate neither in Scotland nor England, being in that historical border town, Berwick-on-Tweed. Messrs. Denery have here a thriving concern, and have large orders on their books for their cycles, which are in great demand in Scotland and elsewhere, being remarkable for their moderate price when their quality is considered.

TIMBER TRADE.—In London, the pine and spruce trade is very quiet, and, for the matter of that, so is the Baltic trade, as, on account of the absence of trade, merchants are only buying what they require for immediate disposal. 3 by 9 yellow deals command good prices, and as there is not likely to be any fresh stuff in yet, it is likely to continue. Floorings and matchlinings are not commanding such high figures, as the demand is slow and the supply is fairly large. The dock deliveries show a better return, the figures being as follows: Deals and battens, 3,266 stds.; prepared boards, 1,097 stds.; showing an increase of about 200 stds. over the previous report.

ENGINEERING TRADE.—There is no improvement to report in the condition of the engineering and iron trades of the Lancashire district, and, with the exception of a few firms who have specialities in hand, there is a general absence of new orders of any magnitude. Locomotive builders continue quiet, and from one of the principal works near Manchester a large number of men have been discharged. Trade in the neighbourhood of Liverpool is decidedly bad, but in the Barrow district engineers and shipbuilders are busy, and although no new orders of any weight have been booked, there is a fair number of inquiries. The unsatisfactory condition of the trade generally is emphasised by the monthly report of the Amalgamated Society of Engineers, which shows that slightly over 8 per cent. of the total membership is in receipt of out-of-work donations. As was to be expected, the iron trade is characterised by a general want of confidence owing to the action of the miners, and although the resumption of work at the collieries has had a somewhat reassuring effect, the general condition of the trade is decidedly bad, and it is considered that both lower wages and cheaper fuel are necessary before any marked revival can take place. In the Newcastle district, orders have been placed with a shipbuilding and engineering firm on the Tyne, and the keel laid down of the first of four very large cargo steamers for the North Atlantic trade. The steamers are for the cattle and copper trades across the Atlantic. Their length between perpendiculars is to be 420 ft., breadth of beam 42 ft., with a carrying capacity of 5,600 tons register. They are to be propelled by twin quadruple expansion engines of 5,000 indicated horse-power collectively, and lighted throughout by electricity.

BUILDING TRADE.—In Aberdeen, masons are busiest, most in demand, and scarcest. Their pay is 7½d. per hour, while one employer has offered 8d. per hour. Painters and decorators are not yet very busy, but a great deal of work lies waiting until the weather becomes more favourable; and this promises not to be long. In Manchester, the weather has opened up, and work has started in good earnest. The jerry-builders are very busy, covering acres of ground with cottages in those districts which were amalgamated with Manchester in November of 1890. It would be interesting to know how many plans were rushed through, at the eleventh hour, by speculators. The new Building Bye-laws of the city, with their 14 in. external and 9 in. party walls, and proportionate thicknesses of timbers, are a veritable bugbear to the jerry-builders of cottage property; with the greatest scheming they find the cost of building has been raised 20 per cent. In Bristol and neighbourhood, building is being carried on rapidly in every direction, as contractors state that, after June 1st, masons' and bricklayers' wages are to be advanced. For buildings to be erected after this date, builders now want a considerably higher price in contracts. Considering the amount of buildings now under construction, and the probable estimate, labour, with its present prospects, should be plentiful during the present year.

SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

I.—LETTERS FROM CORRESPONDENTS.

Tailoring.—J. H. B. (*Pendleton*) writes:—"May we have some papers on 'Tailoring' after the style of the 'Boot making' ones, showing how to cut a suit of clothes to measure? I feel sure it would be a boon to many."—[As soon as a thoroughly competent cutter and writer presents himself, "Tailors' Cutting" shall have its turn in WORK.—ED.]

Walking-Sticks. — RICHMOND VA writes:—"I have a great fancy for collecting walking-sticks, and am most successful in turning them out. As some queries appeared some time ago in WORK, I give my experience. The stick must, above all, be well-seasoned. It should be sand-papered according to fancy, care being taken to retain the bark if required. Apply as many coats of shellac varnish as will give a good depth of varnish, say four; the handle may require more if rough like a bit of root. Rub this down with pumice-powder and water. If the varnish appear thin in places, stop for the present, and put on more. When the stick has been well rubbed down, use a little dry pumice-stone powder to bring out the gloss, and if this is not sufficient, pour a little spirits of wine on a soft rag, and rub the stick lightly over with it. Care must be taken that the rag does not stick; a little manipulation is required."

Fretwork Patterns.—OMADAUN writes:—"Yet another 'tip' regarding fretwork patterns. A great percentage of these consists of either a repetition of the same design—as, for instance, a border in which a certain part repeats until a requisite

length is obtained—or of a pattern in which one-half is the exact reverse of the other. Now, I take it that an exact pattern is the first essential to exact workmanship, and to trace a pattern that shall be perfect and an exact repetition is not always easy; this being especially the case if an enlargement is being made. My 'tip,' then, is simply to make use of the copying-press. If the pattern, or so much of it as repeats, is traced in copying ink, several duplicates can be obtained, which are, of course, exact repetitions of the pattern. Again: as the press copies are equally clear on either side of the paper, it is evident that an exact reversal of a pattern can also be obtained; so that if, for instance, an ornamental vase is required, it is only necessary to take off two press copies, divide them equally in the centre, and use the same half from *each* pattern—one, of course, being reversed; and the result is a perfectly true design so far as both sides being alike is concerned. I have found this to be a useful 'tip,' and it has a further advantage also of leaving the original pattern for future use; and the thin tissue paper used for the copies is also convenient."

Patent.—S. E. (*Upper Clapton*) writes, in sequence to C. E. (*London, N.W.*) (see No. 152, page 763):—"I should be inclined to let the sarcastic remarks of C. E. remain unnoticed were it not for the stubborn fact that he *is* wrong, and that his erroneous advice may lead other of your readers into serious trouble if they allow themselves to be guided by it. Allow me, for this reason, and in fairness to myself (whom C. E. kindly indicates as 'a fool rushing in where angels fear to tread'), to point out and prove his error. On page 492, No. 135, C. E. states: 'This provisional protection lasts nine months from the date of application, and before the expiry of this term the complete specification, claims, and drawings must be filed, or the patent is lost. If, however, it is found that what has to be done cannot be completed within that time, an extension of time of one, two, or three months may be applied for, for one of the three periods named, with the stamps for fees of £2, £4, or £6 impressed upon the application; but no further extension of time will be granted.' In my reply (No. 141, page 587) I tried to point out in a gentlemanly manner that 'one month, and one month only, beyond the original nine months can be obtained for filing the complete specification, and the stamp duty required on the form is £2.' This statement brings down upon me the scathing reply of C. E. (p. 763, No. 152), in which he refers me to the Patent Office Rules, where I am to find that he is right and I am wrong! Now, Mr. Editor, I have before me the Patents, etc., Acts, 1883 to 1888 (consolidated), and in Part II., Section 8, I find these words: 'A complete specification may be left within such extended time, *not exceeding one month after the said nine months*, as the Comptroller may, on payment of the prescribed fee, allow. *Unless a complete specification is left within that time, the application shall be deemed to be abandoned.*' And in the Patent Rules I find, in the list of fees, 'For enlargement of time for filing complete specification, *not exceeding one month*, £2.' Now, Sir, having given C. E. incontestable proof that my original statement was correct, I call upon him to be 'plucky enough' to acknowledge his error."

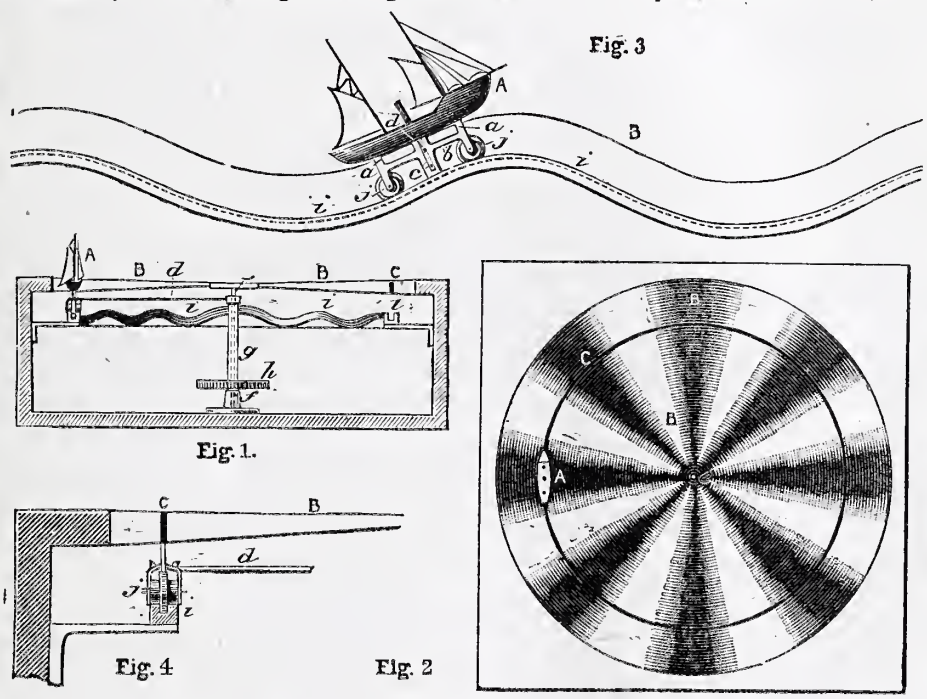
Connecting Link.—BAPTISTA writes:—"With regard to the connecting link for chains mentioned in WORK (No. 152, page 759), I beg to say that links similar to the one described are for sale in the ship chandlers' stores. I say similar, for they are not exactly alike, being sold in two or three different shapes. One link, I remember, is in two halves, connected by a pivot, the arrangement for introducing the links of the chains to be connected being particularly ingenious, though rather difficult to describe on paper. I am sure if the writer pays a visit to some ship chandler's or ironmonger's, he will see links rivalling in ingenuity the excellent one which he describes."

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Brass Ferrules.—RESILIENT (*Hoxton*).—Are these required for fishing-rods or similar purposes? If so, you might try G. Curvell, Jewry Street, Winchester.—M. M.

Model Boiler.—G. S. (*Fulham, S.W.*).—About 14 or 15 B.W.G. will be amply stout enough if you have it of solid drawn tube, which I strongly advise in preference to riveting or brazing. If you are going to rivet, better have it one or two gauges thicker. You can get the copper of Stanton, Shoe Lane, E.C. Price for a small quantity, about 1s. 4d. per lb.—J.

Model Ship.—J. H. (*Leeds*).—From your very indefinite question, I have come to the conclusion that it is not a model ship only, capable of working in rough water, that you want, but a model sea as well, the mechanism for driving the vessel being outside it. And I also suppose that you want the mechanism enclosed in a box, and the ship to sail round in a circle, at the same time rising and falling as if at sea; at least, as near as one can approach to it. If I am right in my conjecture, the four sketches (Figs. 1, 2, 3, and 4) will explain a system which you can modify to suit yourself. Fig. 1 is a sectional elevation, and Fig. 2 a plan; Figs. 3 and 4 are enlarged views of the vessel and lines. The size of everything will have to be made to suit the size of the boat (which, however, must not be large if driven by clockwork), so you must decide that first. Having obtained a vessel (A) of a suitable size, fasten two supports (*a*, *a*) at each end, connecting them by a stiffening piece (*b*), with a narrow vertical slot (*c*) in it of such a length that the finger (*d*, Figs. 1, 3, and 4), though keeping at the same vertical height, may continually push the boat round in a circle, though the latter keeps rising and falling. The sea would be best represented by an evenly corrugated circular piece of sheet-iron (B) painted to represent the sea. Various kinds of waves could be made. The corrugations should be made suitable to the size of the boat, but they should not be too deep, or the power necessary to drive the boat could not be obtained from a clock works. A circular disc can now be cut out so that a slot (C) is left through which the boat supports pass. The central portion must be carried on turned pillar (*e*) rigidly fixed into support (*f*) fastened to the bottom of the box. The exterior portion can be fastened to the wood of the box. Below the slot (C) a brass channel rail (*i*) should run all the way round, every point in its circumference being equidistant from and exactly underneath the surface of the sea at the slot. This rail (*i*) is so constructed that by means of two broad wheels (*j*), with central projections on the rim to fit the channel rail, the boat is kept perfectly steady. The end of the finger (*d*) should pass through the slot (*c*) with a washer fixed on either side, just allowing the end of *d* to pass easily up and down the slot, but with as little shake as possible. The finger (*d*) must be fixed to the top of the sleeve (*g*) of spur wheel (*h*), the sleeve and wheel being drilled to fit pillar (*e*) and turn round on it. The wheel (*h*) can be placed in any suitable position as regards height on the sleeve (*g*), so that it will gear with the last of the train of clockwork wheels. You must arrange the works of clock to suit the power required, taking out some of the quick-running weak wheels, so that you will obtain the necessary power to drive the boat, which should be as light as possible. I hope these few remarks will be sufficient to help you on your way, as I cannot lengthen them out in "Shop" columns, the space is so crowded at present.—P. B. H.



Model Ship. Fig. 1.—Sectional Elevation. Fig. 2.—Plan. Fig. 3.—Enlarged View of Vessel, Rail, etc. Fig. 4.—Cross Section of Rail.

Gloss.—IRIS.—The special and particular gloss upon any class of fancy goods may be obtained by methods quite beyond the amateur's conditions of work. A polish must either be brushed on or "rubbered" on, unless the article is of a nature suited to japanning and stoving. If you require a black varnish or polish for cabinet work (trade quantities), write either H. Kershaw, Newington Causeway, S.E., or C. W. Waters, Great Eastern Street. If yours is merely a fancy novelty, you can get nothing more suitable than a small pot of a good maker's black enamel. These things cannot be satisfactorily made by novices from recipes.—F. P.

Smoking Chimney and Damp Walls.—SLIEVENAMAN.—Doubtless the opening between the two flues would have a bad effect on the draught, and it would be well to try the effect of stopping it before proceeding to further alterations. Your damp wall, I presume, has a rainy exposure—to south or south-west, perhaps. Cement painted, and the paint renewed every third year, would, no doubt, keep it dry; but if your walls are not too high, and the situation one in which you can grow ivy, why not try that natural remedy? It is cheapest, and looks best. The leaves overlap each other, and throw off the rain like weather-slates. By planting it I have made the one damp corner of my own house perfectly dry, and have now bookshelves in it. Put in well-established plants—such as have had four or five years' separate growth—cutting them down to within 20 in. of the ground, and they will soon cover any required space. Your ivy must, of course, be kept trimmed away from spouts, which it is apt to fill, and from roofs, on which it displaces the tiles.—M. M.

Secret Dovetailing.—G. F. B. (*Victoria Barracks*).—The article treating of this subject appeared in No. 129 of WORK.

Telegraph Posts.—K. M. D. (*Harling*).—In ordinary building operations, a coating of red-lead paint answers for preserving wood that is fixed in "mother earth." Two methods are open to use: one, soaking in oil, or of a similar nature, such as will penetrate the wood, and then, when dry, encase the particles with a film; or a body mixture of paint or tar, which, by the nature and thickness of the coatings, seals up the wood from atmosphere and moisture. I do not know of any special mixture in use for above purpose. Oil pigment mixed with petroleum is also a good and cheap paint.—F. P.

Accumulators.—J. H. L. (*Kensington*).—Illustrated instructions on making accumulator cells were given in No. 101, p. 790, Vol. II. of WORK. If you require a current of 4 ampères for a period of four hours, at a pressure of 25 volts, you must have thirteen cells, each cell furnished with lead plates exposing a surface area of three square feet to the action of the acid. The surface area may be obtained by employing several small plates, or by means of three large plates in each cell. As the pressure of the current from each cell equals 2 volts, you may obtain any multiple of 2 up to 26 by connecting the cells in series; thus, two cells will give a current of 4 volts, three cells a current of 6 volts pressure, and so on. Twelve of the cells may be charged in series at once by the current from your dynamo, if the commutator of the machine is suitable to the purpose of charging accumulators—that is, if it has more than two parts.—G. E. B.

Electrical Terms.—R. S. (*Felixstowe*).—The terms volt, ampère, watt, and ohm, used in writings on electric lighting subjects, are names given to measurements of electric currents and conductors for the same. The volt is a unit of electric current pressure, equal to that obtained from one Daniell cell. The ohm is a unit of resistance measurement in an electric current conductor, and equals nearly that of 6 ft. of No. 36 pure copper wire. The ampère is the unit of electric current volume, equalling that obtained from a current of one volt through a resistance of one ohm. The watt is a unit representing the combined volume and pressure of the current, as per example: 2 ampères × 8 volts = 16 watts.—G. E. B.

Safety Bicycle.—X. Y. (*Princes Risboro'*).—The articles on the "Safety Bicycle" appeared in WORK, Nos. 107, 111, 115, 119, 124, 127, 132, 137, 142.

Breeding Cage.—J. P. (*Liverpool*).—An article on "A Breeding Cage for Canaries" appeared in WORK, No. 108.

Bookbinding.—A NOVICE.—The articles on "Bookbinding" appeared in Nos. 6, 9, 57, 61, 65, 69, 72, 75, 80, and 85 of WORK.

Couch Bedstead.—H. S. S. (*Monkwearmouth*). This appeared in WORK, No. 130.

Picture-Frame Making.—NO NAME.—Articles appeared in WORK, Nos. 106 and 109.

III.—QUESTIONS SUBMITTED TO READERS.

**** The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Musical Glasses.—J. R. S. (*Liverpool*) asks for the proper solution with which to wet the fingers to induce music from twenty-eight glasses he has got together.—[Doubtless, some obliging reader will help J. R. S. In the meanwhile, should our friend be visiting London, he should seek out Paternoster Row between one and two o'clock in the day. There he will be pretty certain to discover a genius of romantic mould, who, with the aid of a puddle of water and a few glasses, has been successfully contributing to the glories of the London street music, to our knowledge, for the past twenty years.—ED.]

Puzzle Tobacco Box.—J. T. (*Sunderland*) writes:—"Will some reader kindly give me a sketch of puzzle brass tobacco box?"

C. T. Monogram.—M. (*Prince's Park*) writes:—"Will some reader please give me a design for monogram, C.T., to carve in oak for panel?"

Wind-Power Grindstone.—P. T. (*Birmingham*) writes:—"I should feel thankful if some of my fellow-readers of WORK would kindly give me a sketch of a windmill of a sufficient size to turn a grindstone, say, 3 ft. in diameter; informing me also if the fans can be made to regulate according to the power of the wind."

Ebonising Fretwork.—UTILE DULCI writes:—"Would any obliging reader acquaint me with the best methods and the materials necessary, adding probable cost, for, first, ebonising fretwork cut out of, say, common woods usually employed for this purpose; and secondly, for gilding fretwork made of the same material, a liquid for the latter being preferred?"

Electric Locomotive Engine.—J. J. (*Blackpool*) writes:—"I have a small model locomotive engine which will work by steam. Can I make it to work with electricity? If so, will any reader of WORK please state how, and where I can obtain the necessary materials?"

Lathe.—RICHMOND VA writes:—"Can anyone recommend me a publication giving directions shortly and concisely as to turning metal in a lathe? I have a lathe with all tools complete, but no one to show me their use."

French Polishing.—RICHMOND VA writes:—"As an amateur, I have never succeeded with French polishing, so have looked all round for a substitute, which I think I have found. Will someone who has tried it give me their experience? Here, in the U.S.A., the manufacture and polishing of furniture is carried to much perfection. So far as Richmond is concerned, French polishing is scarcely known, being too troublesome; they go in for quick methods here. Several coats of hard oil finish (or shellac varnish, which is said to do as well) are laid on the piece to be polished, the surface, when dry, to be rubbed down smooth with powdered pumice-stone and water. When a sufficient depth is obtained, a final coat of varnish is laid on; and to produce a glassy surface on this, rotten-stone is applied with a damp woollen rag, and the dry palm of the hand rubbed over it produces a surface which French polish will not beat. I have seen the rotten-stone applied, and can testify to the beautiful surface it gives to the rough varnish. I am told that this process is quite as durable as French polish."

Chip Carving.—PETERBORO' writes:—"Will any reader please give me information on chip carving?"

Syrups.—W. W. (*Glasgow*) writes:—"I would thank any correspondent if he would tell me the name, price, and publisher of any books on the making of syrup for aërated waters on a large scale."

Skin Preparing.—R. R. (*Harrow Road*) would ask a brother subscriber to tell him how to dress hare and rabbit skins so as to get a chamois-leather body with the fur on; and what materials to use with that result.

Sugar Soap, Brushes, etc.—S. J. G. (*London, W.C.*) writes:—"Will some correspondent kindly inform me what are the ingredients of 'sugar soap,' such as painters use for cleaning paint and varnish work, and the proper strength to use it? Also the best way to keep paint and varnish brushes from getting hard and unfit for use after use."

Frame-making Trade.—SENTINEL writes:—"Can any practical hand say or advise which is the most useful and thorough mitre-cutting machine in the trade—say, the one by the Britannia Co., or Booth Bros., or any other? Also, where could I obtain mount-cutting tools, etc?"

Monogram.—TINSMITH writes:—"Will anyone kindly give me a monogram for R. F. for fretwork?"

Fat, To Purify.—L. H. (*Everton*) will thank a correspondent to tell him how to clean dripping and other fats for edible purposes.

Miners' Drills.—LANARKSHIRE writes:—"I shall be obliged if any reader would give me a description for making a hand machine for twisting miners' drills from 1 ft. 4 in. to 4 ft. 6 in. in length, the steel to be twisted being 1¼ in. and ⅞ in."

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Besom Makers.—W. G. (*Ruabon*) writes, in reply to L. S. D. (*No Address*) (see No. 144, page 635), that Mr. Thomas Jackson, of Tai Nant, near Ruabon, manufactures heath and birch besoms.

Candle Making.—J. H. W. (*New Brompton*) writes, in answer to J. W. W. (*Renshaw*) (see No. 153, page 782):—"I have had a long practical experience in candle making. Have you a steam boiler workable up to 20 lbs. per square inch? Whatever process you may choose to adopt, steam is one of the most necessary things."

Venetian Blind Laths.—HALL writes, in reply to H. H. (*Chacewater*) (see No. 151, page 750):—"You can get laths in this city (Birmingham) from A. Shepherd, 58, Ludgate Hill; Blind Co., 192A, Coventry Road; H. Edwards, 9, Stafford Street."

Tailors' Cutting and Fitting.—Messrs. Simpson and Johnston (*Llanbryde*) and C. K. (109, *Wellington Street, Gorton*) desire G. R. D. (*Cheetham*) (see No. 151, page 733) to place himself in communication with them.

Old Paper.—J. H. B. (*Pendleton*) writes, in reply to J. W. (*Plumstead*) (see No. 148, page 702):—"Mr. Chas. Hatton, Gaythorn Paper Mills, Manchester, purchases old paper, etc. He would send J. W. his terms on application."

Wood.—M. (*Bishop Auckland*) writes to J. B. (*Birmingham*) (see No. 153, page 782):—"Try J. Parker, Highgate Street and Conybere Street; W. D. Rudder & Son, Chester Street and Hubert Street; or J. Ball, Midland Saw Mills, Penn Street—all in Birmingham."

Marble Stains.—J. L. (*Upper Holloway*) writes to SCULPTOR (see No. 152, page 764):—"If SCULPTOR will get some salts of wormwood, and dissolve in warm water, then mix with whiting into a moderate paste, and apply to stone or marble, and let it remain upon either for twenty-four hours—and if not successful the first time, apply again—he will draw all stains out of marble, and clear all lichen either from sandstones or oolitic stones. Thoroughly wash the stone with a strong soap (say, of Hudson's No. 2 soap powder) and lukewarm water, and, when thoroughly dry, give a coat of sulphuretted oil. He can make his own oil. Boil in a bath one quart of linseed oil for one hour, with ½ lb. of flower of sulphur, gently and continually stirring same; then take off fire, and let cool; then pour oil from sediment, using oil upon stone. No lichen will hurt his stone if out exposed to the air, for the rain will wash all clean every time. I have cleaned several statues with nothing but Hudson's No. 2 and water."

Blowing Fan.—K. H. (*Blackburn*) writes:—"I take it that WAREHOUSEMAN (see No. 151, page 750) has power in his warehouse. He should write to the 'Blackman Air Propeller Company, Limited,' 63, Fore Street, London, E.C., giving them the length, breadth, and height of the place he wishes to ventilate. They will then send him full particulars as to how the ventilation should be carried out."

Galvanised Iron.—K. H. (*Blackburn*) writes:—"The following is taken from Molesworth's 'Engineering Formulæ,' and may suit COLONIST (see No. 151, page 750). (1) Pickle the article six or eight hours in water containing about 1 per cent. of sulphuric acid held in wooden vessels. The acid requires to be renewed from time to time, according to the quantity of iron pickled. (2) After pickling, scour and wash well in clean water. (3) Keep the article under clean water (in which a little fresh burnt lime has been stirred) until ready for the next process. (4) Immerse in chloride of zinc for one or two minutes, until a skin of fine bubbles is formed on the surface. (5) Dry the article on a heated iron plate, then immerse it in a bath of molten (not glowing) zinc until it acquires the temperature of the zinc bath. The surface of the molten zinc should be protected by sal-ammoniac or some other substance. In some cases there is a partition at the surface of the bath, one portion of the surface being protected with sal-ammoniac, the other with a layer of charcoal. (6) Beat the article while hot, to remove the excess of zinc."

Utilising Coal-dust.—W. J. B. (*Deptford*) writes to HOUSEHOLDER (see No. 151, page 750):—"A cheap fuel may be made by mixing two parts coal-dust, two parts saw-dust, four parts sand, and one of clay with water. Mould into lumps, and set aside to dry. These will not light a fire, but can be used in conjunction with a little coal to maintain heat."

Telegraph Instrument.—M. (*Bishop Auckland*) writes to TELEGRAPHIST (see No. 155, page 814):—"You will require a small magnet, about ¾ in. by $\frac{1}{16}$ in., and of suitable length, fixed on a steel axle, and made to swing on pivots. One end of the axle projects through the dial, and has a needle fixed by one end to it, and with a pin at each side to prevent it swinging too far; two coils of silk-covered copper wire on brass or paper bobbins are fixed inside, and the magnet swings inside the coils. The wire from the coils is connected at one end, and the other ends are brought through two keys, or a handle fixed on an axle, which is contrived to reverse the current by pressing either key, or by moving the handle to right or left. A Leclanché battery will work it."

"Great Eastern."—REV. J. P. (*Durrus*) writes, in answer to MODEL S. L. (see No. 155, page 814):—"The dimensions of the *Great Eastern* were: Length, 692 ft.; beam, 83 ft.; depth, 59 ft.; six masts; 25,000 tons burden; draught of water when laden, 30 ft.; screw and paddle; four decks; spread 6,500 square yards of canvas. The above particulars are taken from a medal struck when the great ship was built. There is a representation of the vessel on the medal."

Glass Blowers.—C. G. M. (*Penistone*) writes, in answer to DROSFAEA (see No. 156, page 830):—"Townson & Mercer, Bishopsgate Street Within, keep all kinds and sizes of glass and tubing. They also make chemical and scientific glass-ware of all sorts."

Engine for Lathe.—D. (*Holyrood*) writes, in reply to LATHE (see No. 150, page 733):—"I should advise him to write to Crossley Bros., Manchester, or to Andrews & Co., Stockport. They both make an engine for small powers, vertical stroke, which occupies very little floor space, and turn out first-class work that can be depended on."

Antique Furniture Designs.—M. (*Bishop Auckland*) writes to H. R. (*Kidderminster*) (see No. 153, page 782):—"One of the following books may suit you. 'Antique Furniture,' price 36s.; 'Furniture of the Sixteenth, Seventeenth, and Eighteenth Centuries,' by Pequenotz, price 36s.; 'Specimens of Ancient Furniture,' by H. Shaw, 25s.; 'Examples of Ancient and Modern Furniture,' by B. J. Talbert, price 28s.; from Batsford, High Holborn."

"Great Eastern" Model.—W. M. (*Stechford*) writes to MODEL S. L. (see page 814, No. 155):—"I have a large model of the *Great Eastern* in glass case complete that I want to sell. If your correspondent hands over two guineas to the National Lifeboat Institution, he can have it. The glass, mahogany case about 3 ft. 6 in. long, 1 ft. 8 in. high, and 14 in. deep, with sea view painted as background, without the vessel, is worth at least 30s., so he can have a bargain, and secure the lifeboat at the same time. Cardboard men, 2,000 on deck and in rigging, show half the number she can carry; the remaining 2,000 are supposed to be below."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—AN APPRENTICE CARPENTER; J. H. (*Stratford*); T. B. B., JUNR. (*Manchester*); W. J. (*Laurencekirk*); VULCAN; J. H. (*Oldham*); J. B. (*Burton-on-Trent*); A. B. (*Westminster*); W. L. (*Basford*); PHOTOGRAPHIC SOCIETY (*India*); BRUSH; LEARNER; S. C. (*Ashton-under-Lyne*); H. S. (*Birkenhead*); G. W. W. (*Shields*); H. A. A. (*Bristol*); READER; R. G. (*Grantham*); W. R. H. (*Lincoln*); P. M. (*Wigan*); A. B. L. (*Nottingham*); MEXICO; J. S. (*Sheffield*); A. E. A. (*Ipswich*); CELLULOID BARLEY; J. H. H. (*Robert Town*); BARRA; T. R. (*No Address*); J. A. (*Bow*); CLOCK; W. M. (*Portland*); EDDIFRA; SEVERAL DAILY READERS; SOCRATES; A. D. (*Sheffield*); W. H. (*Rotherhithe*); R. A. R. B. (*Oxford*); G. R. (*Manchester*); J. H. S. (*Basingstoke*); C. H. W. (*Seacombe*); R. D. T. (*Marylebone*); G. P. W. (*Ulceby*); H. B. S. (*Liverpool*); E. R. A. (*Devonport*); C. M. (*Norwich*); J. A. M. (*Rathfriland*); C. L. (*Cheio Magna*); H. L. (*Lancaster*); H. L. H. (*West Hampstead*); S. V. (*No Address*); J. J. (*Bromley*); F. P. (*Wellington*); E. C. S. (*Stoke Bishop*); L. G. (*Dorking*); F. S. L. (*Liverpool*); G. H. H. (*Leeds*); F. F. (*Erith*); L. F. (*Liverpool*); W. H. (*Londonderry*); W. T. (*Houghton-le-Spring*); C. G. M. (*Penistone*); A. M. B. (*Dublin*); REV. J. P. (*Durrus*).

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Cycle Fittings, mail-cart wheels and shafts, mitre-cutting machines and cramps.—WALKER BROS., Wellington Road, Leeds. [22 R

Fretwork Designs.—25 small, 4d.; six large Brackets, 1s. 1d.; six grand Photo Frames, 1s. 1d.; Catalogue of 300 Miniatures, 6d. Lists free.—TAYLOR'S Fretworkeries, Blackpool. [25 R

Moor's Blowpipe, as noticed in WORK, No. 155, 2s. 9d., post free.—MOOR, 23, Hill's Road, Cambridge. [27 R

Wanted.—Agents everywhere to solicit orders for Hendy's Patent Brush Handle. Write for particulars.—JOHN HENDY, 21, Brougham Street, Bolton. [1 S

Water Motors, from 5s. each; ½ h.-p., 20s.; list, one stamp.—WALTON, 9, Queen Anne St., Stoke-on-Trent. [4 S

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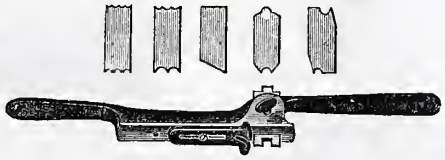

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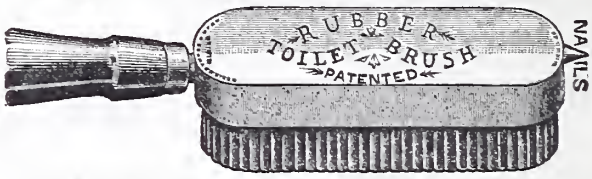

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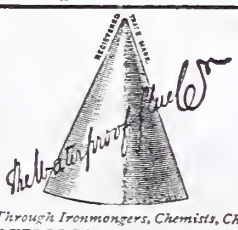

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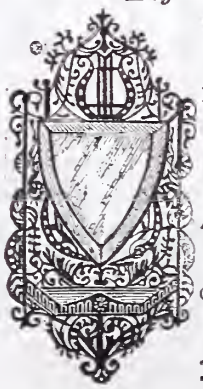

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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VOL. IV.—No. 160.] SATURDAY, APRIL 9, 1892. [PRICE ONE PENNY.

WORK WORLD.

THE police authorities in the North are taking to the cycle. The Chief Constable of Lanarkshire, we hear, is making inquiries with a view to mounting a portion of the county police on bicycles. It remains to be seen how far the plan will prove successful.

* *

The Volunteers have already a number of cycling corps in various parts of the Kingdom, and fresh corps are being formed—one of the latest being the Queen's Rifle Volunteer Brigade, Edinburgh, the cycling contingent of which is already fifty strong.

* *

As an "up-to-date" substitution for the decorative trades' gold leaf, the great dome of the Administration building at the Chicago Exhibition, and the four smaller domes, are to be covered with *aluminium bronze*, a newly discovered amalgam, which is said to glisten brighter than gold. The cost of the foregoing will be about £11,000.

* *

Just recently an Electrical Engineering Co. of Bradford received an order to instal 250 incandescent lamps in the Vatican Bazaar held in the Leeds Town Hall. The whole of the lamps were erected and burning by 12 o'clock next day! Smart work this; yet the cables were fitted in accordance with the fire insurance rules, and to the satisfaction of the Borough engineer.

* *

The bicycle is now being recognised in military circles as a means of rapid locomotion, although the Government is somewhat chary of supporting the movement to any considerable extent. Some of the military experts are, however, enthusiastic over the capabilities of the cycle as an instrument of great utility in the hands of scouts and messengers.

* *

A machine for sewing account books has at last been met by an invention which is being adopted as a labour-saving machine. The system of sewing is much superior to hand work, and books can be sewn tight or slack as desired. It is capable of producing all kinds of work, from small memo.'s to the ledger; from one to six needles can be used. It is easily learned, and gives no bad work.

A new water cycle has been lately constructed and experimented with. The cycle, which takes the form of a triple boat, is propelled by three riders, who set in motion a screw propeller similar to that of an ordinary screw steamer. It travelled at the rate of ten miles an hour on its trial trip, and is said to be capable of greater pace. The trial seems to have been satisfactory.

* *

It will be both an interesting and amusing item of reading for our operative paperhanging readers, that in the City of New York the custom largely prevails of trimming the wall-paper after it is pasted, length by length. The idea of this is, that the risk of getting paste on the front edges is materially lessened. What would be thought of a professional paperhanger on this side who could not paste his lengths clean?

* *

The Plumbers' Registration Bill, under consideration of Parliament, is, it appears, causing a considerable stir amongst the ironmongers of the country, and energetic measures are being adopted to ensure its rejection. The ironmongers contend that the passing of the Bill will create a monopoly injurious to them, master ironmongers being debarred from taking a registered plumber's certificate unless they can handle the tools. This is unfortunate for the plumbers—but what will householders say?

* *

The Manchester lath-renders recently held a meeting to consider the best course to take to prevent the extermination of their trade in this country, for extermination will evidently result if the imports of foreign laths increase at the same rate as they have done in past years. The foreign laths are Swedish, and are made by paupers. Thus the cost of production is small, and the laths are imported duty free as sawn timber, instead of fully manufactured articles, which they really are. It was decided to question candidates for Parliament on the subject.

* *

Bronze kid is still being very much worn for ladies' evening boots. It is as well, therefore, for those who make such, to know that the odd cuttings, such as the shanks and flanks of the skin, being loose, will, if stretched the reverse way of their line of tightness, throw the bronze up in small flakes upon the surface; this being placed across the two middle fingers makes a good rubber to brighten up the new shoes. The frictional heat given out in the brisk rubbing causes the bronze to leave the loose and adhere to the tight leather.

* *

The process of embossing ordinary wall-papers has this last few years been brought to a special degree of perfection. So admirably are the plain and cross threads and fibres of fabrics imitated, that the play of light, which heretofore has been the particular artistic quality of silk for wall-covering purposes, can be made to imitate the surface-sheen of this and almost any other fabric. That which is being done in ordinary papers is now carried to equal perfection with relief wall decorations. We have seen some inexpensive effects in this product that would require the skill of an expert to distinguish, without touching, from stamped leather, tapestry, and other fabrics. Japanese leathers continue to hold sway for artistic effect and brilliant display at a moderate outlay. The richness furnished by the cheap lacquered metal cannot be rivalled at the same cost by any home application of skill and labour.

* *

One of the most striking aspects of decorative trades' development is the tendency to separate the branches having a direct connection with applied art from those related to purely structural or sanitary science. Interior decorative painting, glass painting and staining, the re-modelling of apartments, and the upholstery branches, are getting gradually, but universally, absorbed into one business, under one controlling mind—the "interior architect," or "specialist in decorative interiors." Plumbing, gas and electric lighting, heating apparatus and ventilation, require to be directed by those possessing special scientific training as well as craftsmanship. It is readily granted that very few architects can possess the special knowledge which qualifies dealing with both the above-mentioned exhaustless divisions of modern work. Hence the growing division of responsibility, and the near prospect of three recognised classes of architects—the "structural," the "decorative," and the "scientific."

HAND-WORKING OF SPECULA FOR THE NEWTONIAN TELESCOPE.

BY EDWARD A. FRANCIS.

What the Newtonian Telescope is—Metal and Glass Specula—Reflecting and Refracting Telescopes.

I propose to set out plainly and briefly a few notes on the manual process of grinding, polishing, testing, and silvering, glass specula for the Newtonian telescope.

In the year 1674, Newton made the first reflecting telescope of the pattern which bears his name, having previously given up the attempt to make an achromatic refracting telescope.

The first Newtonian telescope was, I believe, barely six inches in focal length. The curious may verify my recollection, and at the same time see an engraving of the instrument in the "Transactions of the Royal Society." As likely to be of more practical use, I give instead, in Fig. 1, a sketch of a modern pattern Newtonian, simply mounted. In Fig. 2 the action of the instrument is shown. The large concave speculum, A, reflects the light rays back to a point B, where, if uninterrupted, they would form an image of a star, or of whatever other object might be under examination. But, if the observer looked down the tube to examine this image, his head would block away nearly all the incident light. To avoid this, the converging reflected rays are intercepted by the small flat mirror, C, and turned aside so as to form the image at D, where it may be comfortably examined by means of the magnifier, E, called the eye-piece.

At one time the mirrors A and B were made of speculum metal, an alloy which could be polished to an intense brilliancy. To successfully cast this alloy was, however, a very difficult task, and failure was frequent. Too much tin rendered it so brittle that a slight blow, or the expansion of a few drops of water in freezing, sufficed to shatter it; while, on the other hand, the addition of copper, while it toughened the metal, gave to it, at the same time, a yellow tint, and seriously affected the reflecting power. And even when the alloy was cast it was very difficult to grind and polish. Yet good telescopes were made, and the reflecting telescope reigned supreme until the secret of combining flint and crown glass lenses, so as to correct the chromatism which baffled Newton, was discovered. Then the reflector fell into comparative disuse, because of the difficulties connected with its manufacture. An achromatic combination of lenses, once completed and matched, never required retouching; whereas the metal specula often tarnished, and had to be repolished, and perhaps lost in the process the exquisite curve which made them valuable.

But, in 1856, the plan of forming specula of glass covered with a silver film was tried experimentally, and the experiment succeeded. The glass was ground and carefully polished to the necessary curve, and then a film of pure silver, not more than $\frac{1}{200000}$th part of an inch in thickness, was chemically deposited on the polished surface. When the silver tarnished, it needed but to remove it with acid, and replace it with a fresh deposit, the basis curve of glass remaining always perfect. And glass could be so much more easily and satisfactorily worked than any speculum metal, that the reflecting telescope at once took its place again as an instrument in common use.

I add one or two facts in anticipation of questions which are likely to be asked.

To grind and polish the lenses of an achromatic combination for a refracting telescope is a task much more difficult than the grinding and polishing of a glass speculum. In the case of the speculum, ordinary glass may be used, and one surface only has to be worked; whereas, in the achromatic combination (to quote the significant words of a practical optician), "the glass for each lens must be of perfectly uniform density and ascertained refractive index . . . . an elaborate process shows what curves are necessary, and then comes the grinding and polishing of at least four surfaces, and lastly, the edging and correct centring of the worked lenses."

The difference in the labour is shown in the price of the finished work of the best makers. A nine-inch silver on glass speculum by a workman of reputation may be had unmounted for less than twenty pounds; an achromatic combination of the same diameter, also unmounted, is catalogued at two hundred pounds.

Very little, if anything, is gained, so far as common astronomical work is concerned, by the use of the expensive lens. It is, of course, better for some purposes; but in planetary and lunar work, and for ordinary star-gazing, the advantage rests rather with the comparatively inexpensive speculum.

Fig. 1.

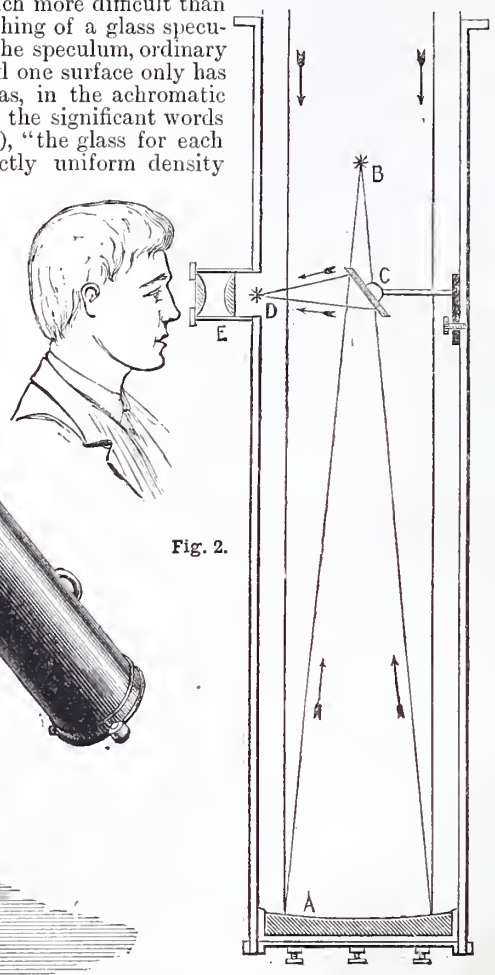


Fig. 2.

Fig. 1.—A Newtonian Telescope (by permission of Mr. G. Calver, F.R.A.S.). Fig. 2.—Section, showing the Action of the Mirrors.

MICROSCOPE EYE-PIECES.

BY O. BECKERLEGGE.

One of the best proofs of interest taken in any subject is when the said subject is made to pass under criticism. No one can complain when this is done in a generous, friendly spirit, made for the purpose of helping to a just conclusion. Indeed, this is the very soul of all advance in improvement: without it there must be stagnation and utter sterility of ideas. At the same time, the main purpose of the writer must be made the subject of criticism, and not what the critic would import into it.

These reflections were occasioned by some remarks made in a friendly way by a correspondent on the design I gave some time since for a microscope. Exception was taken to the fact that chief attention was given to the "brass," and but little said about the "glass." Well, that was the writer's intention. Our critic said that the brass-work to him was "mere child's play," and so he made light of it; but, as his knowledge was somewhat scant on optics, his requirement was information on eye-pieces, etc. Very good; but one wonders how many find the brass-work "child's play." From the writer's standpoint, the arrangement of lenses is mere "child's play," and has been for forty years; but it is only during the last few years that he has acquired anything like proficiency in mechanics. So, perhaps, both the writer and his critic have made the mistake that those subjects which are child's play to them must of necessity be the same to others. It is to correct such an error, if it be one, that he seeks to offer a few words on the construction of the eye-piece of a microscope; and, first of all, just a word about eye-pieces in general.

There is this difference between the eye-piece of a telescope and microscope: on a telescope a much higher power can be used than on a microscope. In the former, a long focus object-glass is used, consequently the image is not magnified to any great extent; the main magnification is made by the eye-piece. In the microscope the object-glass is of short focus, and consequently magnifies the object in proportion. For example, suppose normal sight is 10 in., then, if we use a lens which has a focal length of 5 in., the eye is brought twice as near to the object, and

consequently the object will appear twice as large. Or, if we use a lens $2\frac{1}{2}$ in., then the diameter will be magnified four times, and so on, up to $\frac{1}{2}$ an inch, or other high power. Of course, a high-power eye-piece could be used on any object-glass. But there is this drawback: in all object-glasses of high power, except those of the highest possible quality, there will be some little defect; and to use a high-power eye-piece would be to magnify the image of the object defects and all. Thus, from the construction of the instruments, a much higher power eye-piece can be used on the one than on the other.

Eye-pieces for the microscope are sometimes designated A, B, C, D, etc. They consist of two lenses: a large one nearest the object-glass, called the field lens, and a small one nearest the eye, called the eye lens.

A general rule for diameters is that the field lens should be twice that of the eye lens; thus, if the field lens is 1 in. in diameter, the eye lens should be about $\frac{1}{2}$ in. in diameter. The rule for focal length is that they should be as 2 to 1; thus, if the field lens is $1\frac{1}{2}$ in., then the eye lens must be $\frac{3}{4}$ in. These are placed with their plane side towards the eye, and one-half of their combined focal length apart; thus, $1\frac{1}{2}+\frac{3}{4}=2\frac{1}{4}\div2=1\frac{1}{8}$, so that they would be $1\frac{1}{8}$ in. apart. A stop must be placed between these at the focus of the eye lens, the opening the same as its diameter.

To determine the focal length of the eye-piece, proceed as follows: Multiply the focal length of the lenses *into each other*, and then by 2, and divide the product by the focal lengths when *added* together; thus, $1\frac{1}{2}\times\frac{1}{2}\times2=1\frac{1}{2}$: $1\frac{1}{2}+\frac{1}{2}=2$: $1\frac{1}{2}\div2=\frac{3}{4}$, so that the eye-piece constructed by these lenses would be $\frac{3}{4}$ in. focal length.

The following are given by a manufacturing optician:—

1. Eye lens, $1\frac{1}{2}$	Field lens, 3	Distance apart, $2\frac{1}{4}$.
2. " 1	" " 2	" " $1\frac{1}{8}$.
3. " $\frac{3}{4}$	" " $1\frac{1}{2}$	" " $1\frac{1}{8}$.
4. " $\frac{1}{2}$	" " 1	" " $\frac{3}{4}$.

In making eye-pieces for the telescope, the relative focal length of field lens to eye lens is 3 to 1. In mounting the lenses in their cells, the plan already given should be followed. With these principles, any clever worker in brass should find no difficulty in making any required eye-piece.

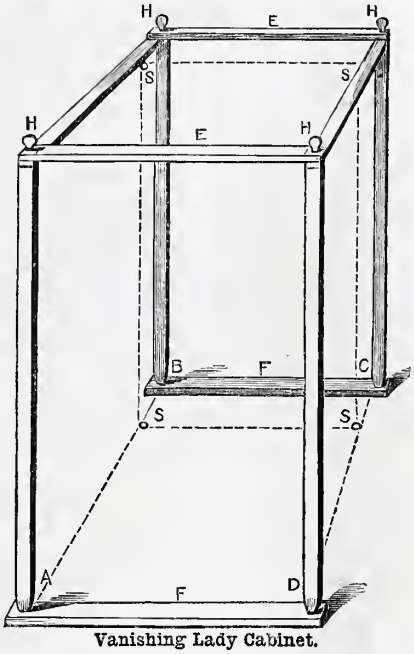
HOW TO MAKE A VANISHING LADY CABINET.

BY E. A. S.

From the above title the reader, no doubt, will imagine that a cumbrous and complex piece of mechanism is about to be described. This, however, as will soon be seen, is not the case, the apparatus being fairly portable and of exceedingly simple construction—so simple, indeed, that one might well wonder whether any audience would be taken in by it at all. That it is so deceived is the personal experience of the writer.

Briefly, the course of the trick is as follows: The curtain having been rung up—or, what is the same thing, the drawing-room folding doors swung open—an oblong cabinet is disclosed, covered inside with black cloth, and furnished with sliding curtains in front. A committee from the audience are then invited to make a thorough examination of the concern, particular attention being drawn by the exhibitor to the fact that there is no mode of exit except through the front. When the committee have satisfied themselves on this point, and have returned to their seats, the young lady is introduced, and a chair placed in the cabinet. She enters it, and sits down. The curtains are now drawn, the exhibitor remarking "that the fair medium is being rapidly precipitated through space." The audience look unbelieving, as well they may; but, the curtains having been thrown back, their incredulity soon merges into surprise, for certainly the young lady has gone, leaving the empty chair behind her. Nor is this all: for by a reversal of the process she reappears as mysteriously as she vanishes.

The accompanying illustration well represents the cabinet devoid of fittings. A, B, C, D are four uprights carrying the rectangular framework, E E, their lower ends being rounded off for insertion in the blocks, F, F, which are bored to receive them; their upper ends are also drilled for the reception of the large screws, H, H, H, H, which pass



Vanishing Lady Cabinet.

through, clamping the framework together, and fixing it to the uprights. Metal washers are interposed between the heads of the screws and the wood. Cross-pieces from A to B and D to C ensure further rigidity, but are not absolutely essential. A curtain rod and brackets complete the skeleton of the cabinet, which is now ready for draping. The best dimensions to vanish a full-grown person are: 6 ft. high, 4 ft. deep, and 3 ft. 6 in. broad; for a child it may be made proportionately smaller, but it must always be fairly deep.

Three pieces of black cloth are now required (any cheap material will do, provided it be not shiny): one, 15 ft. 6 in. by 4 ft.; two, 6 ft. by 3 ft. 6 in. The larger is tacked on inside the framework, and forms the sides and top, one of the smaller lengths being similarly fastened to the back. Small drawing-pins, with their heads painted black, are preferable to tacks, which are difficult to remove without injury to the fabric. Four little black eyes, s, s, s, s, are next attached in the position shown, 9 in. or 10 in. from the back, and a corresponding hook sewn on to each corner of the remaining piece of cloth. Sliding curtains in front and a dark rug for the floor finish the apparatus.

The working of the trick by this time will be pretty obvious. The young lady, having the material concealed about her person, steps into the cabinet, the curtains being closed after her. She then rises from her chair, quickly secures the cloth to the structure by means of the hooks and eyes, and takes up her stand behind it. The cabinet may now be opened, the audience looking in vain for the medium, who is safely ensconced between the false and real back, the increased shallowness being imperceptible to the keenest eye, especially if the sliding curtains are extended so as to hide the exterior sides. Her reappearance is, of course, an equally easy matter. It is a good plan to place two unshaded lamps to the right and left of the cabinet: these dazzle the eyes of the spectators, at the same time giving plenty of light; but care must be taken to allow no direct rays to fall on the back.

The performer can, if he likes, allow one of the audience to mount guard behind the cabinet during the performance. This, however, is open to two objections: in the first place, the spectator—or, rather, non-spectator—may want to see some of the fun himself and come round to the front, when at such close quarters the secret might reveal itself; in the second place, there is a possibility that, owing to natural curiosity or mistaken zeal, he may begin sounding the back of the cabinet with his fists, which at a critical moment would be decidedly awkward for the exhibitor, not to mention the medium.

THE ART OF STAIRCASING.

BY GEORGE F. CHILD.

Introduction—Models of Staircases—Storey Rod—Height, Going, and Width—Rough Sketch—Depth of Joist, Position of Windows, etc.—Setting out from Rod—Number of Treads and Risers—Proportion of Treads and Risers—Ordinary Sizes of Steps for different Classes of Buildings—Setting out Number of Treads and Risers—Data for Scale Drawings—Description of Drawing—Length of Strings—Pitch-board—"Wedge" Strips—Working the Strings—Use of "Router"—Nosing Plane—Enlarged Drawings—Forms of Rails—Putting Stairs Together.

Introduction.—In writing the following course of articles upon the art of staircasing, I had in view the great number of young men in the trade who, though good joiners perhaps (having had no opportunity), were not "in it" at making a flight of stairs. My endeavour, therefore, has been to supply this knowledge in as clear and simple a manner as possible, by giving full instructions, with the aid of suitable drawings, of all important and necessary parts.

Though this series has been written for persons engaged in the building trade, there is no possible reason why others should not profit by them. Indeed, I hope they may, for I feel sure that anyone desirous of taking up this interesting branch of the trade may, by close attention to the following course, meet with success; for, to my own knowledge (this, by way of encouragement), one of the best staircase hands in my district was for many years engaged as a coachman, not even knowing the use of the tools till he had grown up. After this, who will despair? For always remember "what man has done, man can do."

I would urge upon all interested in this work the necessity of thoroughly making

themselves master of the elementary drawings, etc., as shown and described on page 53. There being, as we all know, no "royal road to knowledge," we must make up our minds for a certain amount of drudgery before becoming proficient in anything; therefore, as this page contains the elements of staircasing, we shall do well to master it. After this, each succeeding example will become easy, as the student will be led from point to point in a simple and sure manner, thus interesting and exercising the mind.

Models.—To give greater confidence, I would recommend the student to make a model to scale—say, $1\frac{1}{2}$ in. to the foot—or, if only a part is taken (one of the string-boards, for instance), set out the treads and risers, cutting the string at top and bottom for the floor and landing, when it will be seen at once if the calculations have been correct. Having said this much by way of preface, we will proceed to business by examining the figures on page 53.

Storey Rod.—The first thing necessary is a rod of a convenient size—say, 12 ft. long and about $1\frac{1}{2}$ in. square—for the purpose of taking dimensions of the proposed stairs from the building. We will suppose the landings and floors are "laid"; therefore apply the rod in an upright position from the ground floor to the trimmer joist above, drawing a line upon it level with the landing, as shown at H H on storey rod (S R, Fig. 1). Next apply the rod in a horizontal position from a "plumb" line, H H, as at G G, marking upon it "Going." Now take the width between the walls, W, W, as seen in plan, Fig. 2.

Rough Sketch.—We next make a rough sketch of the part of the building in which our stairs will be fixed.

Depth of Joist.—This being a very important point, as will be seen when we examine the following drawings, care should be taken in this respect by marking upon the sketch—Trimmer (T) 7 in. × 3 in., as at Fig. 1.

Position of Windows, etc.—It is very necessary that all openings for windows, doors, etc., should be known in setting out our stairs; therefore, mark upon the sketch their respective positions, with sizes figured in, as door 7 ft. × 3 ft., etc.

Setting out from the Rod.—We now, by measuring our rod, find that the height, H H, is 7 ft.; going, G G, 7 ft. 4 in.; and width, S S (Fig. 2), 2 ft. 6 in.

Number of Treads and Risers.—All will know that some stairs are easy of ascent, and others quite the reverse. Now the object of the staircase hand being to make his stairs as "easy" as possible, he must keep in mind a certain proportion (given below) in obtaining the number of treads and risers, and work as close to it as circumstances will allow.

Proportion of Treads and Risers.—To ensure "easy" stairs, the proportion of 10 in. for steps and 6 in. for risers should be as nearly worked in as possible, these being the standard sizes.

Ordinary Sizes of Steps for different Classes of Buildings.—Different classes of buildings, of course, require different classes of work; therefore, stairs of this description being only used in small houses, or as back stairs for larger ones, smaller sizes may be taken for the steps, etc.

Setting out Number of Treads and Risers.—Now, as 8 in. for treads and 7 in. for risers is a very good working proportion, we will see how it will work in. As the height, H, is 7 ft., we divide this by 7, which will just come out 12 inches, making 12 risers, there being in *all staircases* one *more* riser than tread (as the landing counts for one). We have now to divide the going, G G, into eleven parts thus: 7 ft. 4 in. divided by 11 will, of course, be 8 in. for the treads. As economy of stuff is a very important factor in all builders' yards, it will be always well to consider in arranging the stairs how the standard sizes of board, etc., can best be worked in; as often, by placing the riser behind or on top of the tread, stuff may be used in without waste. The stock sizes for boards are usually respectively, 7, 8, 9, 10, and 11 in.; therefore, in the case before us, 7 in. for the risers and 9 in. for the treads will do nicely, as this allows the riser to be nailed to back of step, and gives on the step seven-eighths of an inch for nosing.

Data for Scale Drawing.—Having this data to work upon, the next proceeding will be to construct a scale drawing to Fig. 1, sectional elevation, and Fig. 2, plan.

Description of Drawing.—The working drawing should, in *all cases*, be to as large a scale as possible—say, $1\frac{1}{2}$ in. to a foot—as by this means any mistake will be exaggerated. First draw (taking particulars from sketch) the plan, Fig. 2, and divide the space between landing, L, and passage, P, into eleven equal spaces, and mark them from 1 to 12 (L) as in shown, and draw all string-boards, etc., as in drawing.

Next draw the sectional elevation, Fig 1, and from the floor line F L, at the height of 7 ft. (by scale), draw the landing L, trimmer T, and architraves A. Now mark off the going, G G; next divide the height, H H, into twelve equal parts; then, by drawing lines from these marks horizontally to intersect with lines projected from the corresponding lines in plan below, we obtain the top and front edges of treads and risers.

All we have now to do is to draw the string-board, S B. This is done by marking a parallel distance of about 2 in. from the top edges of steps, and a corresponding line under them at a distance equal to the width of string, in this case 9 in. The thickness of steps, etc., may, with advantage, be left out in a working drawing, they only being drawn for the sake of description.

As it is very important that the treads and risers all be of one length, mark on a short rod the width of stairs, with thickness of strings on each end. Now, as the steps are "housed" three-eighths of an inch into the strings, mark that distance *within* the thickness, which gives the length required. Now mark this on two treads; place one on the bench with all the others on top, and the other marked one on top of all. Place the two that are marked as nearly opposite as possible, and draw a line down the edges of all from point to point, square each across, and cut off.

Length of Strings.—To obtain the length of board required for strings, take the distance between *a* and *d* (Fig. 1).

Pitch-board.—For this we require a piece of pine—mahogany would be better—about 12 in. square by $\frac{1}{2}$ in. thick, with one angle planed *perfectly square.*

Setting out Pitch-board.—Now space off on rod with compasses the number of risers (12), and mark the distance *a b* on pitch-board, P B (Fig. 5), writing upon the board "Riser." Do exactly the same with going, and mark it at *a c*; draw a line between these points, which represents the pitch or angle of stairs. At a distance of 2 in. from this line cut off the board, and screw on a strip, as seen in section S. This answers the purpose of guide to run along edge of string.

Application of Pitch-board.—To apply the pitch-board, draw a line the whole length of string two inches from edge, as *a b* (Fig. 3); this figure shows the board fully set out. Now lay the pitch-board flat upon it, with guide pressed close to the edge; then, with a striking-knife run round the board from *a* to *b* and *c* (Fig. 4), being sure not to pass beyond the 2 in. line. Now slide the pitch-board up the string, making *a* coincide with point *c*, and continue this till the proper number of steps are drawn.

Wedge Strips.—Now obtain a thin strip of wood, and if the steps are one inch in thickness, mark on one end $1\frac{1}{8}$ in. and on the other $1\frac{1}{4}$ in. This is for marking the space of wedging, and is applied as at *d e* (Fig. 4), one edge being placed against line made by knife, and a pencil drawn along the other.

Working the Strings.—At a distance of three-eighths of an inch from back edge of string gauge a line on the thickness; this is depth of "housing." Next, with a brace and centre-bit bore in a series of holes, as at *f* (Fig. 4), and clear out the space with a chisel, as at *g*. Next proceed with a tenon saw to cut in every line, as from *g* to *h*, and roughly clear out the space with a chisel.

Use of Router.—The router (Fig. 7) is a tool that can be made by anyone, and is made in various shapes. It should be about 6 in. long and 4 in. thick, with space cut out for plough iron and wedge, similar to a bead plane. We now insert a plough iron, projecting three-eighths of an inch at bottom, and work the tool along all the spaces to bring them to a uniform depth.

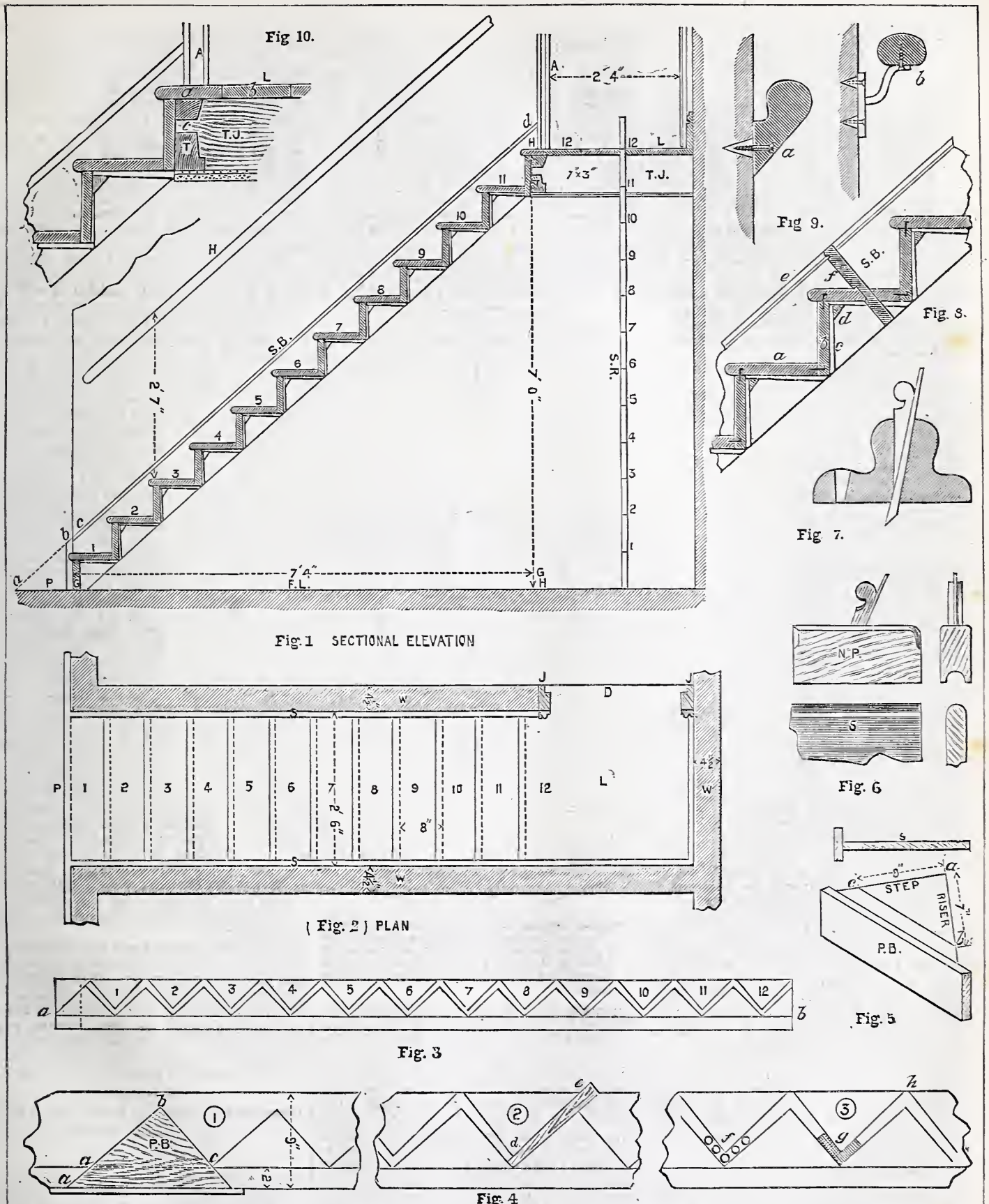
Nosing Plane.—This plane (Fig. 6) is used to work edges of treads or nosings.

Enlarged Drawings.—Fig. 8 is an enlargement of portion of string showing at *a*, tread; *b*, riser; *c*, wedge; *d*, block; *e*, bead; *f*, section of string-board, S B. Fig. 10 is also an enlargement of string at landing, L. A is the architrave; *a*, the nosing which is *always* left off, and fixed after the stairs are in position; *b*, floor boards; T J, trimmer joist, with *tusk tenon* cut on the end, to insert in trimmer T, as seen at *c*. This tenon should be one-sixth the depth of joist, its *bottom* edge being in the centre of joist, the necessary bearing power being obtained by letting in a piece below the tenon for a bearing, and at the top by cutting it as shown.

Forms of Rails.—At *a*, Fig. 9, is seen a form of rail that is often used where it is necessary to fix it to the wall. This is done by screwing it to plugs driven into the joints. *b* is another section; this is fixed on iron brackets, which are also fixed to wall.

Putting Stairs Together.—Place one string on the bench (under a beam in roof if possible), and place treads and risers in their places. Now put on the other string, and lay a piece of stout quartering on it; drive a few stout strips tightly between beam and quartering, and be sure the front edge of steps are in a line, and do not "wind"; now glue and drive in the wedges, nail the steps together at back and front, take off quartering and nail through the strings into steps, glue in three blocks at back as seen at *d* (Fig. 8), and the job is complete.

In my next paper the worker will be taken on to such important matters as newels, landings, balusters, mouldings, etc.



Staircasing. Fig. 1.—Sectional Elevation—S B, String-board; L, Landing; T, Trimmer; T J, Trimmer Joist; F L, Floor Line; S R, Storey Rod; H, Handrail; G G, Going; H H, Height; A, Architrave; P, Passage. Fig. 2.—Plan—L, Landing; D, Door; J, J, Jambs; W, Walls; S, S, Strings. Fig. 3.—String-board set out for working—*a* to *b*, Line of Nosings. Fig. 4.—Enlargement of String, showing at (1) the Pitch-board, P B, applied to String; *a b* being the Tread, *a b c* the Riser; (2) is the application of Wedge Strip, *d e*; (3) *f* shows Holes bored by Centre-bit, and *g*, space cleared out for Saw. Fig. 5.—Pitch-board, P B—S, Section of same; *a b*, Riser; *a c*, Step. Fig. 6.—Nosing Plane, N P, and part of Step, S. Fig. 7.—Router. Fig. 8.—Enlargement of String-board, S B—*a*, Tread; *b*, Riser; *c*, Wedge; *d*, Block; *e*, Bead; *f*, Section. Fig. 9.—Alternative Sections of Rails *a* and *b*. Fig. 10.—Enlargement of Trimmer, T, etc.—T J, Trimmer Joist; L, Landing; A, Architrave; *a*, Nosing; *b*, Floor-board; *c*, Tusk Tenon.

EQUALISING DEVICE FOR ELLIPTIC CHUCK WORK.

BY NORMAN MACLEAN.

Holtzapffel's Device—Origin of New Device—Adapted to Rose-Engine Work—Adapting to Ordinary Turning Lathe—Approximate Size of Proposed Elliptic Work—Division Plates—How to Make the Elliptic Division Plate—Fixing—The Guide Line for Drilling Holes—Use of "Arrows"—To get the Division Plate into Position—Concluding Remarks.

Holtzapffel's Device.—Holtzapffel lays down in his text-book an elaborate device for the equalisation of ornamental work on the elliptic chuck, which, no doubt, will be familiar to most professional and amateur turners, and being, like all his productions, most expensive, places it beyond the reach of all except those favoured with a large income.

Origin of New Device—Rose-Engine Work—Adapting to Ordinary Turning Lathe.—Some years ago I was impelled by a commercial necessity to devise a simple dividing apparatus in connection with rose-engine work, which, however, I shall not now describe, as so few of our readers are interested in rose-engine turning, but rather shall show how such a dividing plate may be made for an ordinary turning lathe. My idea is to give such particulars in a clear manner, so that any ordinary workman (and I know some exquisite workmen among those classed as amateurs) may adapt the device to his own lathe at a very small cost, assuming that the workman has already a division plate, a drilling spindle and overhead motion, and an elliptic chuck.

Approximate Size of Elliptic Work.—In the first place it will be necessary to make a rough calculation of the approximate size of the elliptic work intended to be turned, as the size of the work which is to be done will be a guide for the number of holes to be drilled in the new division plate; thus, for an article 6 in. by 4 in., I have found that seventy-two holes have answered very well, making the pattern fit exactly by means of the eccentric cutting frame.

Division Plates.—As the details of division plates of lathes vary very much, I shall leave the workman to his own judgment; the main thing being so to fit the elliptic division plate over the permanent division plate that it can easily be removed when not required.

How to make the Elliptic Division Plate—Fixing.—Procure a sheet of brass or gun-metal of the required size to suit the permanent division plate, and about ¼ in. in thickness; turn up back, front, and edges, and fit and secure by means of six screws (see diagram) on the afore-mentioned plate, taking care to drill the holes for the screws in such a manner as not to obliterate the holes in the plate.

The Guide Line for Drilling Holes.—This being done to the satisfaction of the workman, remove the disc, after numbering the screws so that the same screws shall be returned to their proper places when re-mounted, and re-chuck, getting the disc perfectly true on face and edge on the circular motion; and then cut a deep narrow line on the part it is proposed to drill the circle of holes. Now remove the chuck on which the disc is mounted, and fix the elliptic chuck in position, and screw the chuck home, and see that the disc runs truly by means of the narrow deep line already cut.

Drilling the Holes.—Now set the slide-rest parallel with the disc, and mount the drilling spindle, using the seventy-two row of divisions on the dividing plate, and throw out the elliptic chuck ⅞ in., making a commencement from the vertical position. Everything now being ready for a start, we will first make sure the slide-rest is in the centre, and see that the drill is quite sharp, and of the proper shape to drill a hole to correspond with the point of the index spring. These points being found satisfactory, get the drill point exactly on the line, and, gradually increasing the depth, drill the first hole until the proper depth is acquired; then tighten up all the "stops" so that the depth of holes may be maintained throughout. Now comes a bit of very delicate work, viz., *to keep the drill holes exactly on the line all round the circle;* as, of course, as the chuck describes the ellipse, the point of the drill will be to the right or the left of the circle according to the position of the elliptic chuck on the lathe. This, although difficult, need not discourage the workman, as, if time is no object, there is no occasion to hurry over the job; but I must confess that a large stock of patience is necessary.

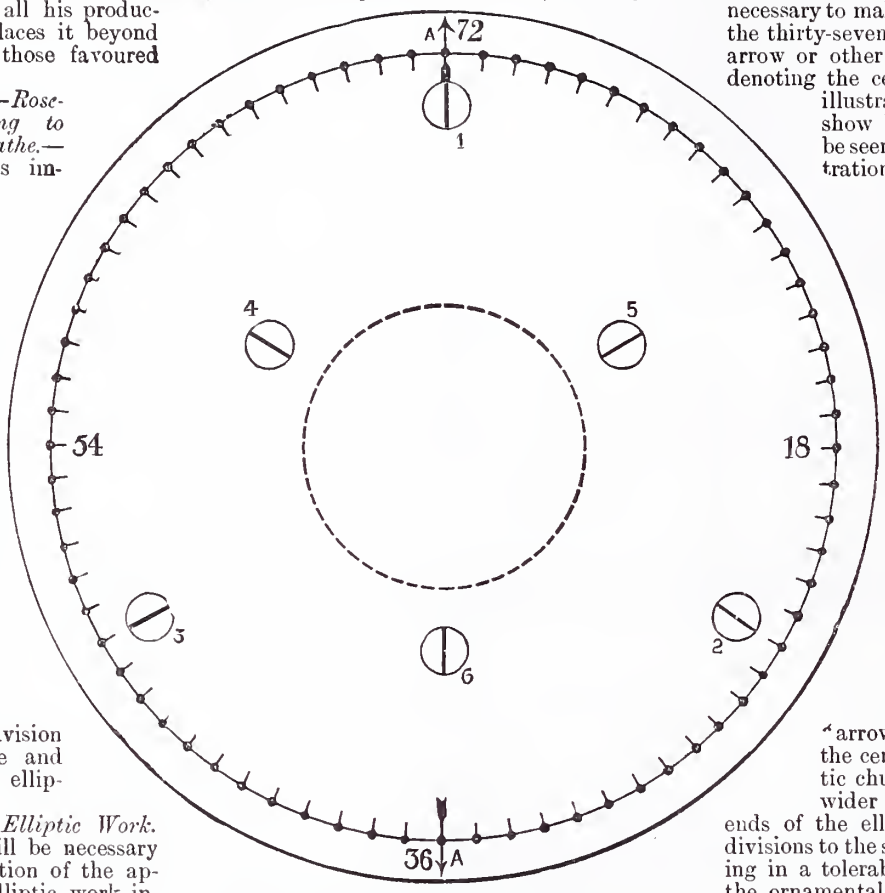


Diagram showing the Dividing Plate for Elliptic Work in Position—A, A, Arrows denoting the Upright, the Elliptic Chuck to be in a direct line with the Arrows; 1, 2, 3, 4, 5, and 6, Screws to hold the Plate to the permanent Dividing Plate.

A Simple Way.—The simplest way I can suggest for getting the drill holes truly on the line is, after drilling the first hole, to unship the overhead band, having convenient a leaden weight, with a wire hook attached, to keep the band taut while it is disengaged from the drill spindle; and, while the drill is stationary, shift the point of the drill by means of the winch handle of the slide-rest until it will lie exactly in the circular cut; re-ship the band and drill the hole, continuing the movements until the whole series of holes are drilled.

The Use of the Engraved Arrows.—Noting that the first hole is drilled while the elliptic chuck is in the vertical position, it will be necessary to make a mark at the first and the thirty-seventh hole, in order that an arrow or other mark may be engraved denoting the centre (as shown in the illustration), for reasons I will show by-and-by. It will also be seen, on reference to the illustration, that the circle of holes is composed of increased and diminished intervals, and that the "arrows" are engraved opposite the widest intervals, and the special use of the "arrows" is to denote the proper position of the elliptic dividing plate on the lathe when used for elliptic work.

To get the Division Plate into Position.—To get the dividing plate into position, first move the elliptic chuck into the vertical position, and then, by means of the worm wheel and tangent screw on the *mandrel*, move round the elliptic division plate until the "arrow" is in a direct line with the centre of the vertical elliptic chuck; this will bring the wider divisions to the small ends of the ellipse, and the narrower divisions to the sides of the ellipse, resulting in a tolerably equal distribution of the ornamental work during the course of the ellipse.

Concluding Remarks.—It will be necessary to bear in mind that, whatever distance the elliptic chuck was thrown out of centre for the purpose of drilling the disc for elliptic work, the same degree of eccentricity must be rigidly adhered to when turning any elliptic article. See, too, that the "arrow" is in line with the centre of the elliptic chuck when in an upright position on the lathe.

INDUCTION COILS: HOW TO MAKE AND WORK THEM.

BY G. E. BONNEY.

Inductive Theories Illustrated by Experiments — How the Inductive Effects of Electric Currents in a Primary Coil are Demonstrated—Magnetic Effects of Induction—Calorific Effects of Induction — Physiological Effects of Induction.

Inductive Theories.—As Work is essentially a practical journal, I pass over the theoretical part of my subject with just a glance at the two terms, "practice" and "theory."

Some persons have an idea that they are terms more or less antagonistic. This is not so. Every man has a theory of his own respecting the way his work should be performed. His theory may be founded on his own experience, or that of other workmen, or it may be framed on his knowledge of natural laws, but it is none the less theory. The theories I shall put forward are those that have been proved by practice, and I hope to show how they may be proved by means of experiments.

How Inductive Effects are shown.—The inductive effects of an electric current are shown in three different ways, and by three different sets of experiments. The first effect may be named magnetic, the second calorific, the third physiological. I am using these three terms more because of a want of better terms, than of their fitness to give an idea of the inductive effects observed. The first shows the relation of electricity to magnetism, the second shows its relation to heat, and the third shows its effects on animal tissues. The first converts soft iron into a magnet, the second is shown by sparks from the conducting wires, and the third by shocks to the nerves of animals.

Magnetic Effects of Induction.—Take a rod of pure soft iron 3 in. in length by ¼ in. in diameter, or a small bundle of straight iron wires of the same length and diameter. Also get some small iron brads or fragments of iron wire, and place these on a smooth sheet of paper. Hold the iron rod to these, or stir them about with the rod, and note that the rod does not affect them in any way, nor do they affect the iron rod. They do not move when the rod is held close to them, nor do they stick to the rod when they are stirred by it. If we bring a toy horseshoe magnet near them they move toward it, and stick to it if brought close enough to them. Now get a few yards of No. 20 silk-covered or cotton-covered copper wire, and envelop the iron rod or the bundle of iron wire with regular folds of the copper wire, laid on side by side so as to form a close spiral from end to end. Connect the two ends of the covered wire to the terminals of a battery, so as to send the battery current through the small coil of wire. Whilst thus connected, bring one of the ends of the iron rod near the bits of iron on the smooth sheet of paper. The bits of iron will be attracted to the rod of iron as to a permanent magnet, thus showing that a current of electricity passing through a coil of wire has an inductive effect on the soft iron within that coil, and this effect is magnetic. When the iron rod has picked up as many of the bits of iron as it will hold, disconnect the end of the covered wire from the battery, whilst holding the iron over the paper. Immediately, on thus disconnecting the wire, the bits of iron will fall off from the end of the iron rod, and thus prove that the inductive effects of the electric current do not remain in *soft*, pure iron, but are only observed whilst current is passing. This property of soft iron is made use of in the construction of induction coils, the cores being made of *soft* iron because this becomes magnetised when a current is circulating around it, but does not remain magnetised when the current is interrupted. As the other inductive effects depend very much on the perfection of the arrangements for interrupting the flow of the current, the use of soft iron is imperative.

Magnetic Effects on Hard Iron.—Take a similar rod of iron and hammer it well on an anvil, or heat it to a red heat and plunge it suddenly in cold water to cool it. This will harden the iron. Wind this with the covered wire as before, and repeat the first experiment with this hard iron, then note the difference in the magnetic effects observed. The hard iron will pick up the iron brads as did the magnet of soft iron, but will not so readily part with them when the current is interrupted. This shows that hard iron must not be used in the cores of induction coils, nor in the cores of electro-magnets.

Magnetic Effects on Steel.—Take a rod of steel of similar size, and make it as hard as it can be by heating it to a bright red and plunging at once into cold water. Wind this with covered wire as before mentioned, and repeat the former experiments, again noting the observed effects. The steel rod will not at first attract the iron brads. When a current is sent through the wire, the rod will pick up the brads, but it will not readily drop them when the current is interrupted. After repeated interruptions of the current, it will not drop the brads at all, because it has become a permanent magnet—that is, it has retained the charges of magnetism induced by the electric current passing through a coil of wire wound over its surface. It is, therefore, altogether unsuitable for use in induction coils.

Experiments with Uncovered Wire.—The student may, if he chooses, repeat these experiments with uncovered copper wire, and thus convince himself that covered wire must be used in making induction coils. He may then coat the core with two or three layers of paper, and wind the uncovered wire over the paper on the core, taking care to keep each coil from actually touching its neighbour. The magnetic inductive effects will be absent from the first, but be observed in the second, although not so pronounced or perfect as when a properly insulated wire was employed.

Calorific Effects of Induction.—Take a straight piece of No. 20 covered copper wire, long enough to form a coil to go around a rod of iron 3 in. in length and ½ in. in diameter: this will take about 5 ft. of wire. Connect one end of this wire to one of the terminals of a three- or four-celled battery, arranged in series, and scrape the opposite terminal with the other end of the wire. A small, bright spark will be seen at the instant of scraping the terminal with the end of the wire. Place a steel file on the terminal, and scrape this with the end of the wire. The spark may then be more distinctly seen. Now bend the covered wire into a zig-zag shape, with folds 3 in. in length, and again touch the file. The sparks will be brighter and thicker. Now wind the wire over the iron rod, but withdraw the rod, and leave the wire as a long spiral. Again touch the file, and note the sparks. The coils of wire have an inductive effect on each other, and this will be noticed by increase in the length and volume of the spark. Now place the iron core in the coil, and again note the spark. It will be increased by the inductive effect of each coil, and the induced magnetism of the iron core. The spark thus observed is caused by a momentary heating of the wire end at the instant when contact is made with the file included in the circuit, and also at the instant when contact is broken. This is due to an insufficient conductor to convey the current, and the spark is caused by burnt wire fragments. If we employ copper or brass instead of an old steel file, the spark will be faint and of the greenish colour characteristic of burning copper. From carbon the spark will be bluish white; from steel and iron it shows all the characteristics of burning iron. Small particles of the points of contact are, therefore, burnt away every time contact is made or broken with the ends of conductors of an electric circuit. If these points are made of an easily oxidisable metal of inferior conductivity, as iron, steel, copper, brass, etc., they soon burn away, and are rendered useless. As the inductive effects desired in induction coils depends so much on the perfection of apparatus for interrupting the current in the primary coil—that is, making and breaking contact between two points in the main circuit—it follows that we cannot employ a metal at this part which might be readily burnt away. We must, therefore, employ a speck of platinum on the point of contact in the breaking apparatus—usually termed the "break" of the coil—because platinum is not so easily oxidised as other metals.

Physiological Effects of Induction.—Whilst conducting the experiments mentioned in the previous paragraph, twist the end of the contact wire once or twice around the forefinger, so as to bring the point of the wire under the first joint, where it can be held with the tip of the thumb, moisten the tip of the forefinger with the dilute battery acid, and touch the file with this at the instant when contact is made with the wire beneath the finger. A tingling sensation in the finger-tips will be felt at the instant of making and breaking contact, if the battery is strong enough to overcome the resistance of the fingers. The sensation will be most pronounced when the experiment is performed with the coil wound on the iron core, and will be intensified by an increase in the number of turns of wire wound on the core. It will also be more intense whilst rubbing the wire end along the teeth of the file, thus causing rapid interruptions of the current.

Take two convenient lengths of copper wire of any gauge, and connect them to the terminals of the battery, one at each end. Clean the free ends of these wires, and bring them into contact across the tip of the tongue. A tingling sensation will be felt in the tip of that member, accompanied by a distinctly acid flavour. Leave on one of the wires, but replace the other with the coil of wire used in the previous experiment. Cross the ends of these two wires on the tongue, and note the increased sensations due to the inductive effect of one turn of wire on another. Repeat this with the iron core in the coil of wire, and note the results. A person's tongue may be in this way educated to take the part of a detective galvanometer, the intensity of the sensations acting as a guide to the intensity of the current. I should not advise the use of this human galvanometer in strong electric currents.

Attach two small wires to the contact points of the circuit—that is, to the end of the wire coil and to the wire from the battery terminal. Cross the ends of these wires on the tongue, and get a friend to make and break contact with the points. The inductive effects of the current can be thus observed.

All these experiments go to prove that the primary circuit of a coil produces inductive effects, since the coils just noted are in the primary, or first circuit, with the generator of electricity. These inductive effects will be remembered when we are constructing the coils described in succeeding papers. In these we shall deal with the secondary effects of induction—that is, the inductive effects produced in a wire separate from the prime conductor, but running side by side with it, separated only from it by an insulator of electricity.

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HOBBYISTS' EMPORIUMS.—In this superabundant age any suggestion of a want not already more than provided for is apt to be treated as a discovery of the "mare's nest" order, so consistently do the laws of domestic supply and demand work. Judging from not a little correspondence which has reached us, there appears to be a real want in the shape of a ready channel through which the hobbyist—*i.e.*, such professional and amateur workers as those who support this journal—could find a sale, at first hand, for the work which exercises the hand and brain during leisure hours—which evening hours every working man has a legitimate right to turn to his own advantage, provided he does so honestly. By devoting his spare time each week to some constructive work, either in connection with his own occupation or some other pursuit for which he may have a fancy, many a man could appreciably add to his ordinary earnings were he in touch with a market to which he might send his labour with some fair prospect of its finding a buying public at the maker's price. There would be no middleman to weight, say, a bent iron candelabra or a carved sideboard, with the profit which he necessarily derives partly from the underpaid maker and the overcharged purchaser, because manufacturer and purchaser would be brought into first contact. This first hand market between the ingenious workers of novelties which go to adorn a home, and those who have to buy such for the purpose of domestic need and ornament, would be a boon which does not appear yet to be provided for on a business scale. Of course, the charitable bazaar schemes are rampant enough, but bazaar prices and figures belong to a region which practical people are obliged to decline to enter. From communications which have been made to our "Shop" pages, it would seem that a good opening exists for something in the way of dépôts at which professed hobby work could find a first hand sale, whether to the public itself or to the tradesman to sell again would be of no moment to the manufacturer. How this outlet can be brought about, and whether a banding together of the various sections of our readers would lead to some practical results, must depend upon themselves. We have already been instrumental in bringing several correspondents into contact with anxious buyers of fretwork and other novelties, from which it would seem that there are tradesmen willing enough to negotiate for work which WORK subscribers turn out, the chief difficulty being that of want of touch—the one class with the other. Having broached the matter in this way, doubtless many of our readers will favour us with their views, and we shall be pleased to give expression to any useful suggestions. Pending further reference to the subject, however, should any hobbyists be anxious to find a market for their craftwork, twenty words can be had in our "Sale and Exchange" column for 1s., and this is not a ruinous expenditure to make upon an article which, if it changes hands, may be as welcome a transaction for the buyer as for the seller.

PAINTING.—The question of technical education for painters, and that of establishing some satisfactory limit to the number of lads or apprentices employed by each master, are both coming largely to the front this year amongst the various masters' and operatives' trade associations. In the North of England and Scotch centres, the interest in these and other kindred trade problems is very keen. It is a singular and regrettable fact that, whereas in a dozen important towns we may find technical plumbing classes established under the Technical Education Act, in very rare cases can we meet with this encouragement in connection with painting and decorating. This is a matter the Amalgamated Society of Painters could well furnish an instructive report upon, and they should speak up.

LABOUR.—The miners' strike, though productive of inconvenience to general industry, will not have been in vain if it reads a lesson on economics to the world at large. We are all of us held more or less in the leading strings of an effete political economy. Only within certain limits does the supposed law of supply and demand operate. The panic of the public, and the opportunity and greed of the middleman, have lately sent coals up from 6s. to 8s. per ton. Yet the proposed reduction of wages which the miners have fought against would have been covered by 3d. per ton! The cost of miners' labour is an almost infinitesimal fraction in the price of London coal. The miners have opposed a silent but dogged protest against the commercial system, in which they are made the pawns in the great game played by the speculators. The example is sure to become contagious. The complete federation of labour is a dream whose realisation may not be so far distant. Such federation must lead eventually to strikes of immense magnitude, or to co-operative undertakings for production, or to a union of employers and employed in industrial partnerships on equal terms. In our opinion, the establishment and development of profit-sharing enterprises will conduce more than any other measure to the promotion of industrial peace. Many firms have already adopted this system with their workmen, and where it has been tried it has been productive of improved relations between employer and employed. With some houses a liberal benevolent fund scheme is more feasible, and it answers all the purpose.

A TASTEFUL OVERMANTEL.

BY FLORENCE CADDY.

HERE is an original way of grouping miniatures and very small water-colours into the work of an overmantel, which, while it is inexpensive, is very tasteful.

I suppose every household possesses a few small treasured drawings, perhaps too small to be framed and hung up separately, perhaps even thought not worth framing, but still "family treasures," that teem with memories, that we like to drag from their hiding-place now and then to recall fond associations. If these drawings are miniatures, they generally live in a box; if they are on paper, they are stuck in a scrap album. Now, how charming these treasures would be if grouped together, and thus made the motive of an overmantel in the manner of the accompanying design!

In constructing an overmantel like this one, we will suppose your mantelpiece is 5 ft. 10 in. in length. You will then require a thin oaken board (about three-eighths of an inch in thickness) 5 ft. 6 in. by 1 ft. 10 in. If the board can be all in one piece so much the better. Teak and mahogany and sequoia wood run wide, and might be easier to procure than oak. Bass is a cheap wood, and runs wide, and its white colour would harmonise with many things (blue china especially), and be less heavy looking if required in a drawing-room. Sequoia wood has a pretty pinkish colour and is a cheap wood.

The board is 1 ft. 10 in. at its widest part, from A to B, where it rises in semicircular form; from D to E the board is 1 ft. 3 in. in width; from D to H the measurement should be 1 ft. 5 in.; and from D to the central dotted line between A and B the distance should be 1 ft. 4 in. The length from F to G is 5 ft. 6 in.—*i.e.*, 4 inches shorter than the mantelshelf—thus leaving space for the 2 inch frame of oak, 1 inch thick, which is carried right round the board.

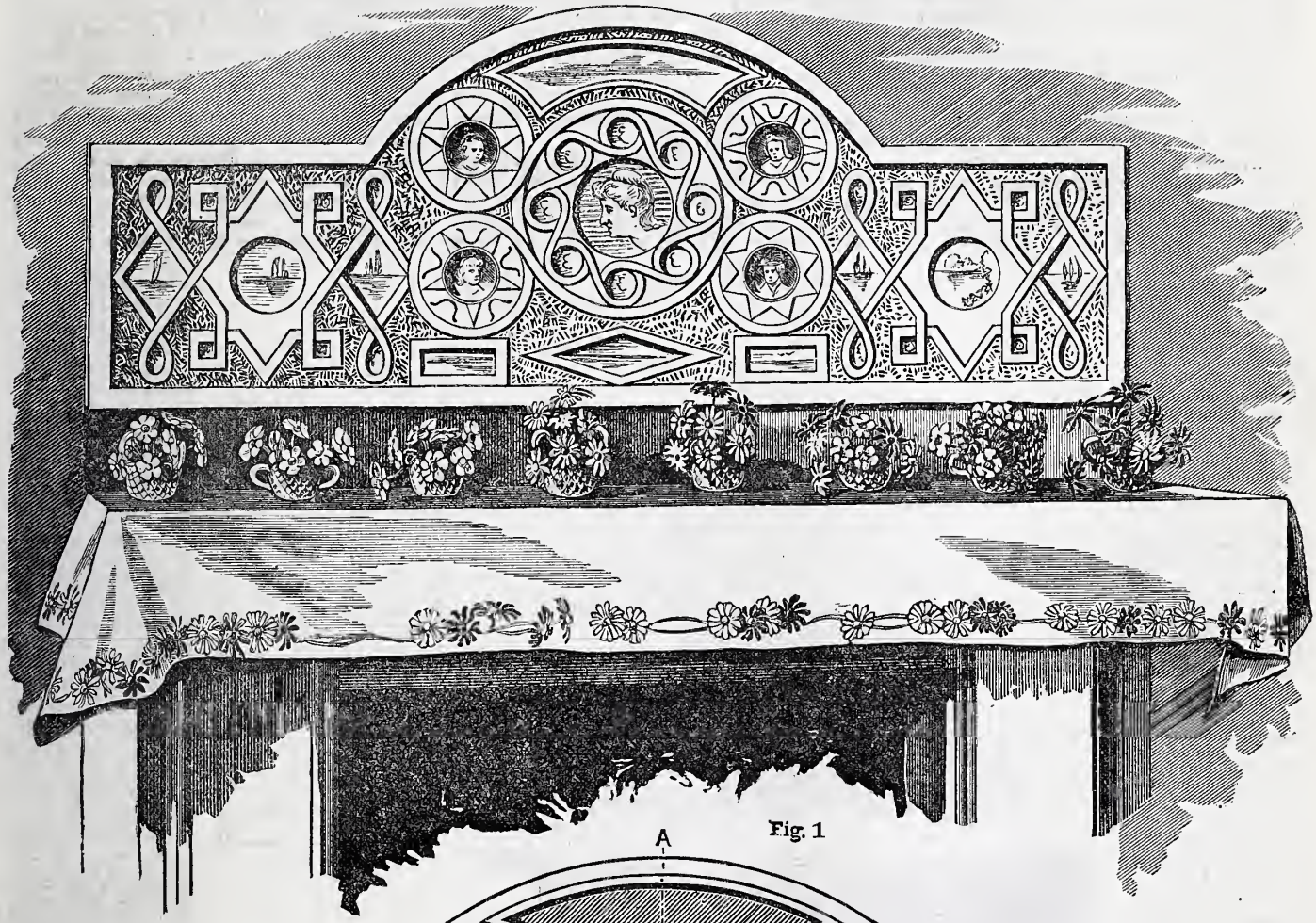


Fig. 1

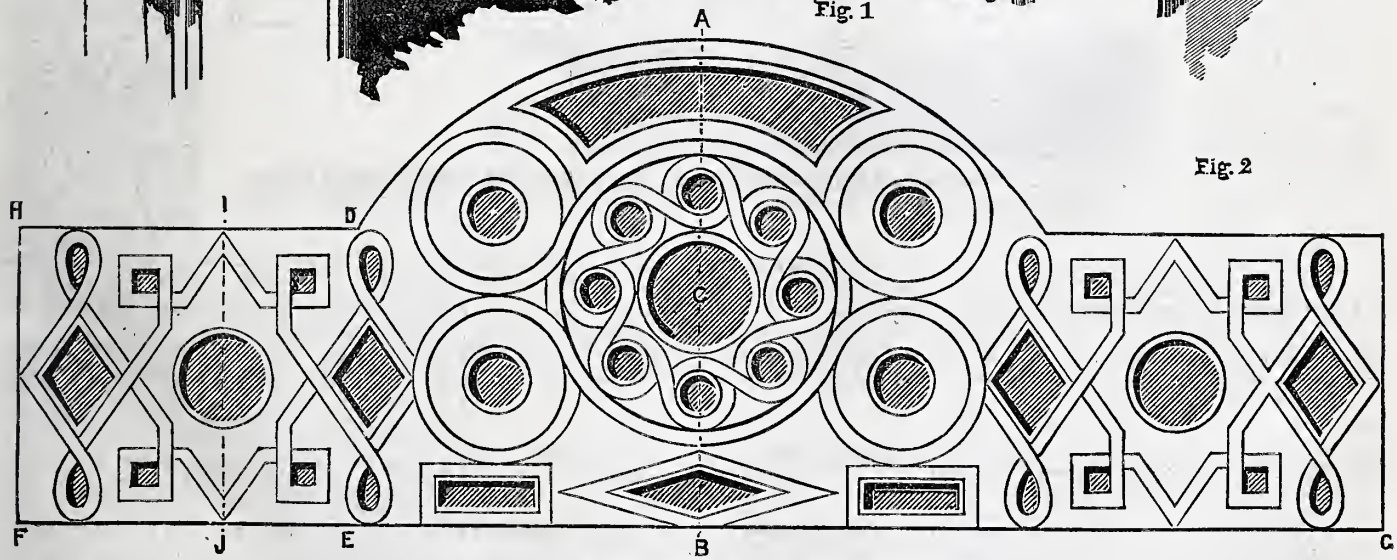


Fig. 2

Fig. 1.—Overmantel complete. Fig. 2.—Working Diagram.

On the board a geometrical pattern is drawn, and round and diamond-shaped holes, according to the pattern, are then made with the fret saw, and the drawings are slipped behind these holes, which act as their frames. The wood is bevelled off round these holes, because the entire thickness of the board (three-eighths of an inch) would cast too much shadow over the small drawings.

The geometrical lines of the pattern are

carved on the board with a small grooving tool, and the spaces between the pattern are punched. The entire board, with the frame, is then gilt; or the punched part need not be gilt if the plain oak is preferred. Great nicety will have to be observed in cutting the curve of the frame over the semicircular part. The point C is the exact centre of the board, and from that point the compasses should describe the central circles.

If you are making your design on paper, to be traced off on to the wood, you can double the paper down the dotted line between I and J, after drawing half the end portion of the pattern, and trace the other half through at the window. You can also double the paper again between A and B, and trace through the other half of the entire pattern, as it is alike both sides; then paste the paper on the plank, and commence with the fret saw.

A sheet of glass is cut the same size as the *board*, to slip between the gilt woodwork and the drawings, just in the same way as we manage our water-colour pictures; and then the small pictures are very accurately pasted on to the "back board," so as to appear on the front side through the holes in the gilt board. The mantelshelf is covered with gold-coloured linen, around the edge of which large white daisies with golden eyes are worked in Harris's flax threads. This linen cover can be periodically washed and ironed, which is a great consideration, as the mantelshelf in the "fire season" is the dustiest place in the room. The overmantel is raised seven inches above the mantelshelf, and that space is covered with a strip of gold-coloured linen, worked in a geometrical pattern with large daisies.

The mantelshelf holds a row of small vases of that popular gold and white Viennese china from the well-known shop at the eastern end of Oxford Street; and, when the season will allow, these vases should be filled with large white marguerites, thus keeping the entire mantel decoration a small "symphony in white and gold."

To look harmonious, this overmantel should be in a room where the furniture is enamelled white, and those charming yellow and white Liberty cottons are profusely used for covers and curtains.

This design for an overmantel would look very well if used for old china instead of drawings; plates and saucers would fill the larger holes (which, of course, would have to be cut in proportion to the pieces of china), and broken scraps of treasured Dresden, etc., could fill the smaller spaces. Thus, the tiniest bits of beloved tea cups shattered past mending could be turned to account in a tasteful manner. Especially if you happen to have any broken Wedgwood or small Wedgwood medallions, here is a pretty way of using the little white figures on their blue or green grounds, so that they should not be forgotten or lost.

In using this idea for old china, no sheet of glass would be required; but a back board, with holes cut to semi-insert the saucers and plates and keep them steady, would be a good plan, though more expensive than hooks or brads, for the same purpose.

If filled with china, this arrangement would be a splendid one used as a decoration above a sideboard.

Now that it has become such a favourite plan to turn cottage pianos with their backs out in the room, a difficulty arises as to how these backs shall be draped or decorated. Here, again, this design could be used beautifully for the upper part of the piano back, and a seat could be placed underneath it.

Of course, for this purpose the design must not be so wide as would be required for the overmantel or sideboard.

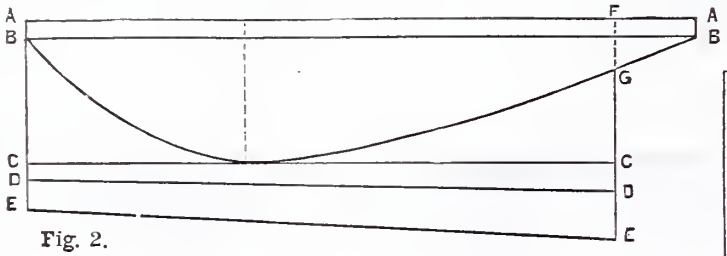


Fig. 2.

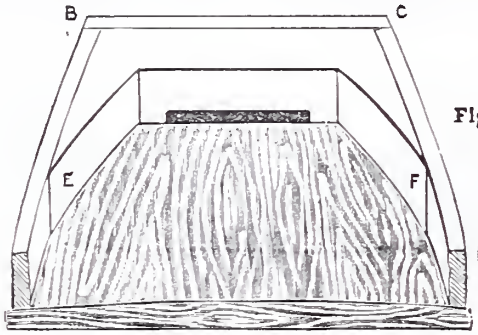


Fig. 4

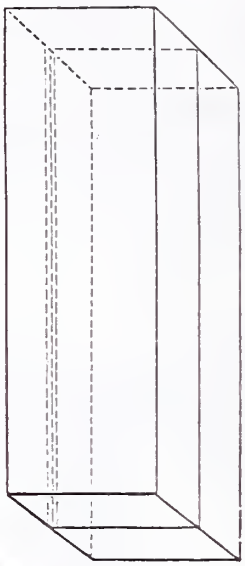


Fig. 1.

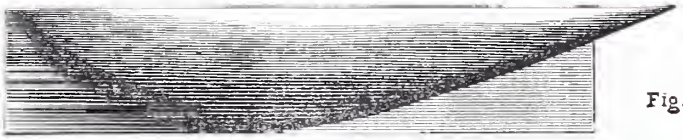


Fig. 3.

Fig. 1.—Block of Wood marked out ready for cutting. Fig. 2.—Side View of Hull, showing various Parts of its structure. Fig. 3.—Shape to be given to Block of Wood. Fig. 4.—Piece of Wood which forms Scuppers.

MODEL BOAT-MAKING FOR BOYS.

BY A CRAFTSMAN

Choosing Block of Wood—Shaping and Finishing Hull—Fixing Deck and Keel on.

The principal thing to be done before commencing the construction of a boat is to get a piece of wood of suitable size and shape out of which to make it. Upon the choice of material the ultimate success of the boat—both while it is being constructed, and during its subsequent career on the water—mainly depends. It should be free from cracks and knots, quite dry, and of a kind of wood easily worked. The wood of the sycamore tree answers all these requirements; it never cracks, soon becomes seasoned, and is easily worked. However, if you are not able to procure sycamore wood, deal or any other soft wood can be used. If you decide on using sycamore, the best thing to do is to procure a portion off a tree of the right length and diameter, and cut it into a rectangular shape, first with a hatchet, and finally with a plane, taking care, of course, that it is thoroughly seasoned.

Having obtained a block of wood of the right dimensions, rule a line lengthways right round it exactly down its centre, passing down the middle of the deck, keel, and bow. Then rule a line on each side of the keel line to represent the thickness of the keel. Fig. 1 is an illustration of the rectangular block of wood with lines ruled round it in this manner, the deck being uppermost. The block is now ready to be cut into shape. Fig. 2 is an outline of the shape in which the hulls of cutters and schooners are generally made. The widest part is usually at a distance from the bows equal to one-third of the entire length. The relation between the width and length varies a great deal, but a good width is one which is a quarter of the length, the depth varying from one-quarter to two-sevenths of the length. If the boat is to be a steamer, the width and depth must be much less in proportion to the length. In Fig. 2 from A to B the hull is built up—*i.e.*, composed of a strip of wood fastened on to the principal block. A wooden keel fixed on to the lower part of the block extends from C to D, and a metal keel extends underneath this from D to E. The dimensions of the various parts of the boat must be fixed upon before the block of wood is chosen, and the depth of it must be equal to the distance from B to C.

Now begin to cut the block into shape. First roughly chop out the interior, leaving the sides about ½ in. thick. This may be best done by boring holes, with a 1 in. centre-bit, close to one another all over the part to be cut out, and chopping away the intervening wood with a chisel. Then turn the block upside down, and shape the outside. In doing this, chop out the keel, except at the widest part, where there is no keel at all (see Fig. 2), with a chisel for about ½ in. in depth. You now have the position of the keel so marked out that it cannot be obliterated. Then shape the sides. These should be made to curve with a continual graceful bend, represented, as nearly as it can be by an engraving, by Fig. 3. They can be roughly shaped with a chisel, and then finished off with a spokeshave or plane. When they are nearly reduced to the right shape, frequently run your eye along the

keel, and see that both the sides have the same shape. When this has been done, shoot the top of the hull and the keel quite true with a trying plane, and cut the bow and the part of the keel where the rudder is placed quite straight with a chisel. The flat part of the hull, near the stern, can be finished off with a small iron smoothing plane, and the upper part of it should be slightly thicker than the lower part.

Now return to the interior, and finish it off. It should be formed with a curve corresponding to that of the sides, and the wood must be chopped out in small pieces until the sides are sufficiently thin. The thickness of ½ in. would be quite enough for the sides of a 36 in. boat. The interior may be neatly finished off with a smoothing plane, the sole and iron of which have been rounded to adapt them to the curvature.

The wooden keel must be put on next. It consists of a strip of wood, the edges of which have been shot quite true. It must be wider at the end which is placed at the stern than at that which is placed at the bows. It is fixed on to the hull by three or four long screws, and care must be taken in doing this that it does not lean over at all.

When the hull has been finished, the deck must be fitted on. This consists of a board thicker in the middle than at the sides, so that the water which washes over it will run off more easily. It is strengthened underneath by braces of wood fastened across it. Before it is fastened down, all mast holes and hatchways must be cut in it. It can also, if you wish, be ruled with lines to represent the joints between the deck boards, and these lines can be slightly indented with a bradawl. It is then fastened to the hull with nails or screws, its edge being allowed to overlap slightly.

Before fixing the metal keel on, a hole must be bored near the stern for the reception of the upper part of the rudder. Bore a small hole with a gimlet through the deck and hull along the dotted line represented by F G in Fig. 2, and then bore a larger hole down this one with a centre-bit of suitable size. Procure a piece of brass tube which will fit tightly into this hole, hammer it in, and file its ends off even with the wood.

Now fix the metal keel on. This can be made of lead or iron. If of the former metal, it should be cast in a wooden mould of the right shape, and if of the latter, it must be forged by the blacksmith. It should be thicker and wider at the end which is placed at the stern than at the other. It is fitted on to the wooden keel by screws passing through holes bored in it.

The scuppers consist of a piece of wood the shape of which is shown by Fig. 4. A long, shallow groove is cut underneath the central part of it, large enough to allow any water which may be shipped to escape. It is shaped so that it will fit into the end and sides of the deck at the stern of the boat, and is fastened down with screws, which should be countersunk. In Fig. 4 the line passing through A, B, C, and D is the upper edge of the bulwarks, and the carved piece of wood passing from E to F is the scuppers. A thin piece of wood is then fastened on to the back of the scuppers, and is wide enough to cover the part of the hull above which they are placed and the ends of the bulwarks. The portion of the hull so covered is represented by A B in Fig. 2, and so would be below D C in Fig. 4. In my next paper I shall speak about the bulwarks, stand, rudder, deck fittings, hull, capstan, painting, etc. In the meantime, the boys should go to work, and induce others to do the same.

SCIENCE TO DATE.

Discovery in a Tumulus.—During the excavation of a large tumulus in Ohio a human skeleton was found clothed in a suit of copper armour. Around its neck was a collar of bears' teeth alternating with pearls. A quantity of what had been fine pearls was found with the skeleton, but were quite spoilt. A second skeleton—that of a woman—was found by the side of the first. It is supposed that they are 6,000 years old.

Balistite.—The Italian Government have been making experiments on a new explosive which has been called balistite. According to the results obtained, balistite is superior to all the smokeless powders used by other Powers. Amongst other advantages, it is said not to deteriorate the interior of the guns in which it is employed.

Brilliant Varnish for Wood. — A German paper recommends the following varnish as giving most brilliant surfaces and of a durable polish. Further, it browns the wood and brings out the venation. Gum-lac is dissolved in twice its volume of water, and the mixture gently warmed until it has acquired the consistence of a jelly. Two parts of this varnish are mixed with one part of olive oil. A light coat is laid on the wood to be polished, and is then briskly rubbed with a pad to make the varnish penetrate into the pores. It is allowed to dry, and the operation repeated three or four times. After some hours the surface is rubbed well with tripoli powder on a rag soaked in olive oil. The operation is finished by polishing with a washleather.

Forgotten Fact.—If sulphur is melted till quite liquid, poured on to a printed paper and allowed to cool, then, after removing the paper by means of sulphuric acid or otherwise, a complete "negative" of the type and illustrations on the printed paper will be found on the surface of the sulphur. Even the finest lines are well marked, and every detail comes out clearly. This fact was observed about fifty years ago, but has, apparently, been forgotten. It might well be available for some interesting industrial application.

Non-explosible Petroleum.—A Hamburg chemist claims to make petroleum non-explosive by the addition of a small quantity of a mixture of bicarbonate of soda, aniline, calcium and magnesium sulphates, salt, sal-ammoniac, and water.

New Phosphorescent Substance.—Zinc sulphide is now being manufactured as a phosphorescent substance. It shines with a greenish light in the dark. The sulphides of calcium hitherto employed are altered by air and moisture, but zinc sulphide is not so attacked, and will, therefore, probably supersede them.

New Method of Insulating Electrical Apparatus. — M. Boudreaux has discovered that paraffin is the most perfect insulator, and has made a series of apparatus for experiments with statical electricity, founded on the employment of paraffin as an insulator. This apparatus will work even when the air is damp, without there being any necessity to heat it. Special arrangements are also made to prevent the access of dust, which is an essential condition for the good working of such electrical apparatus.

Rapidity of the Sun's Revolution.—Prof. Duner, the Swedish astronomer, has re-calculated the time of the sun's revolution from observations made on the displacement of the lines of the solar spectrum in the Observatory at Potsdam. He finds that the sun moves round its axis at the rate of 1 mile 242 ft. per second. The sun's day is therefore equivalent to 25 days 12 hours of our time. Further, he has observed that different parts of the sun have different times of revolution, the latter increasing from the equator to the poles, which is only possible with a gaseous surface.

Electro-magnetic Vibrations.—It is stated that electro-magnetic vibrations can pass through a brick wall as readily as light passes through a piece of glass. In this case it is not too much to expect that we shall have, in course of time, a system of telegraphy without wires.

Solvent for Camphor.—Liquid paraffin is recommended by Rosner as a solvent for camphor. On warming slightly, a perfectly clear and limpid solution is obtained, which can be kept for years.

Silicate of Silver.—No one has yet succeeded in preparing a silicate of silver. Lately, however, a salt of complex composition, containing silica, nitric acid, and oxide of silver, has been prepared.

NOTES FOR WORKERS.

A Mr. Campbell, a Canadian, has invented a "cotton picker" which will pick the ripe bolls and leave the unripened ones and flowers for a later picking.

The Electrical Exhibition at St. Petersburg opened by M. Vishnegradski, the Minister of Finance, has proved a very successful one.

If the telescope be driven by clockwork so as to keep certain stars always in the field, a planet, if present, can be discovered by a prolonged exposure of a single photographic plate; for while the images of the stars will be dots, the planet will, by its movement, trace a "trail" upon the plate.

The best plaster of Paris is used for cementing brass collars and sockets to the glass fonts of lamps. Another method is to boil 3 parts resin with 4 parts strong lye, and, when cold, mix with 5 parts of water. Five parts of plaster of Paris is then worked in and applied; it sets quickly, and is said to be unaffected by petroleum.

The light of the model of Eddystone Lighthouse at the late Naval Exhibition was of 300,000 candles intensity.

Picro-carmine is a good differential stain for microscopic zoological sections, as it stains the several tissues different colours. The specimens should be first soaked well in 70 per cent. alcohol, then put in the stain for a day, then into 70 per cent., and afterwards into 90 per cent., alcohol.

German silver or nickel silver is brass whitened with nickel. Two parts of copper, one of nickel, and one of zinc are the proportions used for making spoons and forks.

The Lion Bridge near Sangang, in China, is the longest in the world, extending rather more than five miles over an area of the Yellow Sea. It is supported by 300 stone arches, a marble lion 21 ft. long resting on the crown of each pillar.

At the Frankfort Electrical Exhibition the total expenditure was 1,362,000 marks, but as the receipts amounted to 1,514,000 marks, there was a profit of 152,000 marks. A mark is worth about a shilling.

A new method of straightening steel plates without hammering them has been patented. The heated plate is plunged into the hardening bath, but not left there until quite cold, as is usually done. When only cool, it is taken out and placed between two cold discs in a hydraulic press, which is then screwed down.

To dye wool black, boil it with its own weight of logwood for an hour, and then add sulphate of iron in the proportion of 1 lb. to every 30 lbs. of wool.

To find the capacity of a square or rectangular tank, multiply the length by the breadth by the height. If each measurement be made in feet, the capacity will be obtained in cubic feet.

Care should be taken in using aquafortis or nitric acid, for if any should touch the skin it will form a bright yellow stain, whereas, if it goes on to the clothes, it will stain them red and make them rotten wherever it touches them.

The melting point of a body is a particular temperature at which that body begins to melt, and is constant for the same substance under the same conditions.

A gramme is the weight of one cubic centimetre of distilled water at 4° Cent.; water being at its greatest density at that temperature.

There will be exhibited at the Chicago Exhibition a model of the first telegraph wire, about nine miles long, erected by Morse along the Baltimore and Ohio Railway.

For the production of the electric light in Spain 50,000 tons of coal were used during last year.

To protect the puddlers in the iron works in Westphalia from the intense heat, furnace shields are now used. A shield is an iron screen hung from a rail overhead, and is kept cool by cold water running down it from a perforated pipe carried by its upper edge next the furnace to a gutter formed on the lower edge.

The Tansa Waterworks, Bombay, is one of the greatest feats of engineering in India, and the dam connected with these works is the longest in the world. They are to be opened by the Viceroy this month (April).

TRADE: PRESENT AND FUTURE.

*** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

SILVER AND CUTLERY TRADES.—There is little to note in the Sheffield silver, plated, or cutlery trades, business being, on the whole, dull.

BOOT AND SHOE TRADE.—Trade at Brighton is, as far as bespoke work is concerned, just like the London West-end bespoke, very quiet, with very few exceptions, and most of the large manufacturing centres are in a like condition.

BUILDING TRADE.—In Manchester, the building trade is getting brisk. Plumbing, especially, is looking up. There are many large jobs in hand, and good plumbers can get plenty of work. The general price now is 8½d. per hour. Everyone in the building line is busy in Bournemouth, and it seems there will be a demand presently for more workmen in the bricklaying and carpentering lines. Wages are fairly good for the country, being 7d. and 7½d. per hour. Last summer there was more work than men, and all here were putting in overtime; and from appearances at present, it will be so again shortly.

TIMBER TRADE.—3 by 11 third yellow planks are very scarce just now, and command good prices, as much as £15 15s. and £16 5s. per standard being asked in the trade for this size. Last November the same goods fetched only £12 5s. to £13. Spruce is likely to be very scarce this year, and prices keep firm. Buyers will do well to obtain their requirements at the present quotations before another rise takes place in the market. The stock of spruce in the Surrey Commercial Docks is reported to be at least 50 per cent. below the amount this time last year in hand. At these same docks is another cargo of Jarrah wood unloading. This wood is much to the front for paving. The price is about £8 10s. per load, or 3s. 6d. per foot cube; and as it lasts so much longer than yellow deal, it proves cheaper. Floorings and matchlinings have been a little firmer, but there is small hope of the rise being maintained. Some mahogany put up at public auction lately was well bid for, and was all cleared at an average price of 4¼d.

FLANNEL TRADE.—This—the principal trade of Rochdale and district—is in a fairly flourishing state, and most, if not all, of the mills are working full time. The fact that the contract for the Navy has been placed in the hands of local firms has, no doubt, had some effect in bringing about this improved state of affairs, which, if it will only continue, will be much better not only for the mill-owners and workers, but for the whole town as well.

JEWELLERY TRADE.—The London jewellery trade is in a state of suspended animation. It is alive, and that seems about all that can be said for it. One hears everywhere of manufacturers discharging their men, of shopkeepers discharging their assistants, and altogether the outlook is bad all round.

SHEET METAL TRADE.—In Wolverhampton, the large sheet iron producing Lysaght mills, which have been standing idle some time, are to be restarted. About 1,200 hands are employed, and the announcement of the reopening of these important works has given great pleasure in the town. A large sum is being expended in new plant. Several tinplate works in Wales are suspending business on account of the depression of trade. Three thousand men are out of employment. The London trade is still very quiet, buyers holding out for low prices. Stocks are getting low, and purchases will soon have to be made. Reports from other parts are equally dull.

ENGINEERING TRADE.—Neither the engineering nor the iron trades of the Lancashire district exhibit any material signs of improvement, although in some branches of the former industry a fair amount of activity is maintained. This is notably the case with boiler-makers, who report a considerable quantity of new work coming forward. With machine-tool makers and stationary engine builders, however, trade has a decidedly slackening tendency; while locomotive builders are, as a rule, but little better situated. Orders have, however, been placed with one large firm in the district for a number of six-wheel coupled locomotives intended for the Western Main Trunk Railway and for other lines under the control of the New South Wales Government. It is stated that the order has been given after careful tests of American Baldwin engines upon the lines mentioned, along with those of English make. In the general engineering trade of the district, there is a decided quietening down, little work and but few inquiries being reported from almost every centre, with the exception of Barrow, where both engineers and shipbuilders are busy. Throughout the iron trade business is in a very depressed condition, consumers only purchasing sufficient to meet present requirements. An immense number of furnaces are damped down, only six of the forty in the Barrow district being in blast, while other districts are similarly circumstanced; but, in spite of this, there is no marked upward tendency in the prices. In Manchester, this trade is quite out of joint, for though the coal crisis is practically over, there yet seems no likelihood of a return to activity. Employers complain that the cost of production is so great that they cannot offer prices that will attract trade. A complaint of this nature is very ominous to the workers.

COTTON TRADE.—The Lancashire cotton trade is in a very depressed condition, so much so, indeed, that the advisability of working short time is being freely discussed by the employers' associations. The protracted strike at the Stalybridge Spinning Co.'s mill continues, and a recent attempt to settle the dispute has, unfortunately, failed entirely, so that, after a strike of six months, the prospect of a settlement appears as remote as ever. It is stated that the Employers' Federation has under consideration a proposal to close the whole of the mills in the Oldham, Ashton, and Mossley districts until the dispute at Stalybridge has been settled. If this course is adopted, it cannot fail to have a most depressing effect upon the trade generally, while the labour community will suffer most seriously in consequence. A cotton-spinning concern in the Rochdale district has declared a dividend of 12½ per cent. on the last quarter's working, but, on the other hand, a similar concern has been at a very heavy loss on the same quarter's working; so that it is difficult to decide whether the trade as a whole is in a prosperous condition or not.

PAINTING AND DECORATIVE TRADES.—Although the spring season of London jobbing work has been, so far, one of average business, many workmen have been on the unemployed list. London is never able to provide work for all the painters living in its districts, and the young provincial journeymen, who are at all times flocking to the city, very seldom better themselves by the change. The smaller provincial towns offer to-day the best outlets for energy and decorative skill. If without capital or influence, there is no place in the kingdom less promising for regular employment and steady progress on the part of a raw provincial worker than at the West-end—the district wherein all the most costly work is executed, and the goal to which so many foolishly aspire.

SHIPBUILDING TRADE.—In the shipbuilding trade there is very little being done. Messrs. Laird, of Birkenhead, have just launched a fine vessel called the *Duke of Clarence*, intended for the Irish service. On her trial voyage she steamed an average of 18·8 knots, which was more than that contracted for. In shipping circles, the chief interest is the proposed amalgamation of the British and Foreign and Standard Marine Insurance Companies. This amalgamation will be one of the largest in the world. One of the most successful firms in the shipbuilding trade in Belfast has entered into a contract with the Union Steamship Company, Limited, for the construction of two new steamers for the South African trade. They will be twin-screw steamers, fitted with two sets of triple expansion engines, and will be capable of carrying large cargoes on such a draft of water as will enable them to cross the bars at East London and Durban. They are not intended for high speed, but will have ample accommodation for first, second, and third class passengers.

SHOP:

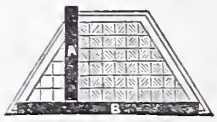
A CORNER FOR THOSE WHO WANT TO TALK IT.

*** *In consequence of the great pressure upon the "Shop" columns of* WORK, *contributors are requested to be brief and concise in all future questions and replies.*

I.—LETTERS FROM CORRESPONDENTS.

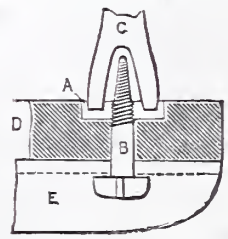
Astronomical Regulator Clock.—T. T. (*Sefton Park*) writes:—"Might I suggest that some contributor would supply a series of papers on the construction of an astronomical regulator clock, with plain dial and dead-beat, to strike the hour, quarter past, half past, and a quarter to the hour, with zinc and steel compensated pendulum? The case might be left to the taste of the maker, if he would recommend a good firm of clock makers to get the parts, finished and unfinished, etc."—[An article upon this subject would be considered.—ED.]

Glass Work.—R. M. (*Croydon*) writes:—"In reference to your article on 'Leaded Glass' (see WORK, No. 147, p. 685), I should proceed with such a job in the following way: First, make out full-size drawing, allowing ¼ in. all round for outside lead to the size and shape required. Next, pin drawing to the bench or board. Next, purchase lead, which is sold at about 4d. per lb., and should be a domestic round lead for body part, and a ⅜ in. flat lead for outside, which, if a trifle too large, could be trimmed down to the size. Next, buy the glass, which would be best if the glass-cutter were to cut it into squares as well as strips for the lines, which could be cut in between squares, or where required, with a wheel cutter (if a diamond is not to hand), costing about 6d. Having procured the glass and lead, lay two straight-edges down on drawing, marked A and B, as shown: The head is then drawn out straight, and cut off as required, starting from left-hand corner from bottom to top, and so on, until the squares are built in as shown in sketch. Next, take up straight-edge, A, and build in remainder of squares, taking care to put sufficient nails round. Shoemakers' lasting nails are generally used, which have steel points and large heads, and pull out of board easily. Next, cut length of lead for right-hand side of squares, and start putting on lead from the bottom, pulling out the nails carefully as the lead is taken up the side of work. Next, carry up the line, cutting it where required, and so on, following round, taking care, in raising the straight-edges, not to shift the work, and, as each outside head is put on, a straight-edge must be nailed down behind them. Before soldering, square up the work, and then grease the joints with composite candle, which is generally used. After soldering both sides with a hatchet-iron with ¼ in. face well tinned, putty can be worked under the leads, and pricked out with a sharp, hard stick. Next, brush briskly with a stiff brush, and put on the finishing touch with a black-lead brush."—[Many thanks for your suggestion. There is nothing in your very practical description of how to make leaded glass work but what I am fully aware of. I omitted to state that the joints should have a touch of composite candle before soldering, but otherwise I think the answer fitted the peculiarities of the question; and this is the great point.—E. D.]



Glass Lead Work.

How to Grind Skates.—G. E. C. L. (*Ipswich*) writes:—"The winter's frosts must have caused many of our 'workers' to bemoan the condition of their skate edges. Many would doubtless be glad to learn how to grind them in view of next winter. The only things necessary are a small emery wheel, an emery buff wheel, and some means of driving them. Those who have a lathe need only put the wheels in between centres on a mandrel, and they are at once provided for; those without a lathe ought easily to be able to rig up an appliance to hold the wheels. I have found the best size emery wheel to be 3½ in. or 4 in., and buff wheel about 6 in. The emery wheel will cost about 2s.; the buff can easily be made out of a piece of wood about ¾ in. to 1 in. thick, and 6 in. diameter, turned up on a mandrel (which should be about 7 in. or 8 in. long from the live centre end). A piece of a thick strap (a soldier's belt is really the best thing) is glued all round the periphery, and further secured by small wooden pins through the leather into the wood. This is now covered with hot glue with emery powder stirred into it pretty thickly, and when it is cold the buff is ready for use. If the skates have wooden bodies and a screw for the heel, it will be necessary to have a kind of screwdriver to go over the screw to take off the nut which holds the screw to the wood, as shown: If the skates are 'acmes,' or other metal-bodied skates, they can be readily taken to pieces with the key. (N.B.—Keep the parts of one separate from those of the other.) First do the flat sides of the blades with the buff wheel; let the scratches be in the same direction as the maker left them, either crossways or end to end. When this is done, change the buff for the emery wheel. You will require a rest to go in the T holder that is quite flat at the top; I use a piece of wood ½ in. thick, 1½ in. wide, and 4 in. long; the height of this must be *very* accurately adjusted. As the blade is tapered, the rest must be below the centre of the lathe. It is right when, the blade being held flat on the rest, the emery wheel just touches the centre of the edge. Use the emery wheel till you have got the blade free from bad places. Do not press too hard, and be careful not to get the edge wavy, but a regular curve from heel to point (you will find the blade to be far from flat on the edge). When both blades are done, change to the buff again, and finish the edge with that. The centre of the edge will not be touched by the buff; that does not matter. The rest must not be shifted for this finishing. If the edges are too sharp—which is very probable—take a

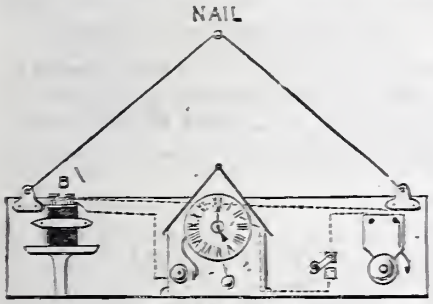


A, Washer or Nut; B, Screw; C, Screw Point; D, Stock; E, Blade.

piece of F emery cloth, and with the thumb and finger give the edge one or, if necessary, two rubs, which will rectify the matter. Skates ground like this will not slip from under you sideways when doing the outside edge, three, or any other figure, and will be found to be as swift as any other for plain racing. When once you have got the emery wheel and buff, I do not think you will keep them for mere skate grinding, but will find them invaluable for multifarious purposes."

Oilstone.—J. E. R. (*Limavady*) writes:—"When an oilstone has worn hollow, it is a difficult matter to sharpen wide tools—such as plane-irons—upon it. The following will be found a cheap and efficient substitute—in fact, far better than a narrow oilstone for wide tools and fast cutting. On a bit of board planed true, say, 7 in. square, fasten, by turning down one edge, a piece of sheet zinc, and use this as you would an oilstone, with the addition of a little emery-flour. With this you can put a polish on a plane-iron or chisel unattainable with the oilstone. Anyone who has tried this will always use it for sharpening wide chisels, plane-irons, etc."

Early Riser's Electric Clock.—CAWD HUD writes:—"I send you a sketch of an arrangement (electrical) for waking me up, thinking it may be of service to those of your readers who have to get up early and at irregular hours. The clock, bell, and battery are secured to a board, as shown, and can be hung up anywhere, like a picture. The battery stands on a small bracket, screwed firmly to the board, and lashed with a stout band of tin, about half-way up the cell, as an additional safeguard from upsetting. The clock is fixed by two screws through the back. To connect up, take a wire from zinc direct to bell, bell to switch, switch to clock; here ease one of the screws which hold the works in position, and twist the end of the wire round it. Take the other wire from carbon to back of clock gong, and twist round screw, as before. Now, so bend the hammer of clock that it stands, when not



Early Riser's Clock.

in action, about ¼ in. from the gong. Wind up the alarm, and the force of the spring will press the hammer tight against the gong, as the disc of the clock works round and releases it. Of course, once winding will do, as the clock alarm cannot go off when the hammer has been bent as described. I may say I can, and do, put every confidence in the bell to wake me, and it has never failed me once since it was put together in January, 1889. It has not required anything doing to it yet, and apparently is as good as it was twelve months ago. Cost, about 7s., exclusive of clock. Mine cost for the lot:—

	s.	d.
Board, 2 ft. 6 in. × 10 in. × ½ in... ..	0	6
3 in. bell (electric)	4	6
No. 2 Leclanché cell	2	0
Ordinary alarum clock	5	0
Wire	0	1½
	12	1½

The switch I made myself. The wires should be run in small grooves behind the board for neatness, and a 'drop' of sealing-wax here and there will keep them in their places."

Mole Traps.—W. S. (*Asby, Appleby*) writes:—"Having seen in 'Shop' queries and answers relative to mole traps, I now take this opportunity of giving a few hints which I can confidently recommend. In the first place, my remarks apply to amateurs, as professionals will know without my telling them. The cheapest and best trap, and handiest in every way, is the tile one made from common drain tiles. Their chief advantages are—durability, inexpensiveness, and being ready whenever wanted. To make them, get a common clay drain pipe 1½ in. diameter, and about 11 in. or 12 in. long. Cut it through the middle, and make two pieces 5½ in. or 6 in. long. The next operation is cutting out the finger-hole at under-side. For this, I found an old hand-saw was best, but as all makers may perhaps not have one, they must improvise something of that nature. After that, cut out the string and trigger holes. For these, nothing is better than an old screwdriver, about ¼ in., filed pretty sharp. The last operation is making the groove for string. For this, drive a nail into a piece of wood that will go into the trap, and work or scrape out the groove at either end. This concluded, the trap is finished. It is of the utmost importance that the tile be *soft*. I could have explained how to make a wooden one, but I have already taken up a lot of useful space. There is not a shadow of doubt but that the wood ones with steel springs are best, but where to get them at a reasonable price I should like to know. One great advantage the tile trap has over wood is that it will neither rot nor crack with sun, and requires no 'seasoning.' I have given no illustrations, as makers will well understand."

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Incubator Fittings.—ONE IN A FIX.—You can obtain glass tubes and all other fittings from Mr. Stevens (see advertisement in WORK, "Sale and Exchange" column, No. 149).—LEGHORN.

Working Cordage.—W. H. (*Bradford*).—Being in Naples, and away from all my drawing materials, I cannot well answer queries. The subject is also too wide to be treated of in "Shop." If W. H. was to write to Mr. A. B. Duckham, nautical agent, Falmouth, he would send him a list of manuals (of which there are several) on the subjects on which he wishes for information. He would thus obtain a great deal more knowledge than it would be possible for me to give him within the limits of a short article.—L. L. H.

"Waterbury" Repair.—W. F. (*St. Cross*).—Send to the Waterbury Watch Sales Co., Snow Hill, Holborn, enclosing, say, eighteen penny stamps, and ask them to send a balance-staff complete for the 10s. 6d. watch, and they will do so, and return overplus—if any—or tell you if not enough sent. Then unscrew the plates, draw out the pin that holds the hairspring at present, and put in the new one. You may not get it in beat at first, but by drawing the hairspring farther through or letting it out, you will soon get it right. It is a very easy and simple job, and I have no doubt you can manage it. If not, write again, and state the difficulty.—A. B. C.

Electric Light Batteries.—E. G. (*Dublin*).—The following numbers of WORK contain the two articles on "Electric Lighting by means of Primary Batteries": Nos. 32 and 39. These can be sent you on receipt of 3d. in stamps. Page 593, containing illustrations of electric light batteries, is in No. 39. As you have the indices to Vols. II. and III., you will be able to find several references to information on electric light batteries in "Shop."—G. E. B.

Camera.—BASEBOARD.—(1) The length is 9¾ in. (2) 8½ in. sight rebate measurement is 8½ in. Fig. 8 fits into rebate in outside case. (3) The bellows is merely slipped out of the metal grooves, pushed into the camera casing, and the baseboard folded up, thus enclosing the bellows part in a box, as it were. The hinge permits the baseboard to be rather longer than it otherwise would be, and forms the lower part of the rigid back framing.—D.

Tin Goods, Lacquer, etc.—S. S. (*Grantham*).—For ready-made tin goods, try Ponders & Baker, Featherstone Street, London, E.C., or Harding & Son, Long Lane, Borough, London, E.C. For lacquering, see reply to H. J. (*Oxford*). Your query *re* spark preventer has been answered.—R. A.

Cycle Tire.—E. D. (*London, S.E.*).—The tire cannot be mended by dissolving, as your correspondent proposes. To mend the tire, cut out the damaged part. Cut the two ends for splicing, as illustrated in No. 137, Vol. III., of WORK, and join with rubber solution, all as described in the accompanying letter-press. The rubber solution can be had of cycle dealers; bottles, 1s.—A. S. P.

Cement for fixing Silver Mounts on a Jug.—W. M. (*Market Drayton*).—Properly mixed and properly applied, thin fine plaster of Paris should hold these mounts on securely. Is the mount deep enough, and is the surface of the jug, where the collar comes, suitably roughed so that the plaster will get a hold? I know of nothing else to use but plaster of Paris.—H. S. G.

Wood for Zither.—YOUNG CABINET.—The belly may be made of cedar, rosewood, pine, or maple, and the back of pine, or even of common deal, if free from shakes and knots. The wood known as Swiss pine, however, gives the best results, and you can procure it from De Witt & Palmer, Drummond Street, Hackney: or you can obtain backs and bellies already cleaned up, at 1s. 6d. each, from Chilvers & Co., St. Stephen's, Norwich. Watch WORK advertisements.—R. F.

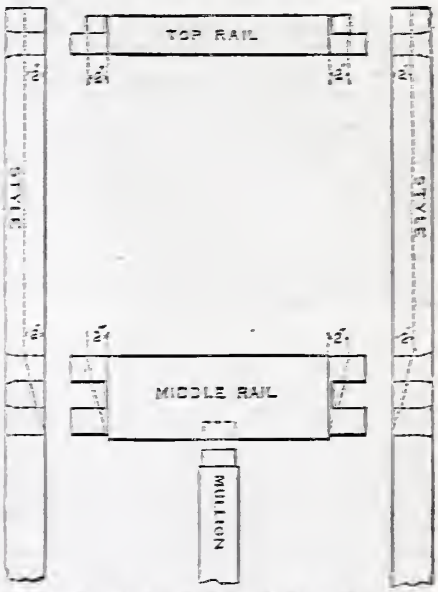
Mechanical Drawing.—READER (*Knutton*).—Perhaps Dawson's "Drawing for Machinists," 4s. 6d., might suit you. Try, too, the book on the subject in Cassell's Technical Series.—F. C.

Carpenters' Basses.—CONSTANT READER.—I know of no carpenters' basses that lock, neither can I see the utility of locking a basket that could be easily ripped open with a pocket-knife. As a rule, carpenters generally keep what tools they are not using in a tool-chest, and only use their baskets as a means of carrying about those they immediately require: but, if I come across such a thing as you want, I will let you know.—E. D.

Incubator.—CHICK.—For method of fixing regulator tube, see reply in "Shop" to F. H. For regulator tube, etc., send to Mr. Stevens, who advertises in WORK, No. 149.—LEGHORN.

Wool Winder.—E. D. (*Woodford*).—Thanks for your views. We shall be glad to see your idea when ready.

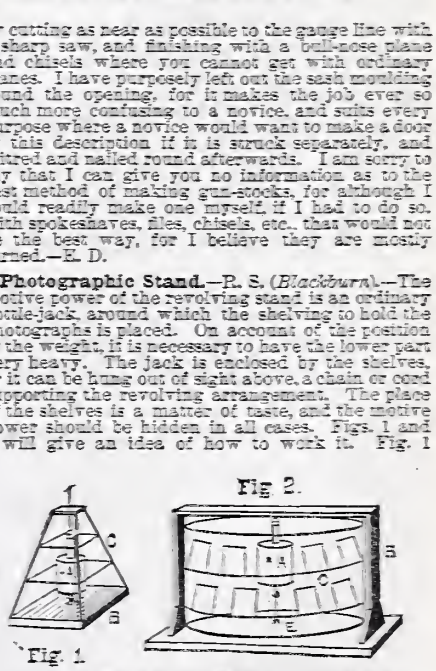
Sash Door.—SUBSCRIBER.—There is very little difference between the making of a diminished style and an ordinary door. I gave a description of how to make a four-panelled door in No. 144 of WORK; and if you look at that, you will easily understand what I am going to say. Proceed to make your door exactly as if the styles were not diminished, leaving out, of course, the top panels and mullion. You might even do all the mortising. When you have got so far, all you have to do is to make up your mind how much you will diminish the styles—say 2 in.; then gauge 2 in. down the upper inside portion of styles, both sides, as far as the top of middle rail, and then splay the line off to the bottom line of middle rail, as dotted line. Now, as you are going to cut 2 in. out of the styles, you must add 2 in. on to each end of top rail, and 2 in. on to each end of top of middle rail, and then make your splay down to the bottom of middle rail to meet shoulder line that would be if the door were not diminished: there being, of course, no plough groove, you must make the haunching for the top and middle rails. The diminishing of styles is done



Sash Door. Elevation of Part of Door. Dotted Lines indicate the difference between a Diminished Style and an ordinary Door.

by cutting as near as possible to the gauge line with a sharp saw, and finishing with a bull-nose plane and chisels where you cannot get with ordinary planes. I have purposely left out the sash moulding round the opening, for it makes the job ever so much more confusing to a novice, and suits every purpose where a novice would want to make a door of this description if it is struck separately, and mitred and nailed round afterwards. I am sorry to say that I can give you no information as to the best method of making gun-stocks, for although I could readily make one myself, if I had to do so, with spokeshaves, files, chisels, etc., that would not be the best way, for I believe they are mostly turned.—E. D.

Photographic Stand.—R. S. (*Blackburn*).—The motive power of the revolving stand is an ordinary bottle-jack, around which the shelving to hold the photographs is placed. On account of the position of the weight, it is necessary to have the lower part very heavy. The jack is enclosed by the shelves, or it can be hung out of sight above, a chain or cord supporting the revolving arrangement. The place of the shelves is a matter of taste, and the motive power should be hidden in all cases. Figs. 1 and 2 will give an idea of how to work it. Fig. 1



Details of Revolving Photographic Stand.

represents the suspended arrangement: A, jack; B, heavy board; C, frame on which shelves are placed for the pictures—the frame should be covered with light wood to hide the jack. Fig. 2: A, jack; B, strong frame to support jack; C, cylinder revolving inside from B, attached to a heavy bottom, E. The cylinder can be made hexagonal, and shelves arranged on the outside.—D.

Boys' Carpentry. — BLUECOAT BOY. — Some papers of this nature are appearing in the present volume of WORK. The first paper, dealing with rabbit hutches, was in the last number (159), so that you ought to be sharpening your tools.

Design and Decoration.—ARTS AND CRAFTS WORKER.—Arrangements are being made by which design subjects by trained decorators will find frequent place in the new volume—*i.e.*, from No. 157.

Xylonite.—H. B. (*Leeds*).—Your full address is asked for by R. J. H., 85, Gardiner Street, Dublin.

Stain for Chair and Upholstering.—AMATEUR. —To darken, as you say, the birch frame of your chair, wipe over with asphaltum dissolved in turpentine (one pennyworth in half a pint of turps). This should answer your purpose admirably, as it stains without giving it a painted appearance; but should you have any difficulty in obtaining this, you should fall back on vandyke brown. To use, take a little of the brown, mix into a thin paste with liquid ammonia—or a strong solution of common washing-soda will do—then thin down with water till you obtain the required tone, which you will readily gain by trying its effects on any odd bits of wood you may have left over when making your chair. As you cannot French polish, the most suitable varnish to use is that known as brown hard spirit varnish, which can be bought at most oil and colour merchants in small quantities more cheaply than you can make it. Should you prefer to make your own varnish, one suitable for your purpose can be made by dissolving 4 ozs. of best orange shellac and 2 ozs. gum benzoin in one pint of wood naphtha. Crush the gums; stir up frequently till dissolved. Strain carefully through fine muslin before using, and apply with a camel-hair brush. For particulars of how the edges of the seats are brought up square in upholstering, I must refer you to Nos. 78 and 100 of WORK, in which you will find "An Arm-chair: How to make the Frame and Upholster it." The subject is there more ably and fully treated than it would be possible to condense into the "Shop" columns.—LIFEBOAT.

III.—QUESTIONS SUBMITTED TO READERS.

*** *The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Storm Glass.—CAWD HUD writes:—"Can anyone of your numerous readers tell me what the ingredients of the storm glass, usually manufactured in America, and sold together with the ordinary mercurial thermometer, are?"

Glass Boxes.—HANTS writes:—"Address wanted where plain white glass boxes (small), glove and handkerchief sizes, can be bought; or, failing this, directions for making a glass box would oblige."

Knife-Cleaning Machine.—F. T. (*Stoke Newington, N.*) writes:—"I should be much obliged if any brother reader would give me instructions in WORK for making a cheap knife-cleaning machine."

Red and Green Fire.—A. J. W. (*Battersea*) would be very much obliged if any kind reader would tell him how to make red and green colour fire powder for parlour amusement.

Ice Cream.—J. W. (*West Brighton*) will thank any reader for a recipe for making ice cream to sell at ½d. and 1d.; also where could be bought a small ice cream machine, and price.

Engineer's Qualifications. — JUNIOR ENGINEER writes:—"Will any reader tell me whether it is necessary to be 'bound' in order to become a M.I. Mech. Engineers?"

Fret Market and Monogram.—S. W. (*Chesham*) writes:—"Will FRETWORKER, in No. 150, page 733, under the heading of 'Market for Fretwork,' kindly send me his address, as I have a few simple brackets I want cut, and have not time to cut them myself? And will someone kindly give me S.W. monogram for painting?"

Bevelled Lamp Glasses. — POOR TINKER writes:—"Can any reader give me address of a firm who sells bevelled lamp glasses wholesale?"

Oilstone. — W. J. (*Browney Coll.*) writes:—"Would any kind reader tell me if there is any way of softening an oilstone? I have one which looks all right, but when I come to sharpen anything on it it scratches."

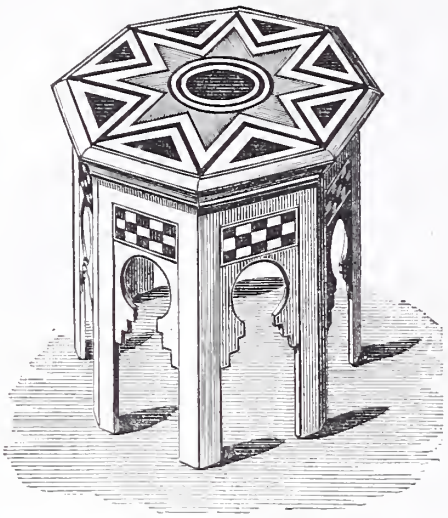
IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Magnetism.—M. (*Bishop Auckland*) writes to BEGINNER (see No. 152, page 765):—"Insert the bars in a coil of covered copper wire, and send a strong current from a powerful battery through the coil of wire, tapping the ends of the bar with a hammer during the passage of the current."

Colours for Diagrams. — C. K. (*Stratford*) writes, in reply to A NEW READER (see No. 152, page 765):—"Effective opaque colours for this purpose may be formed by using the dry powder colours, sold by oil and colour dealers, ground up with flake white on a china slab or piece of glass with a palette-knife. Add a little gum arabic to bind the colours; add a larger quantity if a shining surface is desired. To prevent crayon drawings from smudging, dissolve a small quantity of shellac in methylated spirits, and with a spray diffuser cover the surface of the drawing or diagram with this solution. For dealing with large diagrams, Hughes' 'Aphicide,' or Spray Diffuser, will be found very effective."

Double Flageolet. — M. (*Bishop Auckland*) writes to S. (*Bristol*) (see No. 148, page 702):—"You will most likely be able to procure one of these from Wallis & Son, Euston Road, London, or of Alphonso Carey, Newbury, Berks."

Octagonal Moorish Stool. — J. F. (*Exeter*) writes, in reply to ANGLO DANE (see No. 153, page 782):—"I enclose a sketch for ANGLO-DANE.



Octagonal Moorish Stool.

This could be easily made by an amateur. The best colours to use would be chocolate and dark reds, with a few lines of black in the mouldings and elsewhere to separate the colours."

Lead Weight.—EDDIFRA writes, in answer to W. W. W. (*Nottingham*) (see No. 153, page 782):—"The best way to make pattern would be to make it in two pieces, jointed at A, Fig. 3, the two pieces to be pinned together: the position is shown at E, Fig. 1. I should make it of mahogany. You will want a three-part moulding-box; it could be made of wood, as shown in sketches. The pieces of wood, F, Figs. 1 and 2, are for the purpose of guiding the boxes when they are being put together. The drag, B, Fig. 3, is placed on a level place and filled with sand, of which any iron or brass moulder will give you a tinful. If W. W. W. could get some of the fine dust that collects on the beams of a foundry, and mix it with the sand, it would be much improved. The pattern is then pressed in the sand, and joint made level at A, Fig. 3. Parting sand is

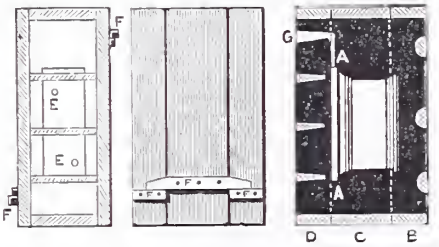


Fig. 1. Fig. 2. Fig. 3.

Moulding-Box Plan.

then sprinkled on the joint—sand that the fettlers brush off the iron castings is much used; the middle box is placed in position, and sand rammed round pattern. Make joint level with top of pattern, and place on top box a piece of round wood—a lead pencil will do—where runner, G, Fig. 2, is shown, and ram sand all round. Draw pencil out, draw off top box, scoop out runner, rap the pattern, and draw the top part out of sand. The pattern will, or should, part at A, Fig. 2. Take off middle box, and connect the runner with impression of pattern; or it can be done before the pattern is taken out. Rap the lower half of pattern, and draw it out. Place the boxes together and run in the metal. I should make a mixture of 9 parts lead and 1 part zinc; it will be a much harder metal than lead alone, and the mouldings will stand more knocks."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—H. N. (*Warbleton*); HALIFAX; G. W. C. (*West Butterwick*); D. G. (*Blairgowrie*); A. B. (*Sheffield*); R. M. (*Barnsbury*); C. C. (*North Britain*); FRAME MAKER; W. D. (*Peckham*); ALPHA; C. W. (*Salop*); LEVER; G. N. (*Henley-on-Thames*); H. C. (*Old Charlton*); H. L. (*Oxford*); S. & J. (*Lhanbryde*); J. R. (*Bagnalstown*); W. W (*Yunhead*); L. D. (*Birmingham*); N. P. B. (*Finsbury*); A NEW READER; A. W. P. (*Leeds*); J. H. B. (*Pendleton*); SURVEYING; J. D. (*Aberdeen*); A. B. C. (*Arbroath*); MECHANICIAN; A. A. P. (*South Shields*); AN OLD SUBSCRIBER; W. W. N. (*Leeds*); J. J. (*Ottawa, Canada*); JIFF; CYMRO; G. S B. (*Huddersfield*); J. W. B. (*Paddington*); H. M. H. (*Cambridge*); J. W. M. (*Stepney Green*); MESSRS. E. M. K. & CO. (*Dublin*); ASPIRANT; P. T. (*Pennington*); W. B. (*Walthamstow*); BASHER; E. E. G. (*Portsmouth*); C. W. (*Duns*); C. C. A. (*King's College*); J. H. (*Bishophill*); JAY BEE; PROBYN; CHAPEL KEEPER; R. M. B. (*Liskeard*); W. S. (*Leeds*); W. H. (*Liverpool*); SPECTEMUR AGENDO; TIDDLER; D. W. (*King's Cross*); C. W. (*Leeds*).

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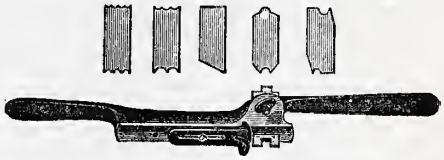

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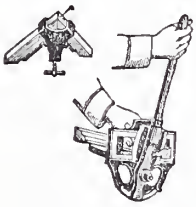

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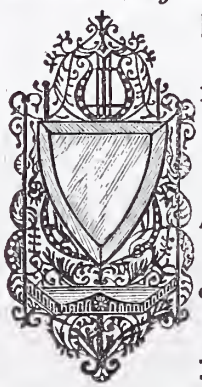

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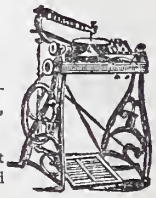

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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VOL. IV.—No. 161.] SATURDAY, APRIL 16, 1892. [PRICE ONE PENNY.

WORK WORLD.

A TOOL urgently wanted has been invented by a young North of England engineer. It is a lock-nut so constructed that, on its being screwed up, one half of the thread, for one quarter of the distance up, is converted into a buttress thread, which is the proper geometrical form to resist vibration. To slack it back, twice as much leverage is required as that which screwed it up.

* *

In making cork sole boots and shoes, old pieces will come in very handy, as they can be ironed over the whole of the inner sole with a glazing iron, and when warmed again the cork can be pressed in. This makes the work more waterproof, holds it firm, and prevents creaking, and holds it well in position, while its top is cut and filed into a smooth surface.

* *

Tesla is to be outdone in the world of electricity. Another genius—in America—is announced. He, like Tesla, professes to have thrown away all existing theories of construction, and begun afresh. His wonders comprise wires without insulation, and a dynamo which is perfectly harmless, and can be handled by a child without danger. We await proof of such statements, remembering that it is impossible to assign a limit to the surprises of a science so young as electricity.

* *

A much-needed reform has been inaugurated in the Ohio railways in the abolition of the old-fashioned heating stoves, and the compulsory adoption of hot water, steam, or hot air as the heating medium. Funeral pyres, so often consequent upon American railway accidents, may now become things of the past. The legislation is clearly of a vigorous nature, as the penalty for non-compliance has been fixed at 1,000 dollars, in addition to 100 dollars a day.

* *

Electricity is to be used for transmitting the motive power in a large flour mill to be built at St. Paul, Minnesota. The engine house, which is to produce 2,000 horse-power, is placed in the centre of a large plot of ground, and the conductors radiate from this centre, carrying the power to Edison motors placed in the surrounding buildings. It is difficult to see exactly where the economy of this arrangement comes in, but it probably depends upon some favourable local conditions.

* *

Flexura, *i.e.*, the steel spring, waists are introduced only by the boot maker who has thought fit to make them a speciality, but if the majority were to follow suit, it would not only be an advantage to them (by the extra money that can be charged for such goods), but also to the general public, for by this means a boot is made firm from the back of the heel to the centre of the waist, and this is just about the length of the calcaneum, and gives it a support; and this bone, in its turn, supports the astragalus bone, and prevents unnatural strain upon various ligaments, and tend to bring about flat feet.

* *

Apropos of the gigantic water scheme for Birmingham, a proposal to utilise the waste water which percolates into the South Staffordshire mines is finding some favour. It is contended that, by using a double service of pipes, this water would prove good enough for manufacturing and street watering purposes, hydraulic lifts, etc., which would leave the present water supply solely for domestic purposes. On the other hand, experts say that for steam generating purposes the mine water is useless, owing to its liability to quickly corrode the boiler plates, thus involving constant renewal of steam boilers

* *

A Sunderland engineer has been giving an eight hours day scheme a trial with his workmen. In the latter part of last year he called them together, and told them that, in his opinion, eight hours per day was quite sufficient to work, and that he wanted to have a practical test; but while this trial was proceeding the men would have to submit to a 5 per cent. reduction in wages, so as to recoup the employer for any loss that might arise in business speculation. The men consented, and the experiment has proved successful—so much so that the master intends soon to refund the men the sums reduced from their wages. What we should like to learn, however, is whether the men, with their increased "play" time, are really the better off. If so, how?

The British Horological Institute have announced the resumption of the lectures on Gems, which they arranged to be given by Mr. W. J. Lewis Abbott, F.G.S., last winter. They were then interrupted by the lecturer's illness, and it is an encouraging sign to see that in one direction at least in London some attempt is made at providing advanced technical instruction to those engaged in trades, such as the jeweller's and lapidary's. Mr. Abbott is well known as an expert; he can, and does, give most useful and interesting lectures, for he knows his subject well. Thanks are due to the committee of the Institute, not only for the course of lectures, but for the convenient time at which they commence—8 p.m.; also for the place of their delivery, which is in the centre of the Clerkenwell jewellers' quarter. Rather a contrast this to the Goldsmiths' Institute at New Cross!

* *

During the coal crisis, an interesting experiment in the use of oil as a substitute for coal in raising steam has been in operation at Black Banks Chemical Works, Darlington. A boiler 30 ft. by 7 ft., working at an average pressure of 60 lbs. per square inch, is supplying power for working the steam engines, hydraulics, and air pumps used in the various manufactures carried on at these works. The boiler is heated by oil supplied through two ¾ in. pipes. A small pipe of superheated steam blows into the oil pipe inside the furnace with a noise which may be heard all over the works. The heat obtained is enormous, and there is no difficulty in maintaining the pressure of steam, which can be regulated by merely turning a tap; the heat is sometimes so great as to melt the brickwork. The oil used is creosote, which is made at the works, and the consumption is about 20 gallons per hour. The process has been adopted in consequence of the failure of the supply of coal caused by the Durham miners' strike; the cost, owing to the oil being manufactured on the premises, is less than that of coal. At night the oil is used for lighting purposes, and the light from the orifice of a pipe 20 ft. from the ground, and through which compressed air is blown, is of sufficient brilliancy to light up the whole works. This is a step in the right direction, and goes to show that the resources of civilisation are equal to so portentous a trouble even as a coal strike.

Three noble tusks of ivory are now to be seen on the principal staircase of Messrs. Rodgers' works in Sheffield. They form a goodly trophy, and are probably the finest teeth ever grouped together. The first is 9 ft. long, 21 in. in girth, weighs 161 lbs., and is worth £150. The second is from the Congo, is 8 ft. 8 in. long, 21 in. in girth, weighs 160 lbs., and is valued at £150. The hollow end of this tusk is 2 ft. 6 in. in depth, leaving a length of 6 ft. 2 in. of absolutely solid ivory. Another, which is also from West Africa, is distinguished by its ebony-lined surface, and is the longest of all, standing 9 ft. 3 in., its girth being 20 in., weight 130 lbs, and value £120.

* *

The Public Health Committee of the Aberdeen Town Council has just taken an important action regarding the sanitation of the city, which it would well befit more pretentious cities to copy. Every house in the town that could in any way be suspected of being insanitary was visited by the sanitary inspector and the medical officer. The outcome of the investigation was the condemnation of a large number of houses in various parts of the city. The reasons which have led to this action have been either the insanitary nature of the structures themselves, or the fact that they interfere with the air space and the ventilation of adjacent buildings. A step of this kind rigorously applied to London—say, in the St. Pancras and Clerkenwell districts—would make certain landlords "sit up."

* *

An exhibition and sale of hosiery and other woollen goods from Shetland took place at Ventnor lately. These exhibitions are occasionally held in different parts of England, with the aim of helping on the sale of the hand-spun and hand-knitted garments produced by the Shetland islanders, for which a dépôt was opened in 1884 under the auspices of Lady Aberdeen. Apart from this agency, from which the workers receive prompt and direct payment, their only means of disposing of their work is to local drapers, who pay them in wares from their own shops, and are not in all instances above sharp dealing. Between the profits made by these men and by the London traders to whom the goods are again sold, before 1884 very little ever went into the pockets of the poor women, whose only source of livelihood is in many cases their wheel and needles. Since the establishment of the dépôt all the profits, excepting necessary working expenses, go to the producers, while their work is sold to the public at lower prices than are charged for it at the London shops. Some of the shawls exhibited were marvels of delicacy and beauty, the mesh, though 2 ply, being as fine as the thread of the heavier kind of Maltese lace, and worked in lovely designs, which the islanders themselves produce and hand on to one another. The best of these shawls was valued at £6, but the price does not appear exorbitant, considering that its production was the work of seven months. Underclothes of delicious softness, wraps and gloves, socks and comforters, and everything that can be knitted for men, women, and children, including shaded wrap shawls in sixteen shades of delicately blended brown and grey, were shown in all shapes and sizes. The prices, considering that everything was the result of handwork, were extremely reasonable.

PHOTOGRAPHY BY ARTIFICIAL LIGHT—A NOVEL FLASH LAMP.

BY ST. MUNGO.

So much has been said and written on this subject that I might well approach it with diffidence, but it has afforded me so much recreation that I am quite sure my experience will be of use to some brother of the tripod.

My first experiments were with an explosive compound of magnesium powder and chlorate of potash, lit with a vesuvian; but this apparatus was so little under control, and made so much smoke, that I speedily gave it up, and hunted around for a better, eventually adopting the modified lamp which is illustrated. There is nothing new or original about it, I suppose, but I have never seen one just like it, and have no hesitation in recommending it before any I have seen, for reasons which will be apparent from the description.

The basis of my lamp is an ordinary Bunsen burner, which is in no way altered. I got a piece of mahogany $4\frac{1}{2}$ in. long, 2 in. broad, and $\frac{3}{4}$ in. thick. About $1\frac{1}{4}$ in. from one end I bored a hole which fitted the Bunsen tube: tight enough to stay in any position, but not so tight as to stick.

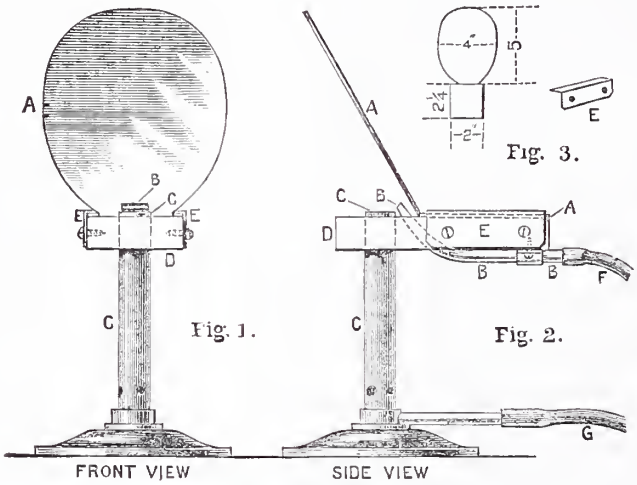
Then I got a piece of brass tube 5 in. long and $\frac{3}{8}$ in. external diameter. This I bent as shown in Fig. 2, where B is the brass tube. Next I cut a piece of tin and bent it, as shown at A. Fig. 3 shows the shape and dimensions of A before bending. Then two pieces of tin were cut and bent in the vice to the shape shown in perspective at E. These, when screwed in the sides of the mahogany, formed grooves for the bent portion of A to slide in. A might have been fixed, but the lamp is easier packed or carried if it is made movable, as I made it. Then a slanting hole was bored in the mahogany to receive the tube, B, which was fastened underneath with a little tin clasp and two screws; and the lamp, with the addition of two indiarubber tubes, was complete.

I had some difficulty at first in focussing, but since I have used my magic lantern to illuminate the sitter I can see the image better; occasionally I get the sitter to hold a taper or candle in various planes, and focus for that; sometimes a piece of bold printed matter held in the hand of the sitter is an aid in focussing.

Having got the focus sharp, and the lens stopped down to f 8 (it works at f 6), I prepare the lamp by introducing about 10 grains of magnesium powder into tube B. For this purpose I simply remove the blowing tube, F, insert the charge, using the small blade of a penknife, three blades full being the usual amount; give the tube a tap or two, so as to shake the powder down into the head, replace the tube, and turn on the gas. The blowing tube is about 2 ft. long, the gas tube as long as may be necessary, according to the position of the supply.

When the gas is lighted the utility of the tin deflector, A, will be seen: it spreads the flame out, and when the magnesium issues from the flattened nozzle at B it is thoroughly consumed. After using some lamps which I have tried, the air was filled with particles of unconsumed magnesium; that never happens with this form of lamp: the powder is thoroughly consumed.

A professional photographer in this town is using my lamp, or, rather, half a dozen of them, daily during bad weather, and is much pleased with the results.



Flash Lamp for Photography. Figs. 1, 2—A, Tin for spreading Bunsen Flame to ensure combustion of Magnesium Powder; B, Flattened Nozzle of Brass Tube through which Powder is blown; C, Bunsen Burner; D, Piece of Hardwood; E, Tin Slides for Deflector, A; F, Tube for blowing Powder into Flame; G, Gas Tube. Fig. 3.—Deflector before bending.

A NEW IDEA IN DOOR-PANEL DECORATION.

BY CHARLES KELSEY.

INTRODUCTION—DESCRIPTION OF THE DESIGNS—COLOUR TREATMENT—MATERIALS REQUIRED—MIXING THE PIGMENTS—GROUND COLOUR OF THE PANELS—PREPARING THE PANELS—SIZE OF THE ILLUSTRATIONS AND METHOD OF ENLARGEMENT—MASSING IN THE DESIGNS—APPLYING THE PIGMENTS—SCHEME OF COLOURING—FINISHING OUTLINE—CONCLUSION.

Introduction.—Many readers of WORK possess some ability in the kindred arts of drawing and painting, and most of these persons are animated by the laudable desire to employ that ability in making their homes more attractive and beautiful. To such, the accompanying designs for the decoration of door panels will prove acceptable.

The mode of their execution, now about to be described, is a novel one, the result being satisfactory, and attained by a small amount of labour: even professional decorators may gather from the description some "wrinkles" which may prove valuable to them.

These door-panel spaces exist in every house, ready for embellishment; and from their conspicuous position form a favourable field for the display of the decorator's art.

The original examples from which the illustrations are taken were executed on the panels on the inside of an ordinary door. In the illustrations, to economise space, the vertical stiles and the horizontal rails of the door are omitted, the panel spaces being alone shown. The designs will be found, so far as arrangement is concerned, applicable to most of the doors to be met with in ordinary houses in towns; and will also lend themselves readily to the variations which may become necessary by reason of the panels, in the door desired to be decorated, being of different proportions to those in the door originally dealt with.

Description of the Designs.—As will be seen, the designs are treated in the Japanese manner. Those for the lower panels represent fish swimming in water, with a few water-plants also indicated. The water is represented by the few ripple lines at the top of the panel, and by a few short horizontal lines lower down, crossing the water-weeds, etc. Those for the upper panels exhibit a treatment of a view over the surface of the water. A few flowers and weeds grow out of the water, some dragon-flies fly above, and some hills are represented in the background. In the upper portion, the bough of apples ignores, in true Japanese manner, the parting stile, and crosses both panels—a treatment which has its advantages, as it brings the two panels into one complete whole.

Colour Treatment.—This being a conventional way of treating a landscape, the colours employed are conventionalised also. Instead of trying to imitate the wondrous variety of colours in nature, a few tints are selected to represent the different parts of the design. These tints are formed by bronzes—*i.e.*, the powdered imitations of gold, silver, etc., and a few mixed tints of bronzes and powder colours.

This treatment emphasises the fact that the designs form a decorative scheme, and that it is not an attempt to paint a picture; and the result will be judged accordingly. Japanese decorators perhaps understand this difference of treatment better than any others, and for this reason their works are almost invariably pleasing.

Materials Required.—These will include charcoal, chalk, or some similar material, for drawing the outline of the designs upon the panels; and a small quantity of each of the following:—

Mediums.—Japanners' gold-size and turpentine.

Pigments.—Gold, silver, and copper bronzes, and a little of each of the following colours in powder: French blue, orange chrome, vermilion, raw umber, and Brunswick green.

Tools.—Two camel-hair brushes, or, as they are sometimes called, pencils. One, a short full brush, for putting in the first masses; and a longer and finer one for the finishing outline. These, with a piece of unwetted chamois leather, complete the outfit. These materials may be procured at any oil and colour store, and should cost but a trifling amount, as the smallest procurable quantities of each only are required.

Mixing the Pigments.—Our intention is to treat the subject with a few coloured bronzes; and, to do this, some judicious mixtures of the colours with the bronzes are required. Proceed as follows: take a little of the green pigment on the blade of a knife, and mix it with a portion of the gold bronze, so as to form a bronze of a greenish hue. If too much colour is added, the metallic lustre of the bronze will be overpowered, and care must be taken to avoid this. Then mix a little of the blue in the same manner with the silver bronze, thus producing a silvery-grey tint. Also mix some of the red with the copper bronze, and make a similar mixture with the brown colour, thus making a rich red and a dark bronze pigment respectively. The orange may be mixed with the gold bronze, forming an orange-gold pigment. Thus, with a little judgment and taste, a few lustrous tints will be secured; and these, with the three bronzes in their simple state, will be the pigments for carrying out the work. All the above-mentioned mixtures must be made with the powdered colours and bronzes in a dry state.

Ground Colour of the Panels.—The idea is to utilise the colour already existing on the door as the ground colour for the designs. If the door has been painted in any of the ordinary flat tints of buff, cream, grey, or green, providing such tints are fairly light, they may be so utilised with advantage without alteration. If the door is painted with some utterly unsuitable colour, a flat tint of either of the before-mentioned colours may be first applied to form a ground; but care must be taken that it is perfectly dry and hard—not sticky in the least—before anything further is attempted. The great advantage of using the existing colour as the ground is the fact that it will be much more hard and dry than any newly applied colour can be. I strongly advise my readers to work upon the existing colour if possible. The design may, with a little judgment, be made to look well upon almost any coloured ground.

Preparing the Panels.—If the paint of the panels presents a glossy surface on which it is difficult to draw, a rub over with a little finely powdered pumice-stone, placed upon a damp rag, will give a better surface for working upon. Indeed, it will be wise to do this under all circumstances, care being taken not to rub through the colour.

Size of the Illustrations and Method of Enlargement.—The designs are one-eighth full size, and may be enlarged to the full size by any of the usual methods. The one usually adopted is to divide the illustrations and the panels into an equal number of squares, making those of the panels eight times larger in length and breadth than those on the illustrations. Say the squares on the illustrations are formed by lines ¼ in. apart, the panels should be likewise divided, only the lines should be placed 2 in. apart. The squares on both panels and illustrations should be numbered alike, and the portion of the design appearing in each square of the particular illustration copied into the corresponding enlarged square of the panel. By this means a properly enlarged copy will be obtained. All these lines upon the panel and also the outline of the design should be drawn with charcoal or chalk, so as to admit of easy obliteration when they have served their purpose.

Massing in the Designs.—Having got the outline on the panels, the next step is to take the largest of the two camel-hair brushes, and charge it with the gold-size. With it mass in all the portions of the design. If the size is too thick to work comfortably, a little turpentine may be worked up with it, but the less of this used the better, as it tends to destroy the sticky nature of the size, which is the property depended upon for the work. If, from the colour of the ground, the size, when placed upon the panel, cannot be seen, a little of one of the colours mixed up with a little turpentine and added to the size will overcome this difficulty. Do not work with the brush barely charged with the size; keep it moderately full.

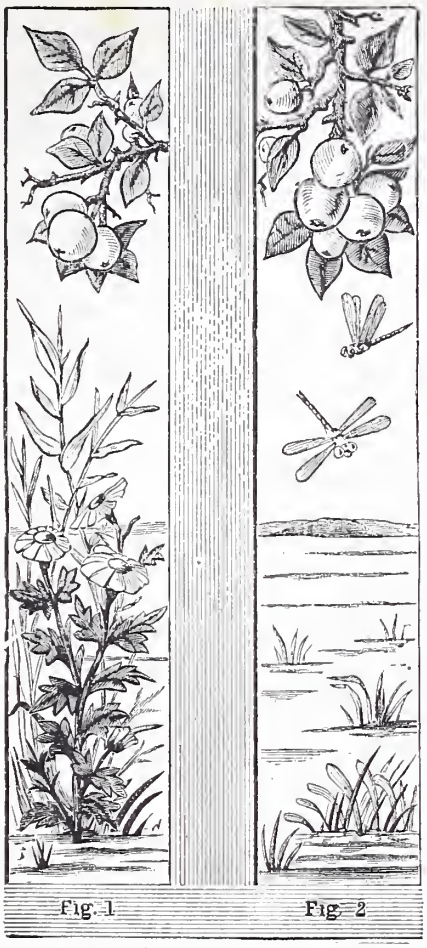
Applying the Pigments.—After the whole or a portion of the designs have been massed in with the size, the work done should be carefully watched to see that the size does not become dry and hard. For this reason too much should not be taken in hand at one time. When the size is dry enough not to smear if the tip of the finger is drawn across it, and yet feels a little "tacky," the pigments must be applied. This is best done by having the pigments each placed upon a separate piece of note-paper, and taking up a small portion, by pressing a smooth part of the chamois leather down upon the pigment and giving a gentle rub. This will cause some of the pigment to adhere to the leather, and the pigment may thus be applied to the particular part of the design where it is required. If the leather is then gently rubbed upon the "tacky" size, the pigment will leave the leather and adhere to the panel. Thus each previously sized portion of the design may be tinted with the desired colour. A separate piece of leather will be required for each tint used.

Scheme of Colouring.—Taste will be necessary in this operation. A pleasing result will be obtained if the colours are distributed as follows:—The high lights of the apples, the centres of the daisy-like flowers, the gills, fins and portions of the bodies of the fish, the bodies of the dragon-flies, and portions of the blades of grass and leaves should be rubbed in with the gold bronze. The silver will be effective used upon the petals of the daisies, the sides and bellies of the fish, the wings of the dragon-flies, the ripple lines on the surface of the water, and similar parts. The copper bronze will be in place on the rosy portions of the apples, the tips of the fins of the fish, the tips of the wings and eyes of the dragon-flies, the tips of the daisy petals, and on portions of the stems and leaves. The silvery grey will be effective on portions of the water, for the distant hills, and the half tones on the fish, on portions of the grass, stems and leaves. The brown tints will be effective used for the apple branches, for the stems, and for portions of the leaves and shaded parts of the fish. The green tint will be useful for the grass and leaves, and for the backs and front portion of the heads of the fish. The red may be used for the apples and portions of the fish and leaves; the orange for the high lights on the grass.

The leaves should be treated much after the style of nature's autumn tints. The whole should be treated so as to produce a pleasing colour effect, taking nature as a guide in the distribution of the tints, but there is no necessity to copy her slavishly in this particular instance. The use of the colours in powder will facilitate the blending of the tints, and many pleasing accidental tints will also be obtained.

Finishing Outline.—The superfluous colour must be wiped away with a soft duster, and the designs will then appear in their broad forms upon the panels. The last operation is by the addition of a brown outline to give force and definition to the designs.

Mix a little of the raw umber and the



Designs for Door Panels. Figs. 1 and 2.—Upper Panels, left and right. Figs. 3 and 4. Lower Panels, left and right.

vermilion together, grinding them up a little with the blade of a knife upon a piece of glass or a china slab, moistening the colours with a small quantity of turpentine. Then add about an equal quantity of the japanners' gold-size, and this will form a paint with which the outline may be made. If this is found to dry "dead," add a little more of the size until a glossy, drying paint is obtained.

The longer and finer of the two camel-hair brushes must now be charged with the brown paint, and the design gone over with it. No formal outline round all parts must be

made, but a few artistic touches are required so as to bring out the salient points and give definition to the designs. These touches should be placed on the shaded sides of the stems, on the edges of the flower petals, on the lower edges of the leaves, with a few markings to indicate the veins. A few touches will represent the gnarled bark on the apple branches and the eyes of the apples, which require also a few touches to express their rotundity and an outline round their shaded sides. The eyes of the fish, with the markings round the gills and mouth and on the fins and tail, may be put in in a similar manner.

A few touches along the surface of the water will indicate ripples, and a line along the base of the hills will give the distant shore. In the lower panels the water will be represented by a few ripple lines at the top, with a few short horizontal touches lower down, crossing the water-weeds, etc.

Conclusion.—This completes the process, and though the description of all the details of the process—oftentimes required urgently by amateur workers—may make it appear a formidable undertaking, in truth it is not so. The worker, with a small amount of ability, will find that the result is easily obtained, and very satisfactory when finished.

When the work is thoroughly hard, a coat of varnish may be given, but this is not essential, nor altogether desirable, for the varnish has a great tendency to destroy the metallic lustre of the colours, which is one of its greatest charms. If the stiles surrounding the panels are of a darker colour (as they usually are in existing flat tinting), the panels will be, as it were, framed in, and their beauty enhanced.

Speaking from experience, I may say that any reader who is induced by the article to take the matter in hand will be more than satisfied with the result. The process described may be used with equally satisfactory results with other designs, which may be suggested by the present one, and by this means the home may be rendered more attractive and its beauty enhanced.

HOW TO MAKE A PHILOMELA.

WITH MORE ABOUT VARIOUS ZITHERS.

BY AN OLD ZITHER TEACHER.

On page 390 of Work, No. 129, Vol. III., R. F. was good enough to give us ample directions as to how to build a zither. On page 747, No. 151, appeared a supplementary article from my pen, dealing with the stringing and tuning of the instrument. The large number of inquiries and letters which have been forwarded to me by the Editor is a proof that a very considerable section of my fellow-readers are interested in this charming and eminently simple instrument. Hence the present article, which, however, is devoted to the construction of a cognate musical vehicle

First, though, let me suggest to any who may undertake the making of a zither, that considerable augmentation of tone can be secured by adopting the shape shown in Fig. 1, which is that of the "Arion" zither. This form was designed by a well-known specialist some years ago, and embodies several distinct improvements over the usual type. Foremost among these may be instanced the greater area of the "tables," or sound-boards, which of course admits of a far greater volume of sound, not, however, at the expense of any of the pure, distinctive tones peculiar to the zither alone. Then, again, the strings are affixed by means of pins, as in the guitar—a matter which conduces more to the elegant appearance of the instrument than to any marked superiority of timbre—although the attachment of the tail-piece to the belly is by some supposed to improve the tone also.

As to the rich form of the "Arion" there can be no two opinions; and it need not be mentioned that there is no difference in the manner of playing. Now, anyone capable of building a zither of the usual shape would have no great difficulties to contend with in the construction of the "Arion," whilst the finished result, being a decided "thing of beauty," should be a "joy for ever." Allied to this is the "harp" zither (a sketch of which I append in Fig. 2). This form of the zither was originally designed to accommodate a large number of supplementary bass and contra-bass strings, which, however, do not appear in the drawing. Such additional strings are of very limited use; but the extremely elegant design might be followed to advantage, especially as it presents no insuperable obstacles to the constructor.

With these few remarks or hints to those who contemplate the building of a zither, we come to the real object of the present article, which is to describe the Philomela and its prototype, the "Streich" zither, for the benefit of the very large number of Work readers who, having overlived their opportunities, can never hope to excel upon the violin. Only about one per cent. of all who commence to learn the latter instrument ever achieve more than mediocrity; and those who really excel have attained their proficiency only at the expense of long-continued and severe application.

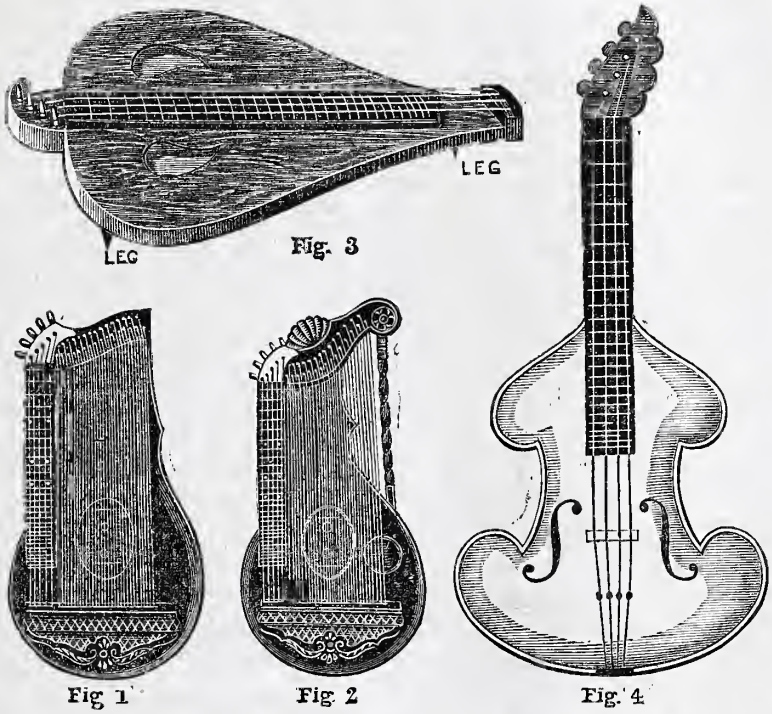
In introducing to the notice of would-be violinists such instruments as the "streich" or "bow" zither, I am confident of receiving the thanks of a very numerous class, as upon either of these very elaborate violin music may be performed with only a few weeks' practice. Of the two, the earliest form is the streich zither (shown in Fig. 3). This consists of an upper and lower "table" or sound-board, of the bellows-like form shown, the upper one perforated with "rosettes" or sound-holes of arbitrary shape. Along the centre for the greater portion of the length runs a slightly rounded fret-board, full instructions for the division of which into semitones have already appeared in the pages of Work. Four metal strings are used, attached at the "bridge" end as on the zither proper, and strained by pegs in the ordinary way. The lowest is of wire, wire covered, and is tuned to G; the second, also covered wire, is tuned to D; and the third is a brass wire tuned to A; while the fourth is a fine steel wire tuned to E. Thus the pitch, tuning, and compass of the instrument are identical with those of the violin. Great facility of execution may readily be acquired, as all the notes are formed by the frets; while the bowing is done across the narrow end, which projects over the edge of the table for the purpose. A single leg, with a minute spike, is provided at about 2 inches from the tail-piece, while two others, somewhat higher, are placed one on each side of the wider part (as shown in Fig. 3).

The tone of the bow zither is almost exactly the same as that of the violin, but is, unfortunately, rather thin and weak. For the latter reason the Philomela, or Philomel zither, or zither-viola (each name is used), has been invented. This instrument approaches very nearly to the violin in tone and volume, and may be regarded as the

perfect form of the streich zither. Although it differs very much in shape, and is played in a different manner, there is no easier instrument of the viol type; and all who have given up the violin in despair are hereby invited to make a trial of the "Philomèle." (This is shown in Fig. 4.) The neck differs from that of any other instrument, inasmuch as it is square and of equal thickness through its whole length. It may be slightly rounded on the fret-board, and the divisions of the latter are the same as on any other form of zither. At the back of the "nut" or thereabouts is a short spiked leg, which rests upon the edge of the table in playing, while the broad tail-piece end is supported upon the lap of the player. A somewhat shorter bow than usual is employed; and of course the fingering is done with the thumb and three first fingers of the left hand. The latter is not curled round the neck, as in the violin, but is held in a drooping position over the fret-board. Now, as to its construction, the philomela offers no difficulties, as the back and belly may be left flat; though if shaped, as in the case of the violin, a more elegant result is obtained.

The admirable articles which have appeared in these pages on the construction of the violin and mandoline—as well as the one quoted, which deals with zither building — comprise all necessary instructions as to the making of the ribs, which is the only delicate matter in making a philomela. As to the size, the viola or tenor violin may be taken as about correct; but of course the neck is wider. Sound-posts are employed, as in the violin. Machine heads are usually affixed, but are not *de rigueur*. For the information of possible inquirers, I may add that the philomela may be bought at about two guineas, but that they are not much known in this country; also that instruction books for the streich zither, which of course would be applicable also to the philomela, are to be procured, but only in the German language. Finally, that considerable proficiency may be attained in a fortnight, while the most difficult violin music may be performed after a few months' application.

I have endeavoured to say my say in as few words as possible, and to convey my meaning as clearly as I could; but if any point remains obscure, I shall be happy, with the Editor's permission, to give any further information through the "Shop" columns.



Philomela. Fig. 1.—Arion Zither. Fig. 2.—Harp Zither. Fig. 3.—Streich Zither, ordinarily called the Bow Zither. Fig. 4.—Philomèle, or Zither-Viola.

HOW TO PAPER A ROOM.

BY ONE WHO HAS DONE IT.

All the old paper should be first stripped off the walls. A painter's stopping-knife is very handy for this; but if you find it will pull the wall about too much, you may leave those parts that are thoroughly stuck to the plaster; but it is better to take it all off, being careful not to dig into the plaster with the knife. Pull out all nails, etc. All loose or bad places should be cut out, and be made good with plaster-of-Paris or a piece of brown paper pasted over them. When dry, give all the walls a coat of thin size (as when clear-coleing a ceiling). The sizing sometimes shows up loose pieces of paper that have not been torn off. If this is so, tear them off, and touch the places up with size again.

Now cut the edges of the wall-paper. The best way for a novice to do this is to unroll a piece of paper right along the length of the table or paste-board, letting the unrolled part fall on the floor at the other end. Then, sitting down, start cutting the edge off right up to the pattern, rolling the paper up with the left hand as you do so. When one edge is done, turn the piece round and unroll it, again letting the unrolled part fall on the floor at the other end as before, and trim the other edge, cutting right up to the pattern. A pair of sharp paperhanger's scissors is best for this, which must be done very carefully and true, as we are going to butt our edges together, and not lap them, so you see they must be perfectly straight. The pattern is straight enough, if you only cut exactly to it in a series of decisive cuts as long as the scissors will allow. The paper is now rolled up again in the same way as it was before you started. Bear in mind that the outside end of the piece is always the top of the paper. Now proceed with the rest of the pieces in the same manner.

To make the paste, put half a quartern of flour in a clean pail, and thoroughly mix it with clean cold water until it is of the consistency of thick cream, and then pour boiling water on it quickly out of a saucepan, mixing it all the time until it thickens. Then stand it by until it gets cold. Sometimes alum is put in it; about half an eggcupful of powdered alum would be an advantage, but nothing else.

You must have a good table to work on, at least 5 ft. 6 in. long. If your table is not long enough, it will pay you to buy two ½ in. by 11 in. pine boards 6 ft. long, and lay them side by side on the table, secured together by two battens screwed on underneath. Cover the top of these with brown paper pasted on. You will now have something to work on, and will not damage the table. Now cut the paper to the lengths required. This is the most ticklish part, but, if you pay strict attention to what follows, you will be all right. First cut off a length 2 in. longer than the height from skirting to ceiling, and tack it up in its place temporarily, so that it is one inch too long at the top and one inch too long at the bottom. Now offer the next length up not cut off, and you will see that to make the pattern match you must waste a piece. How much, of course, I cannot tell, so much depends on the pattern chosen, the length of which is indicated by dots on the edge of the paper; cut this next length off the same length as the first, and tack it up beside it, making the pattern match.

Now by studying these pieces you will see what I mean. The first piece can now be taken down and laid on your paste-board face upwards. Now the next piece, and make the edges coincide as they lay there; then look carefully at them, and lay the second piece directly over the first; now unroll the third piece, making the pattern match with the second on the opposite edge to that which matches the first. Cut it off, allowing enough; but be careful you do not allow too much, or you will cut into the block for the other end of the next piece. Go on in this manner until you have cut as many lengths as you require. Now grasp the whole in your hands and turn them face downwards, get the edges all nice and even, and push the whole of the pieces about 3 inches away from the front edge of the board, letting both ends overhang the board equally.

You should have an apron or you will make your clothes in a dirty state; one with a bib, and a pocket in front, is the most convenient for all these jobs about the house. You next want a brush—a stiff hat-brush will do, that can be washed afterwards—a clean piece of rag about the size of an ordinary duster, and an old wheel castor off a chair fastened to a bradawl handle for rolling down the joints. These things, with your scissors, should be in the pocket of your apron.

Now for hanging. Work your distemper brush well into the paste, and clean it by scraping it on the edge of the pail. Keep the pail in one direction, so that you scrape the brush against the same side, then when you lay the brush on the top of the pail you do not get the handle covered with paste. Pull the first piece of the paper towards you, so that the edge nearest comes over the front edge of the board about half an inch, and draw it to the left, so that it overhangs the board on the right-hand side about half an inch; the right-hand side should be the bottom of the paper. Now commence pasting this first piece, beginning at the bottom,

and paste the whole length of the board. You will see that you cannot paste the board, and the paste that goes on the paper at the back does not matter. Now take hold of the bottom edge of the paper, and fold it back on itself, letting it lay lightly on the other pasted part without wrinkles and the edges coinciding. Now carefully draw it from right to left along the board and paste the rest, being very careful that you do not let any paste get on the face side.

See that your steps are convenient for your getting up on. Starting from one side of the window, carefully take the pasted piece of paper by the two top corners, and bring these next to the ceiling; see that the length hangs straight and upright with the window. Having previously plumbed the outside of the window frame, gently press the top part of the paper to the wall just sufficient to hold its weight; draw the bottom away from the wall and undo the folded portion, letting the whole length hang free of the wall except the top six inches. See that it hangs perfectly plumb, and with a downward sweep of the brush in the centre fix it there, and then brush it outwards both ways from the centre. It should now hang without a wrinkle. Mark on the face of the paper with the back of the scissors along the line where the wall touches the ceiling; draw the paper gently away and cut it along this line, brushing the paper back afterwards; treat the bottom in the same manner. Now go over the whole with your clean cloth, dabbing it all over carefully, and roll the edges down with your wheel or castor. If the top or any other part wants a little adjusting gently draw it away from the wall, and brush it back to its place. Proceed with the next piece, taking care that the pattern matches and the joint butts exactly. Go round part of the room in this manner until you come to the door, and then commence on the other side of the window and go round in the opposite direction, taking care to finish behind the door or in a dark corner. Frequently try the lengths with a small plumb-bob, with the end of the line fastened round a bradawl, so that by lightly driving the bradawl into the plaster directly in the joint of the paper you can at a glance see how you are getting on.

When you come to internal angles measure the width of paper you want from the last piece hung up to the angle, and cut that width on the paste-board, and then hang it, following with the remainder cut off this piece, and then start with a whole roll again.

In all cases I should advise you to use such papers as will stand a lot of handling in the hanging, and from which any paste, etc., can be sponged off afterwards.

English wall-paper is made in pieces 12 yds. long by 20 in. wide, so that in measuring a room for papering, go round the room marking off how many 20 in. there are round the walls, then reckon how many lengths you can get out of the 12 yds., allowing for waste; divide the number of 20 in. there are round the room by the number of lengths you can get out of the 12 yds., and this will give you the number of pieces required.

One pair of paperhanger's scissors, 3s.; flour, 3d., must be provided; distemper brush, we will assume, was bought when we did the ceiling.

In view of the approaching warm weather many rooms will want re-papering—if comfort and health are to be considered; and they should be.

MICRO-PHOTOGRAPHY WORK.

BY ARTHUR RENAUD (B.A. OXON.).

Difference between Actinic and Visual Foci—Precautions to be taken when Focussing—Method of using Vertical Microscope—Method of taking Photographs without a Camera in a Darkened Room.

Having now focussed the object, and got it clearly and sharply defined on the ground glass of the camera, we could proceed to take the negative without further delay, were it not that at this stage of the proceedings there is another matter which has to be taken into account, as, though it is quite immaterial to an unscientific gazer at microscopic objects, it influences very much our photographic work, which has to be conducted with great precision if the results are to be satisfactory. Supposing the camera and microscope have been fixed as directed, and the image focussed with the greatest care, and a plate exposed and developed quite successfully, it may happen (and probably will) that the negative, in spite of the accurate focussing bestowed upon it, is nevertheless more or less out of focus! This, though it may be rather disheartening to one who knows nothing of the cause, may easily be set right by investigation. It is simply due to the fact that every lens, as far as our work is concerned, is possessed of two different *foci*—that is, one called the *actinic* focus, the other the *visual* focus. Now, if in any particular lens these foci coincide, there will be no difficulty, and when the object is sharply focussed on the screen the plate will also receive a sharp image. But in nine lenses out of ten the actinic is not coincident with the visual focus, and consequently allowance has to be made for this in actual work. The correction may easily be made by means of the fine adjustment. One cannot tell beforehand what allowance is necessary, and a plate or two will have to be sacrificed to find out. Only, do not proceed unmethodically, and so waste the plates, but make notes of the amount of displacement—*i.e.*, the number of divisions of the milled-headed screw which have been turned through during re-focussing—necessary to obtain the best results for each objective you use, and these notes will then enable you to go right at once in future.

A simple method of arriving at somewhere near the correct amount of alteration required, and which may very likely hit it exactly, is the following:—Take a photograph in the ordinary way at the usual visual focus, develop, fix, and dry in the usual way. Now, supposing that the foci do not coincide, the picture will be more or less blurred. Remove the lens from the object by means of the fine adjustment, until the image on the ground glass screen of the camera is just as much blurred as that of the negative. Take another negative with the lens in this position, and you will probably have a sharp image. One or two trials will settle the question, and the amount of alteration required for that lens should then be carefully noted for future use. It is worth while to remark that the amount of difference between the foci has no influence on the good or bad qualities of the lens. Some objectives require no alteration whatever, while others which necessitate a considerable movement from the object can be made to give just as good results.

Mr. Wenham has introduced the idea of having a bi-convex lens of low power carefully centred in a setting that can be inserted in the place of the posterior diaphragm or stop; the chemical focus is thereby brought back to the visual focus. If a lens is found that will give the necessary correction exactly, of course this method gives excellent results, but it would probably necessitate the choice of a lens from a large number for each objective, and the majority of my readers will probably prefer to work on the first plan.

Mr. Highley's is a method of combining the object-glass and camera together, which may be interesting and considered worthy of a trial by some readers. The sectional diagram (Fig. 3) will help to explain it.

A tube, A, is inserted in the flange of a camera, which should be able to extend at least 24 in., and the front of it is closed by a plate into which screws the object-glass, B, the eye-piece and tube of the microscope not being used. Over the tube, A, slides another tube, C, which is closed by a plate, D. This latter plate extends beyond the upper and lower circumference of C, and carries a small tube, E, on which is fixed the mirror, F. To the upper part of D the fine adjustment, M, is attached; this consists of a spring-wire coil acting on an inner tube, G, to which the stage plate is affixed. The spring is regulated by means of a graduated head, K, which acts on a fine screw, also attached to the stage plate. Opposite the graduated head is fixed an index, L. The stage and clamps, H, slide vertically up and down on the plate, D, and when these are moved vertically, and the object-slide horizontally, the object is easily moved sufficiently to bring it into the field. This is rather an obscure description, but those who use Beck's microscopes, or others with sliding stages, will easily understand how it works. The amount of the object required being brought into the field by adjusting the stage, the image is roughly focussed by sliding the tube, C, over the tube, A, and the fine adjustment is then used to get the details accurately focussed, allowance, of course, being made for any difference between the visual and actinic foci of the objective. It is said that, by greasing the focussing-glass, which should be a finely-ground one, with oil, this arrangement forms an agreeable method of viewing microscopic objects with both eyes, and is less fatiguing than the ordinary method.

We now come to a method by the use of which a camera which has no arrangement whereby it can be placed horizontally may be used with the tube in a vertical position. To do this a right-angled prism is used, one side of which is fixed to a tube which slides over the tube of the microscope. The image is thereby thrown at right angles into the camera, which stands above the microscope. Fig. 4 will explain the arrangement.

A is an ordinary bellows-bodied camera, placed on a stand, G, which raises it above the microscope, E. This latter has a right-angled prism, D, fixed to the top of the tube by a short brass tube, another one similar to which is fixed to another side of the prism, and slides into a brass tube, C, which in its turn slides into a square chamber, B, fixed to the front of the camera. The right-angled prism reflects the rays from the object on the stage of the microscope into the tube, C, and thus on to the focussing-glass of the camera, A. Having focussed clearly by moving the tubes and the back of the camera (or front, as the case may be), the final focussing is accomplished by means of the fine adjustment, H, of the microscope. By this arrangement it is evident that the same method of illumination may be made use of as in the case of the microscope placed horizontally, as the rays of light can be reflected by

the mirror up through the object placed on the stage.

Another method of taking photographs, with the microscope fixed vertically and using sunlight, is that which has been employed by Mr. Wenham, in which the camera is entirely dispensed with. This may seem astonishing; but the fact is, that the room in which the operator is at work is turned, for the time being, into an enormous camera. Supposing we wish to take photos in this manner, we proceed in the following way:—The first thing to do is to darken the room, which is easily done by having a wooden board to exactly fit the lower half of the window, and a frame of wood to fit the upper half. When these two are up, one on the top of the other, they should fit tightly inside the frame of the window, and exclude the light. If there are any chinks, a few thicknesses of cloth should be glued round the edges, which will be pressed tightly against the sash of the windows when in position, and keep out any rays that might get round the sides of the frames. The top frame is now covered with thick brown paper in which there are no pin-holes. On the wood, at the bottom half, a little carpentering has to be performed. Two circular holes have to be cut, one about 3 in. in diameter, and another, at a few inches' distance from the first, large enough for the passage of the operator's arm. This latter hole has a flexible sleeve attached to its margin which fits round the operator's sleeve, and thus prevents light from entering at the wrong place when his arm is thrust through the hole, and also covers the hole up when his arm is removed. Outside the first hole is arranged a solar reflector, or an ordinary mirror mounted in such a way that it can be turned in any direction round its centre, and thus made to reflect the sunlight through the hole when turned by the hand, which is passed through the second hole for that purpose. If the reader possesses a heliostat, by all means let him use it, by placing it on a shelf fixed outside the shutter in such a position as to reflect the sunlight through the hole as it turns.

The microscope has now to be placed on a table or bench in front of the window, at such a height that its axis corresponds with the centre of the aperture of the first hole, through which the sunlight is entering. The eye-piece of the microscope is generally removed. The object is placed on the stage of the microscope in the usual position, and the light is reflected on to the mirror, and thus up through the object, either directly or condensed by a bull's-eye condenser. A vertical stand, with a board fixed horizontally, is placed on the bench, the board being vertically above the tube of the microscope. This board has, on its under-side, two supports for the plate, which is thus held horizontally above the microscope. All being thus prepared, a card of the thickness of the plate, or a negative glass with white paper pasted over it, is placed in the supports under the board, and the image of the object which now appears on it must be accurately focussed. The top of the microscope has now to be covered with a cap, corresponding to the cap of the lens of an ordinary camera, the light between the orifice of the shutter and the object-glass being shut off by means of a black cloth, or otherwise, and all light except that falling on the mirror beneath the stage is shut off. This can be done by making a sleeve of black cloth to fit round the 3 in. hole, the other end being fastened tightly round the bottom of the microscope, so that no light enters except that falling on the mirror. The plate having been substituted for the card under the board, the cap of the lens is removed, and the exposure takes place, at the end of which the cap is replaced and the plate developed as usual.

If the microscope can be placed horizontally it is best to do so, as the work thus becomes easier, the light being more readily shut off between the orifice in the shutter and the lens, and the board to hold the plate being more readily placed in a vertical position than horizontal; focussing also is rendered easier, as the board can obviously be moved along the table till the correct point is nearly found, and the rest done by the fine adjustment of the microscope. The first plan can, however, be made to give equally good results in competent hands. It is possible by this method to obtain good photographs of different parts of an object not lying in the same plane, by focussing the parts separately, applying pieces of card suitably shaped to cut off the different parts of the images, as required. With very minute objects and high powers, it may be necessary to use an achromatic condenser as well as the bull's-eye.

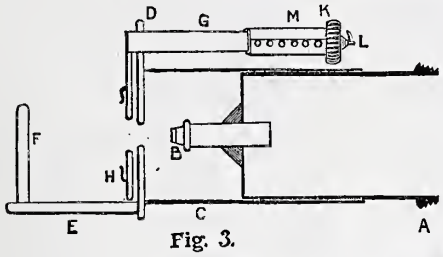


Fig. 3.

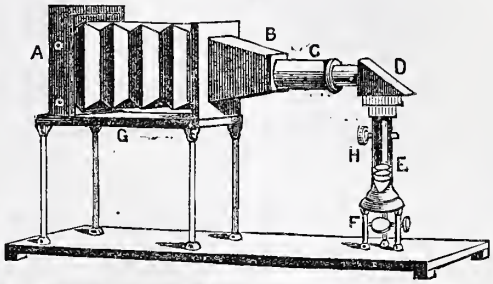


Fig. 4

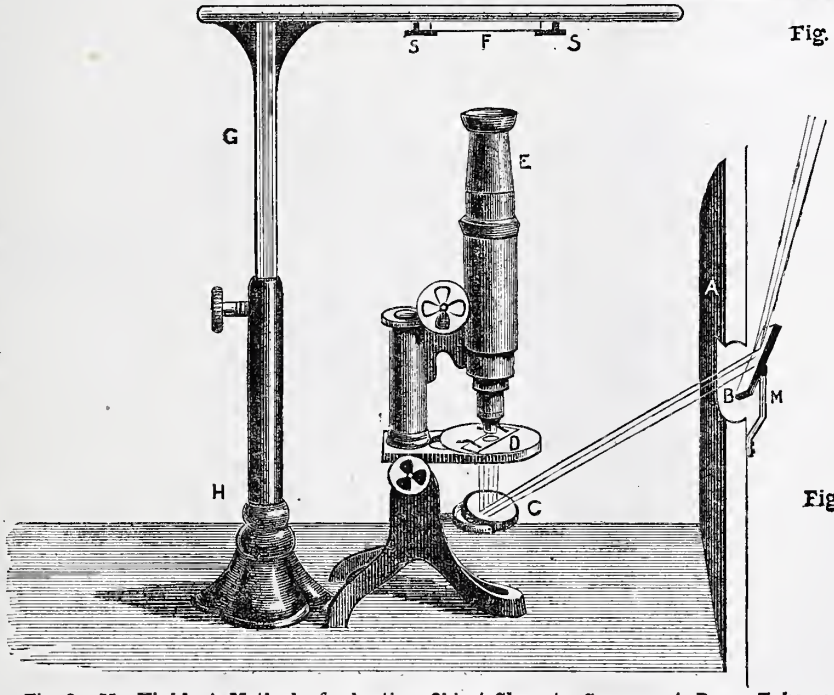


Fig. 5

Fig. 3.—Mr. Highley's Method of adapting Object-Glass to Camera—A, Brass Tube screwing into Flange of Camera; B, Object-Glass fitting into front of Tube, A; C, Tube fitting over A, carrying the Front, D, and the Fine Adjustment, M; G, Interior Tube of Fine Adjustment fixed to Stage-Plate, which carries the Stage and Clamps, H; K, Milled-headed Screw of Fine Adjustment; L, Index of Fine Adjustment; F, Mirror. Fig. 4.—Method with Camera placed vertically—A, Bellows-bodied Camera of any ordinary make, to front of which is attached the Chamber, B, into which slides a Brass Tube, C; D, a Right-angled Prism, to one face of which is attached a Tube sliding into C, to another side a Tube sliding over the Microscope Tube; E, Microscope; F, Mirror beneath the Stage of Microscope; G, Stand to support Camera above Microscope. Fig. 5.—Method of taking Microscopic Photographs without a Camera—A, Shutter with Hole, B, through which the ray of light falls on the Mirror, C, and is reflected upwards to the Object, D, and through the Microscope, E, to the Plate, F; G, Adjustable Stand with heavy Base, H, holding Plate above Camera, supported by Side Struts, S, S; M, Mirror adjusted outside the Shutter.

I have submitted here a diagram of the arrangement, in order to show how the different parts are to be put together. The sunlight is reflected by the mirror, M, through the hole in the shutter, to the mirror, C, of the microscope: a bull's-eye condenser may be placed at B, if required. The light reflected by the mirror, C, passes through the object up the tube, E, of the microscope—the eye-piece having been removed—and is focussed on the sensitive plate placed at F, and supported horizontally above the camera by the struts, S, S, the board being fixed to a stand with a heavy leaden base, H.

The length of the base-board and bellows of the camera is no trouble: the ceiling of the room is the boundary-line. It is far easier to get the picture into any definite space required. Then there is the possibility of focussing in different planes, and, by the same method, of exposing different parts at a time. The thick, yellow portions of the object may be given a longer exposure than the lighter parts. We can arrange a frame to hold the plate, and, by substituting a piece of fine ground glass when focussing, it can be accomplished by a magnifying focusser.

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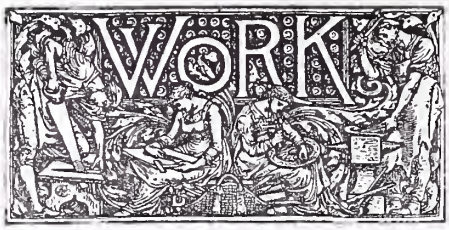

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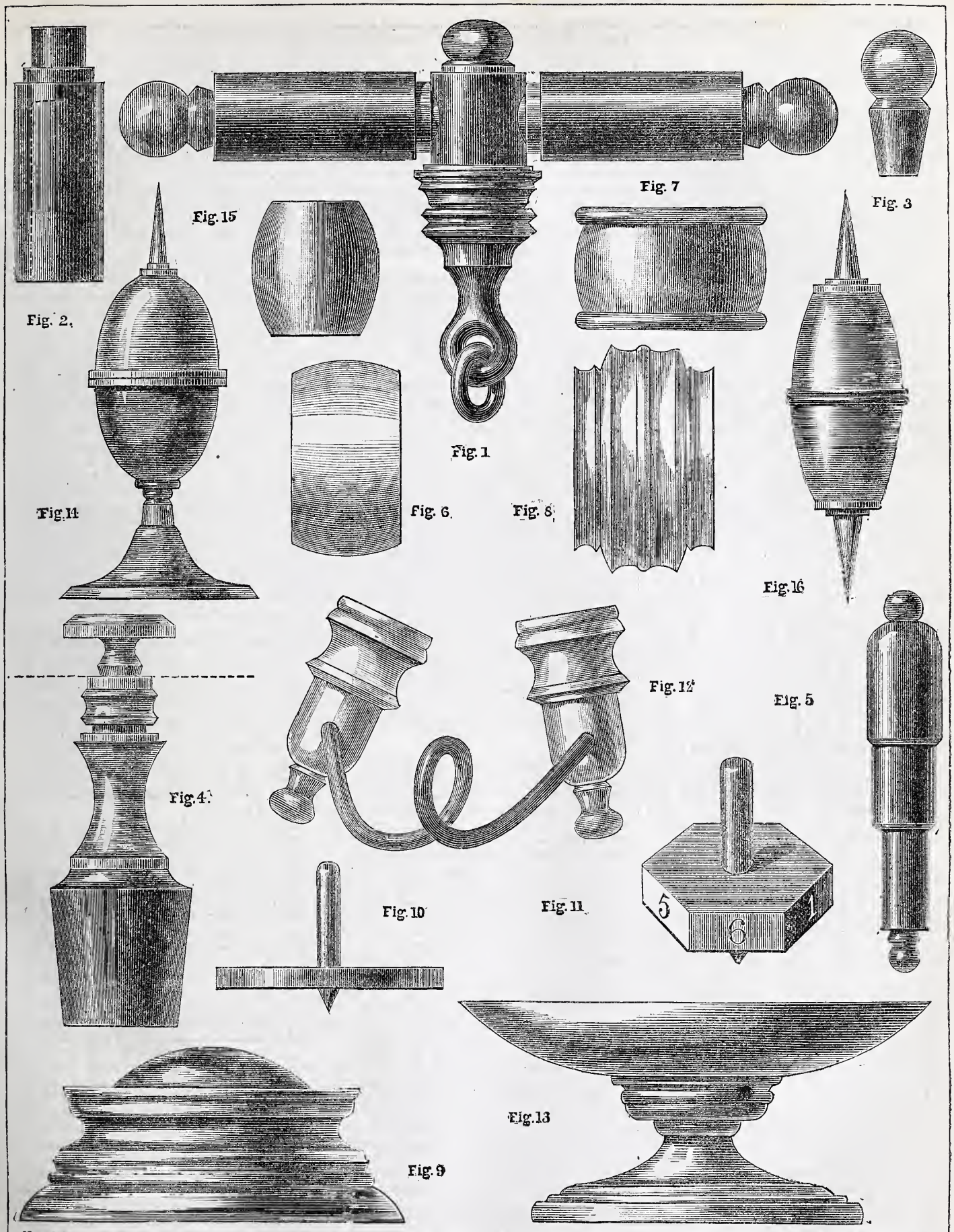
CRAFT TRAINING.—With fit and proper zeal the Worshipful Company of Carpenters, in union with the Joiners' Company, have in progress another competitive exhibition of models, drawings, and specimens of work allied to the carpentry and joinery trades. Too much publicity cannot be given to this scheme, which will declare itself in May next, especially as the prizes offered are worthy of competing for, and are on a scale which should induce all constructive workers in these particular crafts to enter the lists. It is the larger question of technical education, however, with which we are most concerned. It is in the power of these ancient and honourable City Companies to do more for the cause of craft training and the education of apprentices and others than any other public body, and it is a privilege which the Masters and Wardens of each should be jealous to turn to account. No action which the Companies could take would be more commendable than that of inaugurating classes and competitive examinations such as would be calculated to promote the branches of the trade they represent. By this means many trades in this country might be revived, and much of the old repute of English workmanship restored. Certainly no more effective blow could be given to the disheartening inroads of foreign trades and manufactures. These wealthy civic Companies number some seventy or eighty—some of them, it is true, representing defunct industries—industries, however, which in many cases might by energetic action be revived in this country. Speaking at one of the banquets lately, the Master of the "Worshipful Company and Antient Mistery of Horners" stated that he hoped soon to be able to treat the public to an exhibition of articles still made in this country by horners, which might surprise many who regarded the industry as a trade of the past. We shall look forward to this exhibition with much concern, and shall be glad to give it all assistance in our power—movements of this kind being specially identified with such a journal as WORK. May we suggest to this and other City Companies a careful consideration of the subject of systematic and well-devised class instruction—on that liberal scale which they can afford—in the several trades with which the Companies are allied? If moved to do so, the London City Companies could set an example to the whole world in the matter of technical education. We will see if the Guilds will not stir themselves to enhance their great and honourable reputations.

WORKMEN'S TRAINS.—A matter of already great, and still growing, importance to workmen in large industrial centres is their cheap and easy conveyance between their workshops and their homes. To meet this want something has been done by the railway companies; but still not much, when we consider what they might do. The latest cheap train in the morning conveying toilers to work is usually run too early for the convenience of those working in warehouses and shops that do not open until 8 or 9; and it is no uncommon thing for members of these classes to come up to town by a 6 o'clock train so as to avoid the extra payment by ordinary trains. The time between their arrival and the opening of their shops is spent in loitering about the streets, or dozing on seats in public gardens, if the weather be fine; and if it be bad, refuge is taken in a coffee shop, and the weary waiting performed over a mug of cocoa, or tea, or coffee. This is far from a stimulating preparation for a day's work, and it is evident that the interests of the employers themselves lie in the extension of the workmen's train service. The company that stands foremost in this movement is the Great Eastern Railway, whose liberal policy has brought them a rich reward, for towns and working men's homes have grown up all along that line in consequence of its cheap train service, and this has become its most remunerative traffic. As an instance of how far a railway company may go in reducing fares, take the trip between Enfield and Liverpool Street, a distance of eleven miles. The fare by workmen's trains is 2d. return—twenty-two miles for 2d! Eleven miles instead of one for 1d.—the ordinary fare; yet these trains pay the company better than their ordinary trains. The reason, of course, is that the trains are full, and not, as too often happens, *full* of *empty* seats. It is thus not a question of philanthropy, this reduction of fares, but business.

WEIGHTS AND MEASURES.—Thanks to the courtesy of the Speaker and the Serjeant-at-Arms, we were privileged to join in the recent ceremony of examining the standard yard measure and pound weight deposited at the House of Commons. The bronze yard measure, marked "Parliamentary copy No. 4," and a platinum pound weight marked "P. C. IV.," were, by means of a balance of precision, and a microscopic comparator which had been specially prepared for the purposes of the examination, carefully tested; and we can assure our readers that they need have no misgivings on the score of accuracy of these important standards. After the immured standards had been compared, they were replaced in the box, which was sealed with the seal of the Standards Department. The soldering-up of the lead case, and the re-insertion of the stone in front of the cavity in the wall, was subsequently carried out; and except some unforeseen occurrence happens, the next examination need not be made for another twenty years.



Novelties for Wood-turners. Fig. 1.—Double Needle Case. Fig. 2.—Part of Fig. 1, which contains the Needles. Fig. 3.—Stopper of Needle Case. Fig. 4.—Needle Case in shape of a Decanter. Fig. 5.—Needle Case in the shape of a Cannon. Figs. 6, 7, 8.—Napkin or Serviette Rings. Fig. 9.—Pin-cushion. Fig. 10.—Boxwood Top. Fig. 11.—A Teetotum. Fig. 12.—Knitting-Needle Case. Fig. 13.—Pin Tray. Figs. 14, 15, 16.—Thimble Cases.

NOVELTIES FOR WOOD-TURNERS.

BY A TURNER.

Needle Cases—Napkin Rings—Teetotum and Top.

The articles which come under this heading are useful for a variety of purposes, and, when exactly finished, have an extremely picturesque effect. They may all be produced in a very short space of time, and with the aid of the most simple lathe and tools; and since most of them are of rather small dimensions, the labour expended in their production is not very great.

Let us now consider the construction and use of each of these articles in detail. Fig. 1 is a case intended to contain needles or pins. It consists of a turned handle having a ring fixed on to one of its ends, and two oblong cases, which contain the needles, fixed at the other end. Each of the oblong cases has its open end secured by a stopper of the same shape as those which are used in glass bottles. We will commence the construction by making the handle. This should be about 3½ in. long, and should have the part of the end where the oblong cases are to be fitted turned quite smooth for about 1 in. in length, as indicated in Fig. 1. This having been done, and before turning down the other end of the handle, prevent the mandrel of the lathe from rotating by inserting the point of the index spring into the division plate, if your lathe has one. If you do not possess a division plate and index, unscrew the chuck containing the handle from the lathe, and fix it in a vice; then bore a hole with a ½ in. centre-bit through the centre of the part of the handle which was turned quite smooth. Be very careful, in boring the hole, that it goes exactly through the centre of the handle. Now finish off the rest of the handle with ornamentation, as shown in Fig. 1, or in any other manner you please, and remove it from the lathe. The ring must next be turned and cut in half, in order that it may be inserted into the hole bored for its reception in the end of the handle; the two halves are then glued together, and when quite dry, the place where they are joined is carefully pared with a sharp chisel, in order to remove any glue which may have escaped.

We have now come to the two oblong cases, which are to contain the needles. These are made in the shape shown in Fig. 2. A hole ¼ in. in diameter is bored down the middle, and the end is turned down ½ in. in diameter for about ½ in. in length, so that it will fit into the hole which was bored for its reception through the handle. The hole down the centre is best bored with a chisel ¼ in. wide, and having its edge not quite at right angles to its length, but ground so as to form a slight angle with that direction. When both of the cases are completed, glue them into the hole made at the end of the handle, using a very little glue, otherwise it will ooze out over the flat part of the handle, and disfigure its appearance. The stoppers are turned in the shape shown in Fig. 3, the part which enters the case being made rather rough, so that it will not easily slip out. As regards the material out of which this article can be made, hard woods are of course necessary, and boxwood, ebony, or ivory would make a very handsome case. The appearance would also be greatly enhanced by turning it so that the alternate segments are formed of ebony or some other dark wood, and ivory.

We have now come to Fig. 4. This is another needle case, turned in the shape of a decanter. It is constructed in the same manner as the former case, a hole being bored down its centre for the reception of the needles. The stopper meets the top of the bottle at the point indicated in the design by a dotted line, and has its top turned flat and about ¾ in. in diameter. Other kinds of needle cases of the bottle form will readily suggest themselves to the reader; for instance, he may make some in the shape of hock and other wine bottles, and some in the shape of claret jugs. When the body of the bottle is very wide as compared with the neck, it is best not to hollow out the neck, but to make the neck to take off where it widens out into the body of the bottle.

Fig. 5 is another needle case, turned in the shape of a cannon. Its length may vary from 2 in. to 3 in., and it would look best if constructed in ivory. The stopper may be made as shown in Fig. 3, or can be made to screw into the cannon's mouth. You can easily devise other cannons of a different pattern, some being made short and thick to resemble "Woolwich Infants," others being made long and thin to resemble field guns. You can also, if you feel inclined to bestow the necessary time and trouble, supply trunnions, touch-holes, and the various other parts of the machinery of real guns. Figs. 6, 7, and 8 are napkin or serviette rings. The best way of turning them is to first of all turn a ring of wood, having a width equal to the intended width of the ring when finished, and of the same thickness as that of the ring at its thickest part. Then re-chuck the ring on the lathe, finish off the edge where it was cut off, and turn down the outside into the shape shown in one of the figures. When wood which has a pretty grain is used, Fig. 6 is the best form, since by presenting a flat surface it exposes the beauty of the grain to view. Holly wood is very suitable for making rings of this shape, since, when finished off with fine sand-paper, but without polish, it has a beautiful ivory-white colour, which is diversified by amber markings.

Fig. 8 is rather more complicated, and would look nice if executed with segments made of different materials — ivory and ebony, for instance. Of course, the labour and time consumed in making these rings are greatly lessened by turning a dozen or more of the same design at the same time.

Fig. 9 is a pin-cushion consisting of a single piece of turned wood, having a portion of its inside hollowed out so that a bag of plush or satin, stuffed with bran to form the pin-cushion, can be glued into it. The wooden part, if, for instance, 3 in. in diameter at the top and 1½ in. thick, should be hollowed out so as to form a hole 2 in. in diameter and 1 in. deep. It must be re-chucked, with its top turned towards the mandrel of the lathe, so that its base may be turned quite flat and polished. The plush bag must be made so that it fits tightly into the hole destined for its reception, is compact in itself, and projects about as much above the wood as shown in the design. Some pin-cushions can be made quite small—about 1 in. or less in diameter—and fitted with bags stuffed with emery powder, when they will form emery cushions. Others, on the other hand, can be made 5 in. or 6 in. in diameter, and may have their woodwork fluted, inlaid, and otherwise ornamented. These pin-cushions and emery cushions form very suitable objects for sales at bazaars, where they sell well, and will fetch a high price compared with the trouble expended in making them.

Fig. 10 is a boxwood top, which is spun by twisting the upper part between the forefinger and thumb, and allowing it to drop on a smooth surface. It is about 1½ in. in diameter, and the part by which it is spun is about 1 in. long. It is turned with the point on which it spins facing the back centre, and is separated from the lathe by gently rounding the end of the upper part with a chisel held sideways on the rest. The point must not be quite sharp, but should be slightly rounded, by which means it will be found to spin much better.

Fig. 11 is a teetotum, also made in boxwood or in some other equally hard wood. It is made exactly in the same manner as the former top, except that it is cut into an hexagonal instead of a circular form. The numbers are written on the middle of the faces in ink, or they may be done in black paint with a fine brush.

Fig. 12 is a knitting-needle case, which is meant to hold a set of knitting-needles on which some article is being knitted. The arrangement consists of two circular pieces of wood, which are made exactly alike, and have holes ¼ in. in diameter and 1 in. deep bored down the centre of their thick ends. They may be made in ivory or some kind of hard wood, and can be variously ornamented. A hole is bored near the end of each, and they are fastened together by a piece of elastic 4 in. long, the ends of which are fastened into these holes by knots on the inside. In order to use the knitting-needle case, the ends of the knitting-needles are brought close together, and are inserted into the holes which were bored down the centre of each piece of wood, the piece of elastic preventing them from slipping off.

Fig. 13 is a pin tray suitable for holding pins, studs, and various other stray articles of haberdashery. It is about 2½ in. high and 4 in. in diameter, and when the stem has been turned and the bowl has been hollowed out, it must be re-chucked in order that the bottom may be turned perfectly flat and polished. The bowl may be made of ebony, the middle part of ivory, and the base of ebony. Care should be taken to render the interior of the bowl quite smooth and evenly curved, since it is shallow, and greatly exposed to view.

Figs. 14, 15, and 16 are thimble cases of various forms. They are made in two pieces, which either screw together or are fitted together in the ordinary way, the place of junction being indicated in the designs by a dark line which, with the exception of Fig. 1, is in the centre of the case. A small hole can be drilled down the centre of the stem of the lower part of Fig. 14, and when fitted with a small stopper will be suitable for the reception of needles. The outsides of the cases may be inlaid with spots of various woods, as taste may direct, and the pointed ends of Figs. 14 and 16 would be improved if made of ivory.

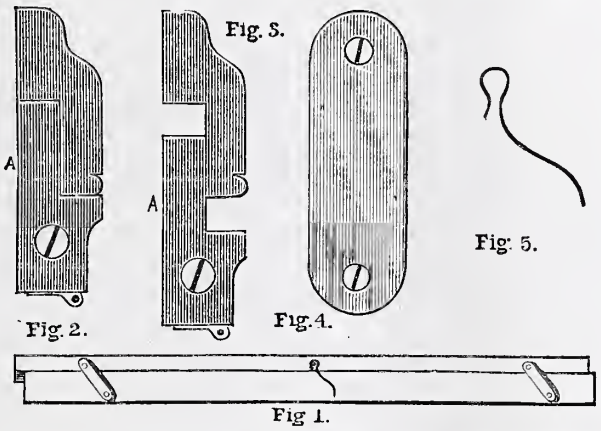
In conclusion, I will state that the reader can easily devise various other forms in which to construct needle cases, napkin rings, and the various other articles which have been described, and that he can ornament them according to the tools which he possesses. The chief thing to be aimed at in the construction of these nicknacks is a good finish, and it should be constantly borne in mind that a well-finished surface will enhance the aspect of an indifferently ornamented article; whereas a badly-finished surface and irregular inlaying, fluting, etc., will quite spoil the appearance of an article which would otherwise have been extremely pretty.

A DRAUGHT EXCLUDER, AND HOW TO MAKE IT.

BY CHOPSTICK.

We are continually being reminded that plenty of ventilation is a good thing, and I do not intend to deny that it is so, but I think that everyone will agree with me that it is *not* a good thing for the fresh air to be admitted at the bottom of the door; and yet, how many houses are there to be found in which there is not too much space allowed at the bottom? In fact, if the door is well fitted at first it will not continue so for any length of time, as whether the sill be stone or wood (and the latter is the best, in my opinion), it soon gets worn away, and in comes the cold wind as well as the rain and snow. Several patents have been taken out for draught excluders at various times, and they answer very well for a while, but all that I have seen have soon got out of order, and then they are useless; and as they are expensive as well, I put on my thinking-cap to see if I could not devise something better and cheaper, and the result was the article I am about to describe, which can be made for about one quarter of what the patented articles cost, and serves the purpose equally as well if not better than the best of them, and has nothing about it to get out of order. It is so ridiculously simple that I think any joiner would be able to make it from the drawings only; but as we are not all joiners, I will give a few explanations, so as to give all a chance of keeping out any future chilling winds.

For materials, we shall want a piece of yellow deal, 3 ft. long 4 in. by 1 in., two brass plates, as Fig. 4, which is drawn full size—that is, 3 in. by 1 in., and about $\frac{1}{16}$ in. thick—and a good stout lock spring (Fig. 5). To make it, first cut the 4 in. by 1 in. board into two pieces, which will then be two inches wide; then plane them up properly and rabbet each of them 1 in. by $\frac{1}{2}$ in., so as to fit one in the other, as in Fig. 2. They can then be finished off to any shape to please the fancy. I have shown the shape which I finished mine. Now take the brass plates (Fig. 4) and fix them on the back diagonally, as shown in Fig. 1; they can be screwed on at first and then marked, and afterwards taken off and the wood cut away, so that they lay level with the surface. It will now be plain to all that if pressure be applied to the bottom piece at A (Fig. 1) that it will cause the two pieces of wood to open, as shown at Fig. 3. Now, this pressure is applied by the door-jamb when the excluder is screwed on to the door, so that the bottom piece is about half an inch more to the right hand than the top piece (or to the left hand if the door opens that way). On the door being closed, it pushes A (Fig. 1) against the jambs at the hanging side, and thus forces the bottom piece in contact with the sill. Now we are all right as long as the door is shut; but on opening it, our excluder would drag on the floor, and this is where the spring (Fig. 5) comes in. This must be fixed (sunk in level, of course) to the top piece with a screw through the loop and the short arm abutting against the sinking in the top piece, and the long arm abutting against the sinking in the bottom piece, so that on the pressure at A being released, the spring will throw it back, and thus raise it at the same time. And now for fixing. In the first place, force the two pieces open, and put a piece of $\frac{1}{2}$ in. stuff between them in the rabbets at the front side, so as to hold them in the same position as they will be in when the door is closed. Then cut them to the right length, so that they will go easily between the door-jambs. Then scribe the bottom to fit the sill, and tack a length of indiarubber draught tubing along the bottom, with the tube part outside, as shown in the end elevation. Now close the door, and, holding the draught excluder firmly down, fix it to the door with about four screws; then open the door, and remove the piece of wood which you placed between the two parts, when the spring will act and raise the bottom piece so that it will clear the floor easily. All that now remains to be done is to put a screw in the end, as in Figs. 2 and 3, and another in the door-jamb, so that the two coincide when the door closes. These screws will take the pressure from the wood and also give us a chance of regulating the article; as, by unscrewing one screw it will push the bottom piece down on the sill with more force, while by screwing one of them in it will ease the pressure in case we have made it too tight. A coat or two of varnish would do a good deal towards preserving the wood, and should be put on before fixing, so that the back will get its share as well as the front. Care must be taken to make these draught excluders the right way, according as the door opens to the left or right. Beyond this everything is very simple, and I hope that none, after this, will complain of their doors not fitting close, as the remedy lies in their own hands.



Draught Excluder. Fig. 1.—Back Elevation of Draught Excluder—A, End to go to Hanging Side of Door. Fig. 2.—End Elevation of ditto when Door is open—A, Side next Door. Fig. 3.—End Elevation when Door is closed. Fig. 4.—Brass Plate (full size). Fig. 5.—Spring (full size).

Remember,—That one cubic foot of sea water = 64·11 lbs.

That one gallon of pure water = 10 lbs.

That 6·24, or $6\frac{1}{4}$ gallons of pure water = 1 cubic foot.

That 1 square foot of cast iron 1 in. thick weighs 40 lbs.

That 1 square foot of cast iron $\frac{1}{2}$ in. thick weighs 20 lbs.

This is very useful when getting out the quantities in estimating, as 40 is so readily divisible by the regular divisions of an inch.

That when driving shafting or machinery by strap or rope, the *slack* side should always be on the top.

SCIENCE TO DATE.

Liquid for Gilding Objects.—Gold bronze mixed with a solution of gutta-percha in benzine or chloroform is recommended for this purpose by a German contemporary.

Porcelain from Asbestos.—M. Garros has invented a new kind of porcelain. Asbestos is ground to an impalpable powder, and made into a paste with water. This paste is moulded into the form desired, and the object is dried in a stove. It is then baked in what is technically termed a "seggar" (a case of fireclay) for sixteen or seventeen hours, and then the temperature is raised to 1,200°. A porcelain more translucent than ordinary porcelain is thus obtained. It can be used for the filtration of liquids, as acids for example; and it is also claimed that it prevents the passage of micro-organisms. Thus, a liquid containing 1,200 microbes per cubic centimetre was absolutely sterilised by filtering it through this porcelain.

"Ginger-Beer" Plant.—Prof. H. Marshall Ward has lately brought before the Royal Society some interesting results of a study of the organism known to villagers as the "ginger-beer" plant. He finds that it consists of a species of yeast living together with a bacterium. The latter organism destroys a substance, produced by the existence of the yeast, which is a poison to the yeast, and would stop its development if not removed. The action of the bacterium in decomposing this poison as fast as it is produced enables the yeast to live much longer than it could by itself. A case such as this, where two organisms live together for the advantage of one and with no injury to the other, is called in biology "symbiosis."

Artificial Rain. — Recent experiments and discussions on this subject seem to lead to the conclusion that, *when atmospheric circumstances are favourable*—that is, if there is probability of rain—then a concussion of the air such as is produced by an explosion may determine its formation

NOTES FOR WORKERS.

Galena is the principal ore of lead, and forms extensive veins, traversing clay slate in Cornwall, and limestone in Derbyshire and Cumberland. It is also found in Scotland, Flintshire, and the Isle of Man.

A good soft varnish can be made by boiling together for some time 4 oz. linseed oil, $\frac{1}{2}$ oz. white wax, and $\frac{1}{2}$ oz. gum benzoin.

An electric letter stamper is being tried at the Post Office, Washington, U.S.A., in which the time-stamp is altered every minute.

It is proposed to erect a fac-simile of the Tower of London at the World's Fair, Chicago.

An underground city, with streets of houses two or three stories high, has been discovered in Bokhara by the Russians. It dates back to two centuries before Christ.

Nearly all native sulphur comes from Sicily, but it also occurs in Iceland, parts of Italy, Mexico, South America, and more or less in all volcanic districts.

In many German villages some tradesman has a small telephone exchange installed in his house or shop. This is connected with the nearest telegraph office, and thus answers the purpose of an official telegraph office in the village.

A patent has been brought out in America for a new insulating compound composed of carbolic acid or creasote, shellac, vegetable drying oils, asphalt, gums, or resins.

Jupiter is 84,846 miles in diameter, and its mean distance from the sun is 475,692,000 miles.

Six seams of coal, amounting to 14 ft. 6 in., have now been discovered in boring operations at Dover.

The specific gravity of any body is the ratio of its weight to that of an equal bulk or volume of some other body, as water, taken as the standard or unit.

The Belgian Government will resume, from January 1st, 1893, the working of all telephone lines in Belgium, which are now worked by private companies.

TRADE: PRESENT AND FUTURE.

**** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

HARDWARE TRADE.—The large works in Sheffield have settled down again after the coal stoppage, and the manufacture of railway material is, for the most part, satisfactory. Orders for marine goods are of a fairly average character, with the exception of for the Clyde, where trade is very slack. The makers of hydraulic-pressed shafting and of castings for marine purposes have not lately received many large orders, and the slackness is likely to last until a further naval programme is initiated by the present Government or its successors. Some owners of large iron and steel works, taught by recent experience, are considering the acquisition of colliery property. In Rochdale and district, the ironworkers are not doing well. Most of the foundries are working short time, and, from the scarcity of orders, seem likely to do so for some time to come.

COTTON TRADE.—The Stalybridge strike has had a far-reaching influence upon the cotton trade of Lancashire, and is calculated to be fraught with serious consequences. At a recent meeting of the Employers' Federation, it was shown that 91 per cent. of the employers in the districts of Oldham, Bury, Hyde, Stockport, Heywood, and Rochdale were in favour of a general stoppage of work. This decision involves the stoppage of 17,500,000 spindles, and the non-payment of about £50,000 in wages.

SHEET METAL TRADES.—In materials, the London market is as dull as it can well be. For black sheets there is scarcely any demand; galvanised sheets are very little better; consequently, quoted prices are difficult to realise. Wolverhampton reports are very similar, trade being disturbed by numerous failures. Some of the iron works are closed, and many only work irregularly. Unless a great change takes place, several tin-plate works in South Wales will cease production. Demand is almost nil, and it is as much as makers can do to obtain cost price. Prices of sheet steel, £7 10s. to £8 10s.; sheet iron, £6 10s. to £7 10s.; tin plates, Bessemer steel cake, 12s. to 12s. 3d. I.C., best charcoal, 13s. to 13s. 9d. I.C., block tin, £89 10s. to £90 per ton.

CYCLE TRADE.—In the Midlands, trade still shows signs of activity, notably in Coventry, Nottingham, and Leicester, many of the firms working overtime. There is a tendency to reduce wages, the fitters and turners in one establishment having to submit to a reduction on the ground that foreign competition is so keen, and foreign-made machines are flooding the markets.

SILVER AND CUTLERY TRADES.—One of the largest Sheffield firms has found it necessary to place their men upon three days per week, and smaller firms have not been able to treat their *employés* so well. The dulness also affects the razor and scissors trades, so that the improvement which took place a short time ago has not been sustained. Few orders are coming in from the States, and the general opinion amongst business men is that there will be no improvement in trade until the Presidential and General Elections are accomplished facts. Another large Sheffield silver firm is bringing out a new process of decorating silver goods by hydraulic pressure, representing chased, embossed, and engraved work generally. The present difficulty is the matching of different sized articles of the same shape.

BOOT AND SHOE TRADE.—There is not the business stir that generally runs with the first of workers' holidays. In London, the best hand-sewn work is looking more brisk. The Union Machinery Co., Ltd., the Campbell Machinery Co., and the Rockingham Machinery Co., have combined together, and formed themselves into the Union Boot & Shoe Machinery Co., Ltd. This alliance of three good companies should be of great trade benefit to more than those directly concerned.

BUILDING TRADE.—In Rochdale and district, matters still keep in a very prosperous condition. The prosperity is having its effect on the workmen. The bricklayers' labourers having given notice of an advance of a halfpenny per hour, and it not being conceded by the masters, the men struck work.

ENGINEERING TRADE.—Increased depression marks the Manchester trade in almost every department, with, perhaps, the exception of boiler-makers, who report a fair amount of new work coming forward. The large Lancashire textile machinists continue fairly busy with orders in hand, but the future prospects in this section are by no means encouraging. Marine engineering in the Lancashire district is in a most depressed state—the only work of any importance secured by the principal Mersey firms being in connection with the conversion of compound marine engines into those of the triple expansion type; one or two Liverpool firms have a fair amount of this kind of work in hand at present. In recognition of the depressed state of trade, the skilled workmen in the Mersey shipyards have accepted a reduction of 5 per cent. upon the rates lately prevailing; while the fifty-three hours movement appears to have been abandoned by the engineers in the Liverpool district. In the Barrow district, shipbuilders continue busy, and both engineers and boiler-makers are still well employed. The unsettled condition of the iron trade continues, and the majority of the furnaces in the north of England are damped down. There is scarcely any disposition to buy, and the demand for both raw and manufactured material is small.

JEWELLERY TRADE.—There is but very little to be said of the jewellery trade in London. That a slight movement is observable is without question, but it is confined to inquiries and demands for this or that article on "appro.," and in most cases it is returned within a day or two. One of the signs of bad trade—*i.e.*, prolonged stock-taking or intermittent attacks of stock-taking—is still present. Altogether, the traveller's job is not, at present, a very enviable one; neither is the workman's, for that matter, for if the one cannot book orders, the other cannot have the job to execute them, and to show new goods now is to spoil the market when the trade does wake up. One hears the same story of very little to do from nearly all branches—engravers, enamellers, and stone dealers included.

MINING TRADE.—Wheal-Eliza sett and materials are offered for sale. It has been very rich in its time as a semi-private undertaking, £70,000 having been paid in dividends. It still employs 250 hands, while it is practically the sole representative of mining left in what was once one of the most famous mining districts of Central Cornwall. Tin ticketing.—300½ tons of tin ore on offer at Redruth brought the average price of £50 18s. 2d., against recent prices of £51 4s. 1d. and £51 2s. 1d.

TIMBER TRADE.—Some 3rd white matching FAS mark was sold recently for 2s. 9d. per square, a price which could not have given much profit to the importer. As the demand for this class of goods is very limited, and the supply large, it will account, in some measure, for the small amount given. Among other lots were the following: 10 ft. 3 by 11 2nd pine, £14 5s.; 12 ft. 3 by $\frac{8}{10}$ 2nd pine, £15 15s.; 13 ft. 3 by 11 1st pine, £23 5s. (a small lot only); 13 ft. 3 by 9 3rd spruce, £7 15s.; HAB 3 by 9 3rd yellow, £13; PFW 3 by 9 4th yellow, £9 15s.; ABA 3 by 9 6th yellow, £5 2s. 6d.; S×W 1¼ by 7 3rd yellow flooring, 9s. 6d.; S×W ⅞ by 7 3rd yellow flooring, 6s. 9d.

SHOP:

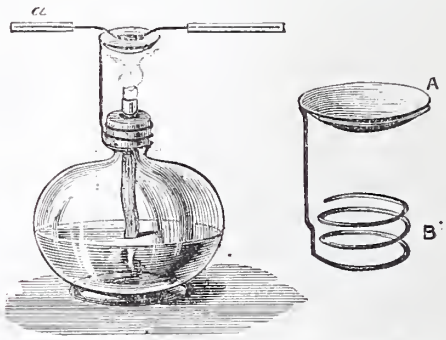
A CORNER FOR THOSE WHO WANT TO TALK IT.

I.—LETTERS FROM CORRESPONDENTS.

Lactitis.—W. J. F. (*London, E.C.*) writes:—"There would seem to be little connection between milk and ivory at first glance; but our clever and inventive transatlantic relations have discovered a method by which the former liquid can be changed into hard and strong 'lactitis,' which is the name given to this newly discovered way of obtaining ivory, and which, being both hard and strong, is suitable for the manufacture of such articles as billiard-balls, combs, knife-handles, and penholders. This important discovery was explained at some length in the scientific chronicle of a recent issue of the *American Quarterly Catholic Review*, and some of the readers of WORK may possibly be interested in the following extract, which fully explains the *modus operandi* to be followed:—'The milk is first coagulated, as in the process of making cheese. This is then strained, and the whey rejected. Ten pounds of the curd are taken, and mixed with a solution of 3 lbs. of borax in three quarts of water. This mixture is now placed in a suitable vessel over a slow fire, and left there until it separates into two parts—the one as thin as water, the other rather thicker: somewhat resembling melted gelatine. The watery part is next drawn off, and to the residue is added a solution of one pound of a mineral salt in three pints of water. Almost any mineral salt will answer—for example, sugar-of-lead, copperas, blue or white vitriol. This brings about another separation of the mass into a liquid and a mushy solid. The liquid is again got rid of by straining, or better, by filtering. At this point, if desired, colouring matter may be added; if not, the final product will be white. The solid is now subjected to heavy pressure in moulds of any desired shape, and afterwards dried under very great heat. The resulting product, which has been named "Lactitis," is very hard and strong.' Such a discovery as this cannot fail to prove profitable to those who have found it out."

Testing for Accuracy.—J. C. K. (*London, N.W.*) writes:—"I read the statements of tests, and that is why I remarked upon them. To test when the work is finished is a doubtful plan, and what a bungle to alter then! Assuming true square of angles and lengths of sides of frame, where and why the necessity for testing? And if the work shows inaccuracy by the diagonal tests, to re-mitre the corners—for they would be all wrong—if there were any visible errors? Suppose a framing of 4 ft. by 5 ft. to be tested diagonally by the lath-rule and the bit of chalk; and to be quite accurate in chalk marking, a square must be set on floor or flat surface, to mark up true in the acute angle, or if outside the frame, a mate must put his finger to the end of the lath-rule while the measures are made, after asking, 'Now, are you right?' and the important chalk or pencil mark is made for one diagonal. Then the measure of the others becomes momentous, and the injunction for the mate's finger-tip to do its duty is—'Now, be sure you're right.' If alike, how exultant must be man and mate! But if wrong? The head is scratched, perhaps there is a clicking of tongue—'te! te! te!'—of disappointment, and the square is applied to the corners to find out which of two are in or out of square; then perhaps lengths of order of frame are measured, and the twist of frame looked to. I have seen it done, and pointed out to men that it is an unscientific hedge-carpenter's plan—near enough for gates and hurdles, if the eye is not trained for accurate estimate of measure of such rough work. Three places to test winding is better than two. G. P. says the opposite sides of a trapezoid are not equal in length. If the sides projecting from a base-line are not equal, how can it be a trapezoid? J. S. says it is a 'storm in a teapot'; he is right, as storms there are so harmless. But I want the readers of WORK to be right as two 'T's,' and not go the wrong way to work. We all mean the same, and I am pleased to meet such genial fellow-workers, as it is obvious the intentions of all are for the welfare of WORK."

Soldering Connections.—C. H. L. (*Falmouth*) writes:—"The following is an arrangement for soldering joints in electric bell work, and for electrical connections generally. This arrangement serves to illustrate the old adage that 'Necessity is the mother of Invention.' In the course of my electrical pursuits I have often found the 'soldering-bit' to be inconvenient, for various reasons: fire not being available, awkward position of wires, etc. I found it necessary that some method must be adopted. I have never come across anything of the kind in my experience, so hope this will prove of service to others. All the apparatus required can be made by an amateur, and for a very small outlay. In the first place, an ordinary methylated spirit lamp, as shown in the diagram below, is necessary. Then, from a piece of sheet-copper, make a receptacle for the solder, about the size and shape of an ordinary watch-glass. This copper can be 'hollowed' in the



Lamp and Soldering Apparatus complete, with Wire being soldered—A, Copper Receptacle; B, Wire twisted to fit over Neck of Lamp.

following manner: Procure a short piece of metal tubing about 1½ in. in diameter, and the gong of a bell about the same size. By placing the sheet-copper over the hole of the tube, and forcing the bowl-shaped part of the gong inwards, the copper is compressed into the tube, and becomes the required shape. The edge of this copper vessel is then bent around a piece of wire, which is twisted as in the design, and serves to hold it over the flame. A little solder is put in the copper vessel, and the lamp lit. The wire to be soldered is bent a little rounding so that the joint can be immersed in the molten solder after the 'flux' has been applied. Joints can thus be soldered with surprising ease, and in a very little time, thus doing away with the excuse, so often given, why the joints are allowed to be 'dry,' which is the cause of a majority of faults in electrical work: this, no doubt, prejudicing a large number of people against electric bells."

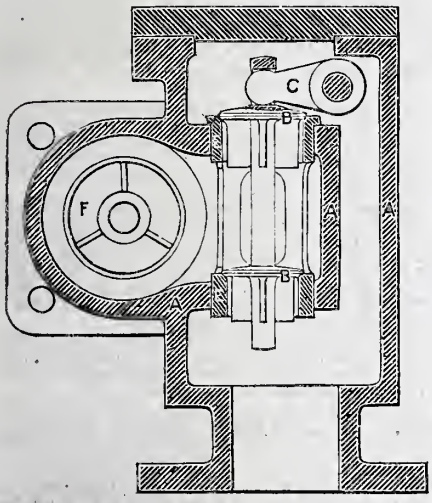
II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Gas Burners.—E. T. (*Dolton*).—Peebles burners are made in eight different sizes. They may be procured from any ironmonger, and are usually sold at 1s. 3d. each. They are fitted with a patent governor, which checks the pressure of gas, thus ensuring a steady flame and economising the consumption.—T. W.

Greenhouse and Dovetailing.—F. C. (*Bath*).—Articles on Building a Greenhouse appeared in Nos. 12, 14, and 15, and on Dovetailing in Nos. 129 and 148.

Mandoline and Graining.—W. W. C. (*Salford*).—Articles on Mandolines appeared in WORK, Nos. 66 and 153, and on Graining in Nos. 55, 58, 62, 65, 69, 72, 76, 79, 84, 89, 93, 95, 98, 100, and 103.

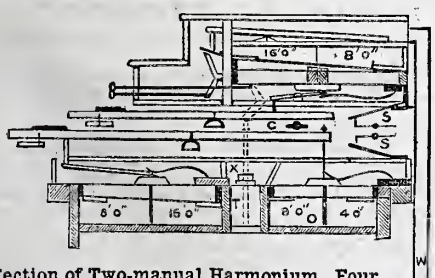
Throttle-valve. — AMATEUR. — The butterfly throttle-valve is simpler and easier to make than any other equilibrium valve. I send a sketch of the form often used on large engines. A A A is the main casting, B B the double beat valve moved by the arm, C; E E is the valve seating. The steam enters from the stop-valve, F, *between* the two discs of the equilibrium valve, which are very nearly, though not absolutely, the same size, since the lower disc



Equilibrium Throttle-valve combined with Stop-valve.

must pass through the upper seating. The butterfly for the ¼ h.p. engine is shown in the sheet of details on page 328 at Fig. 29. It is provided with a central stem, or chucking piece, so as to enable it to be turned to ½ in. diameter when at an angle of 45 degrees with the axis. This is all that is necessary to make it fit well enough to stop the engine; it is not steam-tight, and need not be, since there is the stop-valve as well.—F. A. M.

Harmonium.—C. J. S. (*Battersea Park*).—If you want a coupler to your two-manual harmonium, I think both key-boards will have to be balanced or centre-hung. The section of pan sent would do well for bottom key-board; but I think two manuals involve two separate pans. Be sure to obtain reeds of various scales, and regulate them to different degrees of power, or your instrument will be a very monotonous affair. Messrs. Dawkins, of Charterhouse Street, supply narrow and broad reeds, reeds with curved tongues, as well as special sets for oboe, musette, voix celeste, etc. I give a section as a suggestion, which only needs explaining that the stop levers of lower manual must be of thin brass, and that the keys must be reduced to allow them



Section of Two-manual Harmonium. Four rows of Reeds on Lower Manual, two rows of Reeds on Upper Manual; S, S, are Swell Shades; C, Coupler; T, Space for Stop-action for Lower Manual; W, Wind Trunk; X, where full Organ may be applied.

to pass between. If, however, the action is from each end, like an organ, this cutting of the keys will not be necessary. The section is not to scale, and C. J. S. must be prepared to make a full-sized drawing, which will not be difficult if he first obtains or makes pans for the reeds he wishes to use, and keys to suit pans, using the sketch sent as a suggestion. The swell doors, marked S, should be actuated by knee levers; and although the upper action may be held by side irons, the wind trunk must be movable. "Grand jeu" may consist of a rod, with levers to act upon the tables at X. This is really too large a subject for "Shop," and therefore many omissions must be expected and excused.—B. A. B.

Stirrup.—MECHANIC.—Your stirrup has been examined by a well-known horseman, qualified to pronounce an opinion on stirrup improvements, and yours in particular. From your inexperience, you have not comprehended the fact that one of the causes of accidents in the hunting-field is the release of the foot of the rider from the stirrup at "taking off" or "landing" at a jump, and, with young riders, losing their tread in a stirrup. These accidents are so frequent that many patents are taken out to retain the foot in the stirrup. The accidents from dragging by the foot in a stirrup when thrown is of rare occurrence, and need never occur if the rider has a safety stirrup, such as was described and illustrated in WORK about a year back (see Index). It is both a retaining and releasing stirrup, and with spring safety latches on which to hang the stirrup-leathers, safety is doubly assured. Even some of the safety latches have the demerit of letting the leather slip off when a horse rears or rises at a high bank, causing the best of horsemen to slide back out of his seat on to the ground. In riding, the aim should be to keep in the saddle, and the feet in the stirrups. Unfortunately, your stirrup opens so easily that it would be difficult to use it without its opening, which is a fatal objection. You should read "Riding: The Use and Misuse of Reins and Stirrups." The whole art of horsemanship is condensed comprehensively.—J. C. K.

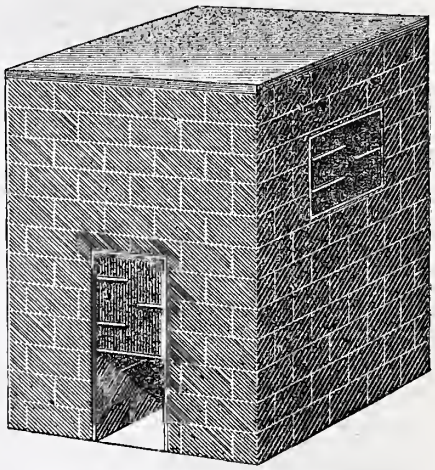
Parchment Papers.—J. S. (*Amsterdam*).—In giving the names of the manufacturers of chromo and parchment papers, it may be mentioned that these productions are confined to a few mills in Great Britain. To give a full list of dealers would, I am afraid, occupy too much space in WORK. In parchment papers there are many makes—real and imitation—in the market, and many wholesale stationers sell parchment papers of foreign manufacture. The following are the British makers of chromo papers: Dickinson & Co., Apsley Mill, Hemel Hempstead, Herts; Olive & Partington, Dover Mills, Glossop; Potter & Co., Hollins Mills, Darwen; J. & J. Makin, Wallhead Mills, Rochdale; J. Collins, Stoneywood Paper Mill, Denny, Stirlingshire; Inveresk Paper Co., Musselburgh, Scotland. The English makers of parchment papers are the Ekman Pulp and Paper Co., Northfleet, Kent; Ramsbottom Paper Mill Co., Ramsbottom, near Manchester; Spicer Brothers, 19, New Bridge Street, London; Hythe End Paper Co., Staines, Middlesex; and J. Cropper & Co., Burneside Mills, Kendal, Westmoreland. As before stated, the list of stationers and paper makers' agents in a position to supply chromo and parchment papers is so extensive that I cannot do better than refer your correspondent to "Kelly's Directory of Stationers, Paper-makers, etc." Some useful information may also be obtained from the "Directory of Paper Makers," which contains a list of wholesale stationers in London. The publishers are Marchant, Singer & Co., St. Mary Axe, E.C.—F. G.

Box Battery.—J. A. P. (*Leicester*).—The fault mentioned by you is one common to all primary batteries, but is specially noticeable in some, including those in which bichromate of potash is employed. It is a prominent feature in all single-fluid cells, but is lessened by using chromic acid instead of bichromate of potash. As the box battery described in WORK, Vol. II., pp. 591-2, is composed of single-fluid cells, it is liable to the fault common to all this class, but may be said to be the only one that can be used in furnishing current to an electric lamp. The current flags shortly after the circuit is closed through the lamp, because a film of hydrogen forms on the carbon plates, and thus increases the internal resistance of the cells. Keeping the plates or the solution in motion washes off this film, and checks this nuisance, which is named polarisation. Severing the carbon plates with a sharp tool, so as to roughen their surface, will partially mitigate this fault, but a perfect depolariser for a single-fluid cell has yet to be discovered.—G. E. B.

Cement for Tinfoil.—ELECTRICIAN.—If you think the ordinary flour paste not strong enough because the tinfoil is thick, use good hot thin glue instead of paste. The adhesive properties of paste and of glue are much enhanced by closely fitting and smooth surfaces. See to it, therefore, that the foil is made to fit closely and lie smoothly to the wood.—G. E. B.

Medical Coil.—W. T. K. (*Darwen*).—The core of a coil, whether medical or spark coil, must be of iron wire. Steel wire is altogether unsuitable. Iron wire is better than a solid rod of iron. Get and study the "Induction Coils" articles in WORK, Vol. IV.—G. E. B.

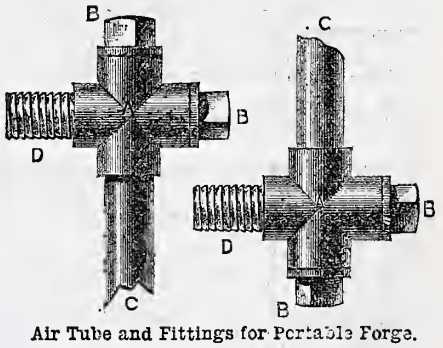
Chimney-pieces. — OVEN. — Without knowing the amount of work you want to do at once, it is rather difficult to give you size of oven. In some works they are large enough to contain one hundred pieces at once, and may be from 12 ft. to 15 ft. long, 6 ft. to 8 ft. wide, and 8 ft. to 9 ft. high; lined with fire-bricks, with arched tops and tight-fitting iron doors. They are heated by a furnace and flues under the floor. The temperature will be from 80° to 120°. If you only want to experiment, and if you have not done any of this work before, I should recommend you to make a small oven similar to sketch, about 1 ft. 6 in. square inside. A furnace with iron door and grate bars is formed underneath. This should be one brick thick, lined with fire-brick above the bars, the furnace covered with a 3 in. fire lump, and the oven built on this with fire-bricks—half brick thick, if inside; if outside, make it one brick thick, so as to retain the heat. An iron door is fixed at one side, and two small holes above fitted with plugs, so that you can insert a thermometer. Cover the top with a fire lump, and carry the flue from furnace up one side of oven, and connect to a chimney. If you have no chimney near, an iron stove-pipe or some sanitary pipes may be used. The materials for this will cost about £2 10s. You would most likely build it yourself; if not, it might cost 10s. If you want to do something larger, you can make the oven longer, but it will be better not to increase the width, as fire lumps are cheaper than arching. The materials for making the enamel may be purchased from a wholesale chemist, the address of whom you may obtain from any local chemist, or from a directory. I suppose you know how to mix them, as you will have little chance of success if you do not, the mixing being a trade secret. The slates are first polished till



Small Oven Sketch.

smooth, then coated with enamel, and dried in the oven; then ground a second and third time, and coated each time. After the third time they are polished with rotten-stone. If you want to go into it as a business, your best plan will be to advertise for a competent manager, and erect the works under his supervision. The following are some proportions for enamels, but I cannot guarantee them: Calcined flint (ground), 3 parts; minium, 4 parts; nitre, 2 parts; and borax, 1 part. For blue, add to this 1 or 2 parts of oxide of cobalt to 10. Green: 1 or 2 parts of oxide of chromium to 6. Violet: peroxide of manganese, 1 or 2 parts to 30. Yellow: chloride of silver, 1 or 2 parts to 6. Black: oxide of copper, oxide of cobalt, and oxide of manganese, 1 or 2 parts to 15 parts of the first.—M.

Small Portable Forge.—J. B. (*Carrick-on-Sea*).—It is with great difficulty that I can decipher many parts of your letter, so that you will excuse me if I fail to interpret your meaning aright. In the first place, you ask if the forge described (pages 705, 706, No. 149) would weld 1 in. square iron bar. I should certainly advise you not to try. If you put a great weight on the top of bellows, and worked very hard at the handle, you might be able to do so, but even then it would be a great strain on the framework and nozzle, and would very soon wear the machine



Air Tube and Fittings for Portable Forge.

away. For bending and forming 1 in. iron bar, I have no doubt it would be all sufficient, but certainly not for welding two pieces together as you seem to require. Your next question is, Should not the nozzle be higher? I have not specified any height from the bottom of tray, so you may place it to suit your requirements. If you are going to treat rather large work, you might have it higher than shown; but for small work it is plenty high enough. Of course, if you have a fire-clay brick bottom, as I suggested in my article, the height will be of no consequence, as the brick will withstand any amount of heat. You are mistaken about the fuel to use. Breeze is by no means ashes, as you say, but very fine dry coal. Your next question is how to

bend the tube to shape, and keep it in order. In order to bend the tube to the required shape, you must heat it to a good red heat (not white), and then quench the end for about 4 in. in water, and bend round the anvil nose to the required shape. This sounds very easy, but requires great care not to flatten the tube in the operation. Your next suggestion is with regard to having plugs for cleaning the tube. The arrangement is a good one, but on a small forge, such as I have described, it is hardly necessary, as cinders are not very liable to get down the nozzle. In case, however, you wish to make your forge with such an arrangement, I give a rough sketch of tube and fittings. A, A, are two four-way iron gas elbows, tapped at each opening for ¾ in. iron gaspipe; C C is the ¾ in. iron pipe to convey the draught; B, B, B, B, are four square-headed plugs to screw into the open ends of elbows, so as to be easily removed for cleaning; D, D, are two long iron nipples screwed outside to fit into the elbows, the top one fitting through the back nut, tray band, and into the iron nozzle, and the bottom one fitting into the middle board of bellows. I think this will be about plain enough for you to understand. With reference to the forge made by the Britannia Company, of Colchester, I have not seen their list, so cannot advise you. If you send them a legibly written letter, I have no doubt they will give you full particulars.—CYCLOPS.

III.—QUESTIONS SUBMITTED TO READERS.

**** The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Setting Tiles.—PEN writes:—"Will someone kindly instruct me, through WORK, how to fix tiles round a sink-stone? Please give all details."

Fretwork.—W. J. H. (*Shepton Mallet*) writes:—"Will any kind reader of WORK inform me of a buyer for fretwork?"—[Any fancy dealer in any town would be disposed to consider photo frames and the like, if the price suited him. Look up the names and addresses of fancy trades dealers in the directories. Meanwhile, buyers should advertise their addresses in WORK.—ED.]

Ice.—J. J. McQ. (*Drogheda*) writes as to the best way for keeping ice when one has not got a refrigerator.

Armour.—C. J. F. (*Eastbourne*) writes:—"Will any reader of WORK give me the addresses of makers of suits of decorative armour? In London preferred."

F. T. Monogram.—E. A. T. (*Burnham*) writes:—"May I ask if any reader of WORK would kindly give me a monogram of the letters F. T. for painting on a box?"

Stereoscope.—F. (*Bedford*) writes:—"Can any fellow subscriber tell me how to make the interior and exterior of a good stereoscope, to hold, say, fifty slides: one that would, by the turning of a knob or button, bring another view before the eye? I saw one several years ago, and would much like to make such a thing. Also, where could the lenses be got? A working drawing would be much appreciated."

Mackintosh Stains.—J. H. M. (*Co. Meath*) writes:—"Would any of your readers kindly let me know the best way to remove stains from a white waterproof coat mackintosh? I fear soap would injure the texture."

Copper Surface.—W. H. (*Londonderry*) writes:—"Would someone kindly give me a wrinkle to obtain a reddish-pink colour on the polished surface of copper?"

Swing Cot.—W. P. F. (*Wellington*) writes:—"Would any fellow reader of WORK kindly give me instructions how to make a swing cot? I want to make it all of wood (red deal), and stain and varnish it. What I want to know is: what size and kind of joints, whether smaller in the bottom than on the top, and what height the hood ought to be; also, what sort of bearings to rest upon. I have directions for making stand—No. 122, Vol. III."

P. H. P. Monogram.—VULCAN writes:—"I should be obliged for the initials P. H. P. I wish to carve them in relief, so as to stand about ¼ in. off the work."

Working Model.—APPRENTICE CARPENTER writes:—"Would any reader of WORK tell me how to make a model steer itself so that it would come back again, supposing it were a large lake?"

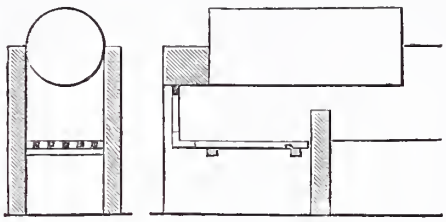
Movable Shed.—AMATEUR MECHANIC writes:—"I want to build a movable shed in *sections*, to rest on brick-work foundation; dimensions: 20 ft. long, 12 ft. wide, 7 ft. high at eaves, and 11 ft. at ridge. Will one of your readers kindly give me the proper scantling of timber for uprights, sills, rafters, to ensure stability without unnecessarily adding to the weight? To be roofed and covered with corrugated sheets. Also, the best size to make the sections for convenience in moving. I thought about 6 ft. by 7 ft. Also, the best way to frame and bolt the corner sections together, and if the roof can be made in sections also, so as not to nail rafters to wall-plate. Would angle-irons to fix rafters to upright and plate be strong enough for a building of this size, and at what distance should they be fixed? I shall mortise all the framework; and I am rather in a difficulty as to the strength and best mode of proceeding with mortises and tenons at the corners (as the house is to be movable). Any other hints, or sketch, will oblige. Will the roof require a tie-beam or rod, or more than one? and are 24-gauge sheets heavy enough?"

Plant Propagator.—BARRA writes:—"I shall feel obliged if some reader would give me, through Shop, details of how to make a propagator for raising plants from seeds, etc., with dimensions and a few working plans."

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Working Drawings.—M. (*Bishop Auckland*) writes to CEYLONESE COLOMBO (see No. 153, page 782):—"You will most likely obtain these from some of the following books: 'Cast and Wrought Iron Bridges,' by Wm. Humber; 'Bridge Construction,' by W. D. Haskell; 'Trusses of Wood and Iron,' by W. Griffiths; 'Iron Bridges,' by F. Campin; 'Cranes,' by J. Glynn, from Crosby Lockwood & Son; 'Bridges,' by H. Haupt; 'Long Span Railway Bridges,' by B. Baker; 'Bridges,' by J. W. Grover; 'Bridges,' by R. H. Bow; 'Cranes,' by H. R. Toune, from Spon, Strand; 'Pattern Book for Cabinet-Makers,' from Batsford, High Holborn."

Model Boiler.—M. (*Bishop Auckland*) writes to P. E. G. (*Great Bridge*) (see No. 155, page 814):—



Section of Boiler Setting.

"I send sketch for setting boiler. Use fire-brick above the bars, and form a bridge at the back end of bars, and carry a flue to the chimney."

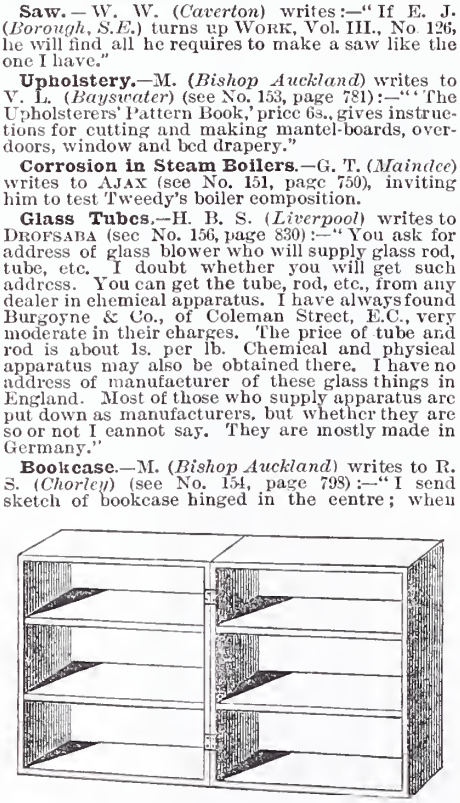
Saw.—W. W. (*Caverton*) writes:—"If E. J. (*Borough, S.E.*) turns up WORK, Vol. III., No 126, he will find all he requires to make a saw like the one I have."

Upholstery.—M. (*Bishop Auckland*) writes to V. L. (*Bayswater*) (see No. 153, page 781):—"'The Upholsterers' Pattern Book,' price 6s., gives instructions for cutting and making mantel-boards, overdoors, window and bed drapery."

Corrosion in Steam Boilers.—G. T. (*Maindee*) writes to AJAX (see No. 151, page 750), inviting him to test Tweedy's boiler composition.

Glass Tubes.—H. B. S. (*Liverpool*) writes to DROFSABA (see No. 156, page 830):—"You ask for address of glass blower who will supply glass rod, tube, etc. I doubt whether you will get such address. You can get the tube, rod, etc., from any dealer in chemical apparatus. I have always found Burgoyne & Co., of Coleman Street, E.C., very moderate in their charges. The price of tube and rod is about 1s. per lb. Chemical and physical apparatus may also be obtained there. I have no address of manufacturer of these glass things in England. Most of those who supply apparatus are put down as manufacturers, but whether they are so or not I cannot say. They are mostly made in Germany."

Bookcase.—M. (*Bishop Auckland*) writes to R. S. (*Chorley*) (see No. 154, page 798):—"I send sketch of bookcase hinged in the centre; when



Centre-hinged Plain Bookcase.

folded to be fastened with two hasps and lock. If not suitable, if you write again, giving more particulars, I will send you another sketch."

Electric Motor.—M. (*Bishop Auckland*) writes to C. H. (*Clerkenwell*) (see No. 155, page 814):—"Your best plan will be to get a set of castings for the motor from some electrician, the addresses of several of which have been given in WORK; they will supply you with the wire, and give you instructions for making. If you have no lathe, you had better get the armature turned ready and the commutator fitted. You will require one of suitable size for driving a sewing-machine. Would it not be better to light the lamp direct from the battery?"

Amber.—D. (*Holyrood*) writes to S. M. A. D. A. (*Tunbridge Wells*) (see No. 154, page 798):—"I unfortunately broke an amber mouthpiece short off at the thread. I found that I could drill the amber readily by *slightly warming* the drill, and tap the thread in by also slightly warming tap, letting tap remain in until amber hardens again. If too hot, amber will spoil."

Oil Light.—D. (*Holyrood*) writes, in reply to G. C. (*Pendleton*) (see No. 154, page 798):—"The Wells oil light, and others of a similar make, depend on pressure of air or steam forcing the oil through a burner, which is so constructed as to partially, at any rate, vaporise the oil by the heat of the flame itself before it issues from mouth of burner. To start it, of course burner requires to be heated by an independent flame. The vaporised oil burns readily with a large powerful light. It is only suitable for large powers and outside use."

Adhering Composition.—M. (*Bishop Auckland*) writes to F. W. (*South Darenth*) (see No. 152, page 765):—"You might try Prout's elastic glue."

Softening Indiarubber and Metals.—M. (*Bishop Auckland*) writes to LUDOVICUS (see No. 154, page 798):—"You will find a good description of Indiarubber Stamp Making in Nos. 38 and 40."

Cottage Architecture.—M. (*Bishop Auckland*) writes to DORKIN (see No. 157, page 14):—"The following would, perhaps, suit you: 'Cottage Building,' by C. B. Allan, price 1s. 6d. (Crosby Lockwood & Co.); Palliser's 'Model Homes,' 5s.; or 'Cottages,' by W. S. Gerhard, 4s. (Spon)."

Leather Work.—J. H. H. (*Robert Town*) writes, in answer to J. B. M. (*Blairgowrie*) (see No. 156, p. 830):—"Leather work is a work which would be difficult to learn by book. You should write to W. H. Wood, Ashton Clough Road, Liversedge, for information as to materials, etc."

Magnetism.—EDDIFRA writes to BEGINNER (see No. 152, page 765):—"Bars of steel may be magnetised by inserting them in a hollow bobbin of thin wood wound with several layers of thick copper wire. A powerful current is then sent through the wire, contact being made and broken several times. They can also be magnetised by stroking with the poles of a powerful electro-magnet."

Ornamental Brass Castings.—A. G. (*Sheffield*) writes to J. P. (*Accrington*) (see No. 152, page 765):—"For these, apply to Messrs. Horton & Son, Brass Works, Bailey Street, Sheffield."

Mill Bills.—AN OLD HAND writes to W. H. J. (see No. 155, page 814):—"Mill bills, or mill picks, require very careful forging; any increase of temperature above a blood-red is detrimental to the quality of the steel. When carefully forged down to the required thinness, you may heat them to a blood-red, and quench them quickly in the following: three gallons water, 1 oz. of oil of vitriol, 2 oz. of common soda, and, say, a tablespoonful of salt. Let the bills remain in until they are cold. If the stones are French burrs, the following is very good: three gallons water, 3 oz. each of spirit nitre, spirit hartshorn, white vitriol, sal-ammoniac, alum; add a handful of salt, and use as above."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—C. E. W. (*Leeds*); H. A. H. (*Chatham*); AMATEUR LITHO.; G. J. S. (*Arundel*); J. H. (*Leeds*); CAP-A-PIE; CONSTANT READER; J. E. (*Harrogate*); J. E. B. (*Butterwick*); H. & S. (*Manchester*); L. S. & SONS (*Redditch*); V. L. (*St. Leonard's-on-Sea*); D. W. H. (*Tredegar*); J. J. T. (*Liverpool*); LUDLOW; S. & J. (*Lhanbryde*); G. E. E. (*Mildmay Park*); T. D. (*Gateshead-on-Tyne*); S. & CO. (*London, E.C.*); X. Y. Z. (*Liverpool*); A. M. (*Glasgow*); S. R. (*Withington*); F. M. (*London*); ANXIOUS; A LADY READER OF "WORK"; F. T. (*Stoke-on-Trent*); E. H. (*London*)); S. M. A. (*London*); W. C. (*Banbury*); W. J. (*Birkenhead*); W. B. (*Newton Heath*); W. H. (*Leeds*); ANXIOUS; AMATEUR; H. G. (*Lewisham*); A. E. S. (*Glasgow*); J. K. (*Bradford*); G. A. H. (*Leeds*); M. I. N. E.; INCLINE BRAKESMAN; A YOUNG READER; VULCAN; A. B. C. (*Darlington*); E. P. (*Southampton*); W. C. G. (*Bowes Park*); Q. J. D. (*Fairfield*); J. O. R. (*Culross*); KORRIC; A. W. J. (*Phipps St.*); H. B. (*Finsbury Park*); G. C. (*Longton*); J. E. S. (*Leytonstone*); H. S. (*Pimlico*); T. E. H. (*Leeds*).

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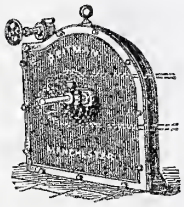

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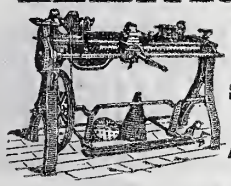

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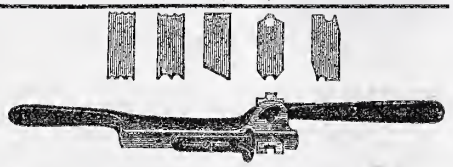

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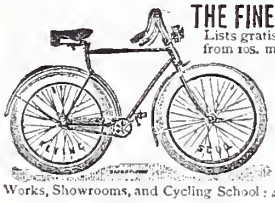

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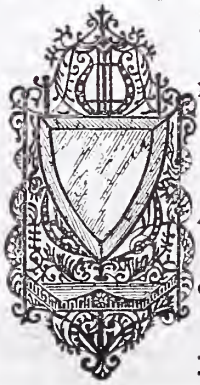

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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VOL. IV.—No. 162.] SATURDAY, APRIL 23, 1892. [PRICE ONE PENNY.

WORK WORLD.

LORD ROTHSCHILD has just fitted up, at Tring Park, an electric saw mill, comprising a circular saw, band saw, mortising, tenoning, and moulding machine, supplied by Messrs. Ransome & Co. This is, we believe, the first saw mill which is entirely driven by electricity.

* *

Lead is one of the worst metals to get mixed with gold; even $\frac{1}{2000}$ part of lead melted with 22 ct. gold, and cast into a bar, will cause it to be so brittle that it can be broken with a slight tap from the hammer. Therefore, remove all traces of pewter solder from old work before remelting, for pewter solder is composed of lead and tin.

* *

A handy and ingenious little article has been invented on the principle of the well-known pencil sharpener, for tapering broom, rake, and hoe handles. To dealers in these articles who have to fit any number of these handles, this ought to recommend itself. All that is needed in the way of fixing is to screw it to a bench or wall, and it is ready for work. Six handles can be fitted in the time of one on the old method.

* *

A short time ago, Messrs. Broadwood, the celebrated pianoforte makers, purchased three logs of mahogany cut from one tree for the enormous sum of £3,000. These logs were about 15 ft. long and 38 in. wide. They were cut into veneers $\frac{1}{8}$ in. thick. The wood was peculiarly beautiful, capable of receiving the highest polish, and, when polished, reflected the light in a most vivid manner like the surface of crystal, and, from the many forms of the fibres, offered a different figure in whatever direction it was viewed.

* *

An interesting exhibition, containing many first-class specimens of work from abroad, Australia, South Africa, Burmah, and New Zealand, is going on in Dublin, consisting of specimens of the work of the chief prize-winners in the Vere Foster drawing and writing competitions. There were 620 competitors in ordinary writing, 35 in ornamental lettering, 279 in drawing, and 58 in painting. It is interesting to note specially that the chief prize for writing was secured by an Irish girl of Clono National School, co. Sligo.

A wonderful clock is likely to find its way to the Chicago World's Fair. It is only 21 in. high, but it is 9 ft. wide and 3 ft. deep, and will indicate time to the last stroke in 9999. The image of an angel strikes the minutes on a bell, while another strikes the quarter hours. A skeleton, representing Death, strikes the hours. After each hour is sounded, figures representing the twelve apostles appear and bow before an image of Christ. A procession of praying monks passes into the entrance of a church at 6 o'clock. Shortly before midnight a watchman gives the signals for each hour, and at 3 o'clock he goes off duty, and a crowing rooster appears to announce the dawn of day. During Christmas times singing choruses and the four seasons are represented by symbolic figures. The entire apparatus of the clock can be shown in twenty minutes by means of an ingenious invention. This seems to beat the Strasburg clock out of time.

* *

According to all accounts there is going to be another strike in the London building trade this summer, this time on the part of the bricklayers. It is sincerely to be hoped that they will not carry matters to such an extent as the carpenters did last year; they, it will be remembered, struck for an eight hours day and an increase of wages; the proposed increase of wages would have nearly brought their money up to the same amount as it was with a nine and a-half hour day. This, to an ordinary observer, would not seem a very extraordinary demand, but the employers thought otherwise, and what was the result? After spending thousands of pounds and causing great hardships to their families, to say nothing of themselves, the matter was submitted to arbitration, and the decision of the arbitrator was received by the men exactly as they had pledged themselves it should be, although, as some remark, they are now working "decimals of time."

* *

Most sanitary authorities will welcome an appliance which does away with the old-fashioned putty or indiarubber joint between the arm of a w.c. pan and the flush pipe; such an appliance is now on the market. It consists of a brass flushing arm connected to the bottom of the flush pipe with a properly soldered joint, and is so constructed that it delivers the main force of the water directly on to the soil and paper sufficiently to pass round and cleanse the whole of the pan, not only driving the whole of the contents from view, but thoroughly out of the trap into the drain. It appears strange that plumbers and others, who would as soon think of committing a crime as connecting the top part of the flush pipe with the waste preventor union by anything else than a proper "plumber's joint," should so long have been satisfied with a piece of rag and string at the other end. The only drawback is that the use of this brass arm is confined to those w.c. pans specially constructed for it.

* *

Now that the fret and silk as a means of decorating the fronts of upright pianos is being looked upon as old-fashioned, they having given way to the more modern style of panel fronts, gold incised or marqueterie, or both in combination, our German cousins are turning their attention to the backs, which have hitherto been finished in a very offhand manner, being looked upon as in every case destined to stand against a wall. Now fashion dictates that they may stand in the middle of a room, or at any rate standing free all round, or forming a cosy corner. Consequently—chiefly amongst the Germans at present, though London makers may soon follow in the wake—it is becoming more and more regarded as the correct thing to spend as much taste and expense in decorating the backs as the fronts. In this direction a recent strike amongst the "varnishers," as the polishers are called in America, led the Yankees to endeavour to dispense with their services. In some cases this was done, and at the same time the difficulty of hiding the individuality of the piano as a piece of furniture was overcome by making the cases of commoner wood, and passing them on to the upholsterers to cover in velvet, silk, etc., in the prevailing fashions, thus bringing them more in harmony with their surroundings. English makers ought to "hurry up," and with fret backs, on good silks, make the cottage piano backs things of beauty and, if possible, joys for ever. We will offer some designs.

* *

All the investigations of maritime surveyors prove that the ocean bottom is much like the land above the ocean. In the

United States survey, for the electric cable between California and the Hawaiian Islands, the mountains beneath the sea are so serious an obstacle that a detour must be made. Starting from Salinas Bay, near Monterey, California, is a deep gully 200 fathoms deep, and on each side the rocks rise to within five fathoms of the surface of the ocean, and gradually deepen to 2,500 fathoms, with much irregularity of surface, till 3,200 fathoms are reached, or about three and a-half miles, when the depth is about three-quarters of a mile less. Two degrees further along it changes to 400 fathoms deep, then drops to 700 fathoms, then to 2,700 fathoms, followed by a rise to 2,000 fathoms; then there is another fall of 700 fathoms, and a fairly gradual sinking and rising follows till 3,000 fathoms are plumbed; now a mountain peak rises up about the third of a mile, to less than a quarter of a mile from the ocean surface. This is a summary of two surveys, twenty miles apart, by the United States surveying vessels, one recently, the other fifteen years ago. A third survey will have to be made to find ground on which the electric cable can be laid.

BENT IRON WORK, AND HOW TO DO IT.

BY J. H.

Mounts for Vases.

Mounted Bowl—Legs—Cross Strips—Bottom Scrolls — Varnishing — Mounted Vase—Legs—Scroll Work on Legs — Mode of Uniting Legs—Cross Strips—Bottom Ring—Rings, Use of Copper—Upper Ring—Union of Rings—A Second Example of Mounted Vase—Hanging Flower Vase—Bottom Ring—Suspension Bracket—The Scroll Work—Imitation Chains.

Vases.—We are now ready to commence some not very difficult designs in bent iron, and I have selected a glass bowl and some vases for our first essays. The general designs and the same methods of union which are illustrated in these figures will also serve for vases of other forms and diverse sizes.

Mounted Bowl.—Fig. 12 illustrates a glass bowl, A, suitable for holding flowers or ferns. This is supported with the four legs, B. These legs are shown enlarged in Fig. 13, together with the scrolls, by means of which they are tied to each other and against the vase.

Legs.—In the first place, prepare four scrolls like B from the ordinary thin iron strips of $\frac{3}{8}$ in. in width. The quick turns of the scroll at the bottom must be bent with the round-nosed pliers, but the flat curves above can be better bent against one of the flat wooden pins shown in the previous article. The extreme end is turned over at *b* to fall down within the bowl, clipping its edge; and so the bent iron is secured to the bowl at that part.

Cross Strips.—The bowl is supported, and the strips, B, tied at the bottom of the bowl with the two strips, C, C. These are carried straight underneath the bowl if the bottom is flat, or suitably curved if the bottom is convex. They cross each other at the centre (Fig. 13 *f*), and may be fastened to each other there with a spot of solder, though this is not essential. Then, where C and C abut against B, they are secured with clamps, *a*, of bent iron, pinched fast with the flat-nosed pliers.

Bottom Scrolls.—The mounting may be considered complete at this stage if time is a consideration; but the stand will be steadier if the circle of double scrolls, D, is added. The legs, B, will be thereby prevented from spreading outwards, and the curves will form a neat filling-in beneath the bowl, relieving it of the naked appearance which it would otherwise have. There are four scrolls in the figure, and they are clamped to each other at *c* and fastened to the legs at *d*, either with solder or with fine soft iron or copper wire, as seen at d^1 (Fig. 13). This completes the mounting.

Varnishing.—It is usual to varnish all bent iron work. There are several preparations employed, as Judson's black, or a mixture of drop black in gold size. Of these varnishes I shall have more to say later on.

Mounted Vase.—Fig. 14 shows a vase mounted on four legs. One of these legs, with its attachments, is shown enlarged in Fig. 15. The whole of the work is made of $\frac{3}{8}$ in. strips.

Legs.—The main strips which form the legs, A, are bent to the scroll form at bottom and top with pliers; the flat curve in the body is bent round a suitable templet block of wood. The first leg being made accurately, the other three are tested by it, until all four are uniform in shape and size. Or they can be tried upon a full-sized drawing; for it is always desirable before commencing anything in bent iron to mark the outlines to full size upon a black-board with chalk, or upon a chalked board with pencil or crayon.

Scroll Work on Legs.—The scrolls, B, are then bent, and fastened to the legs, A, with clamps at *a*, *a*, and to each other at *b*. There are three scrolls, B, to each leg. There are also two small scrolls, C, at top and bottom, which are clamped to A, and to one of B respectively at b^1. Note that whenever double curves occur in bent iron, as at the parting, b^1, two strips are required to form them, because a single strip cannot be divided by bifurcation. This is shown clearly in Fig. 15.

Mode of uniting Legs.—The four legs, with their scrolls, being prepared, they will be fastened around the vase by means of two cross strips, D, D, and three rings, E, F, G.

Cross Strips.—The cross strips, D, are bent to fit the bottom of the vase, which they support. They are formed into scrolls at the ends and united to the legs, A, at *c*, with clips.

Bottom Ring.—The bottom ring, E, is bent round into a circle, either to a line struck with compasses, or around the edge of a wooden disc, and its ends are overlapped for a length of about $\frac{3}{8}$ in., and soldered. It is fastened to the four legs, either with solder or with soft iron wire (as in Fig. 13, d^1).

Rings, Use of Copper.—The rings, F and G, are made differently. F forms a frustrum of a cone—very narrow, it is true, but, nevertheless, sufficiently conical to give some trouble in the setting out. Its form could be developed and cut out of thin iron, but this would give trouble also, which might be saved in making it in copper, which can be hammered to almost any form with ease. The strip of copper, bent round as a parallel ring, can be hammered to the correct form around a disc of hard wood (Fig. 16), having the same bevel as that portion of the vase which the ring has to embrace. The band of copper will look well by comparison with the iron; in fact, all the bands might be made of the same metal. Later on, I shall show several examples of the introduction of copper ornaments among the bent iron; and even when copper is used only because of its superior ductility, and a uniform black seems desirable, copper can always be varnished to match the black iron.

Upper Ring.—The upper ring, G, is a parallel zone, and may be easily made in iron. Though the bottom ring, E, is in contact with the *inside* faces of the legs, A, it is better that F and G should encircle A. Another point is how to fasten these rings to A. It is possible to fasten them with wire, in the same way as that shown at Fig. 13, d^1, and this, I think, is the usual method; but it is tedious, and does not make a neat job, because it is impossible to make the rings embrace the legs tightly by this method. The method I show is this.

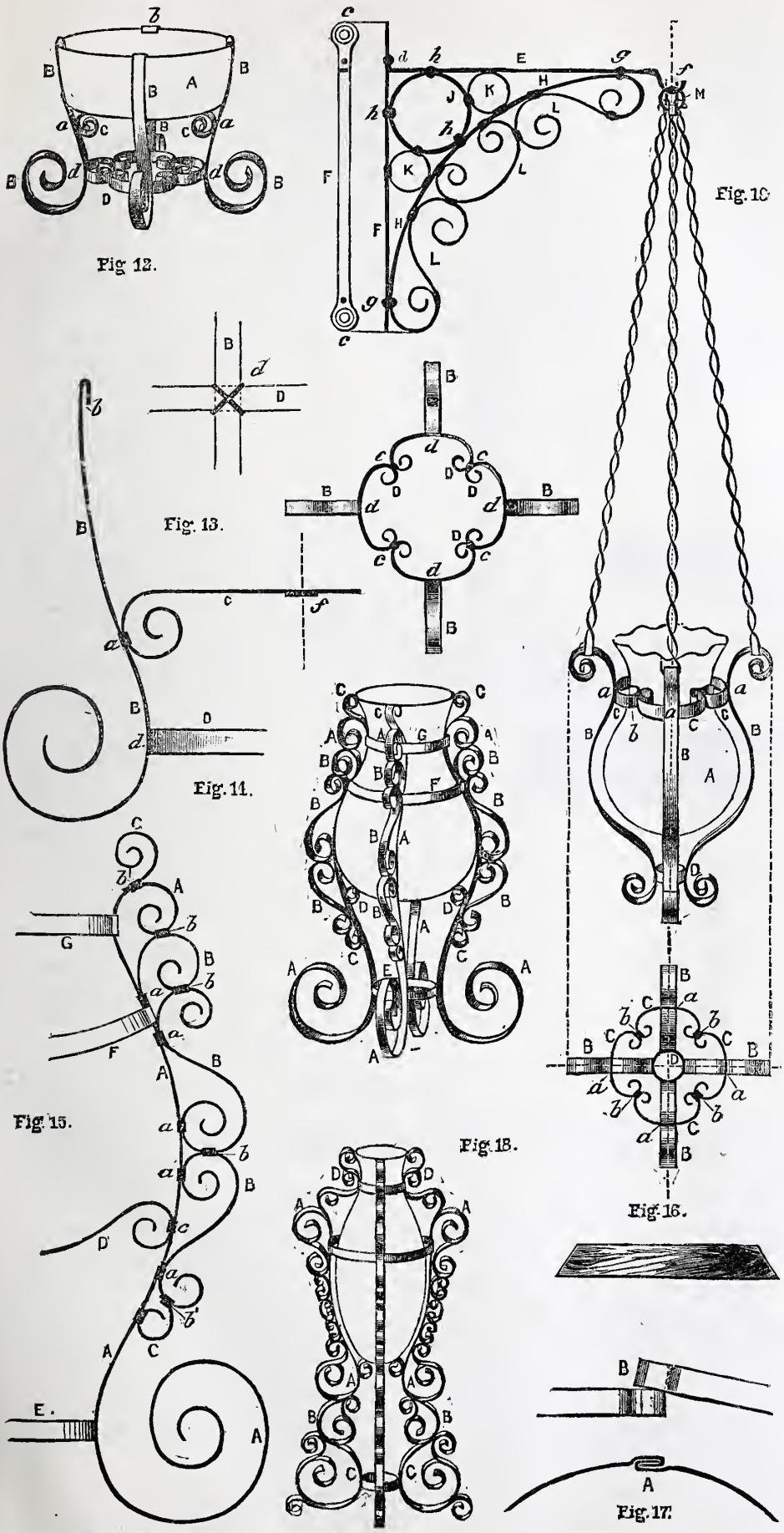
Union of Rings.—Take the diameter accurately, and then turn over the ends to make a tinman's seam-joint (Fig. 17, A); then embrace the legs, bring the ends over one another, B, and slip the two parts together, and the ring will be bound tightly around the legs.

A Second Example of Mounted Vase.—Fig. 18 shows another vase of a more slender form, and mounted in a different design. As the method of making this is essentially similar to the previous one shown, scarcely any comment is necessary. In this instance the main strip of iron in the legs terminates at A A, and the legs are completed with additional curves, B, C, and D. In every case in this figure where curves come into contact they are secured with a clip. The figure is, however, too small for them to be shown distinctly.

Hanging Flower Vase.—Fig. 19 illustrates a hanging flower vase or bowl. A is the vase, B, C, D its framework, and E its supporting bracket. The vase is carried thus: There are four enclosing ribs, B, curved all alike to the outline shown in the figure, using wire pliers and suitably sweeped templet-pins (as previously illustrated). The ribs are united, and the vase suspended by the four double scrolls, C; the scrolls are united to B at *a* with fine iron wire (as illustrated at Fig. 13, d^1); or the opposed faces may, of course, be soldered. This is generally preferable, on the score of neatness, wire fastenings savouring to a workman's taste of cobbling. But be sure of the security of the soldered joints before trusting fragile vases to them—that is all. These flat joints, however, are among the very simplest jobs that can occur.

Bottom Ring.—At the bottom, the ring, D, is fastened to B, either with wire or by soldering. When this ring has been fastened, then the vase may be inserted, and the curves, C, fastened to one another with clips at *b*. The ribs, B, and curves, C, can easily be opened out sufficiently to permit of the insertion of the vase, and with care the clips may be pinched at *b* without injuring the vase; or wire may be used instead of clips.

Suspension Bracket.—The vase is suspended from the bracket, E. I shall have a good deal to say further on about different kinds of brackets. This one is characterised by the most severe simplicity of outline, being, in fact, of quite an elementary type. Its framing is made of iron, having a cross section of about $\frac{3}{8}$ in. or $\frac{5}{16}$ in. by $\frac{1}{8}$ in. There are three main portions—the back, F, top, G, and diagonal, H. F is flattened at the ends, *c*, and drilled to receive screws for fastening the bracket to the wall G is turned up and riveted to F at *d*, and is bent at the other end, *f*, to form a suspension



Bent Iron Work. Fig. 12.—Mounted Bowl. Fig. 13.—Detail of Scrolls—Plan View and Mode of Binding. Fig. 14.—Mounted Vase. Fig. 15.—Detail of Vase Stand. Fig. 16.—Block for Coning Band. Fig. 17.—Method of fastening Bands. Fig. 18.—Mounted Vase. Fig. 19.—Hanging Flower Vase; B, B, B, B, Plan with Vase removed.

hook; H is curved, and riveted to F and G at *g*, *g*.

The Scroll Work.—The ring, J, made of the same section of iron as the framing, acts as a stiffener, preventing H from yielding inwards under pressure. It is riveted at *h*, *h*, *h*. All the rest of the work—the small rings, K, and the scrolls, L, L—may be made of the thin iron strips, and clips (as shown) will be employed for holding them fast together.

Imitation Chains.—For the suspension of the lamp I show imitation chains, made of bent iron, twisted (as previously shown in the drawing of elementary forms, Fig. 8, page 6). Each length of iron, after having been twisted, is turned over at each end, and is brought underneath the top curve of B at one end, and at the other is slipped into a ring, M. The four rings, M, are slung in the eye, *f*, and sustain the vase.

SLATERS' WORK.

BY A MASTER SLATER.

Slaters' work is the art of covering roofs with various kinds of slates. They are found in North Wales, Westmoreland, Cumberland, Devonshire, Cornwall, and other parts, also in Scotland and the north and south of Ireland.

Slates are obtained from the Silurian rocks, which are nearly the oldest formation. The best are from the argillaceous strata laying on the mica schists and gneiss, and covered by the old red sandstone or mountain limestone. They are composed of silica, alumina, oxide of iron, potash, magnesia, carbon, and water. The best slates have a metallic ring when struck, and should be practically non-absorbent; they are sometimes tested by being set half their depth in water, and if in the course of six or eight hours the damp has not arisen, they are good; if damp to the top, they are porous and absorbent.

The grey or stone slates are obtained from the laminated beds of stone found in the coal measures in various parts of the country, and are principally composed of quartz and mica.

Welsh Slates.—These are most extensively used, and are quarried in Carnarvon and Merionethshire, in North Wales. The following are some of the principal quarries: Bangor, Carnarvon, Portmadoc, Port Dinorwic, Llanberis, Glenfaron, Oakley Old Vein, etc. They are of various colours—blue, purple, pale green, and grey; the green colour is supposed to be caused by an excess of magnesia, the red by oxide of iron, and the dark-coloured by carbon. At Lord Penrhyn's quarry at Bethesda between four and five thousand men are employed.

Slates are known by various names, according to their sizes—Doubles, 12 in. by 8 in.; Plantations, 13 in. by 10 in.; Ladies, 16 in. by 8 in.; Viscountesses, 18 in. by 10 in.; Countesses, 20 in. by 10 in.; Marchionesses, 22 in. by 12 in.; Duchesses, 24 in. by 12 in.; Princesses, 24 in. by 14 in.; the sizes vary occasionally in the smaller slates. Slates up to these sizes are sold by the thousand of 1,200; above these sizes are called ton slates, and are sold by the ton.

The slates are quarried from the rock by blasting in large blocks, which are sometimes eight feet in length; these blocks are then split by long thin chisels and mallets into slabs the full size; these are cut across into smaller sizes, and again divided by thinner chisels into the proper thickness for

roofing slates. If the blocks are exposed to the weather too long they lose the property of being split. After the slates have been split to the desired thinness, they are trimmed and dressed at the edges into the different-sized slates.

Devon and Cornwall Slates.—These slates are of a similar quality as the Welsh slates, and are quarried at Ashburton, and other places in Devonshire, and at Camelford, and other places in Cornwall.

Westmoreland Slates.—These slates are quarried near Kendal, at Coniston, Buttermere, Ambleside, and other places in Westmoreland, Cumberland, and Lancashire; they are a pale green colour, and are thicker and not so fine as the Welsh slates. In covering roofs with them, different-sized slates are used on one roof, the largest sizes being laid on the eaves, gradually diminishing to the ridge.

Grey or Stone Slates.—These slates are quarried extensively in Yorkshire, Durham, Lancashire, and other parts; they are quarried in large blocks, which are afterwards split (to form the slates) into slabs from 1 in. to $\frac{3}{8}$ in. thick; they are cut into various sizes, the thickest slabs being made into the largest slates; the head or top end is slightly rounded, and they are hung on the laths by oak pins put through a hole in the head. In some old buildings the leg bones of sheep have been cut in two and used as pins; stronger roof timbers and slate laths are required for these slates than for Welsh slates. These slates are laid on in different sizes, in the same manner as Westmoreland slates.

Tools and Appliances used by Slaters.—The tools used by the slater are the lath hammer (Fig. 1) for nailing on the laths; one side is formed into an axe, to cut off the ends of the laths. The slate hammer (Fig. 2) is used to nail on the slates; the point is sometimes used to hole the slates, the projecting claw is used for drawing nails. The slate knife, or saixe (Fig. 3), is used for squaring and trimming the edges of the slates; the point on the back is used for making the nail-holes in the slates. The cutting iron, or stake (Fig. 4), is used to lay the slates on while trimming the edges or cutting them. The ripper (Fig. 5) is used for drawing the nails out of old slating in repairing or stripping old work. The pointing trowel (Fig. 6) is used for pointing the slates and ridges. Wooden gauges for marking the slates are made by driving two nails through a short piece of lath, leaving the points projecting. A chalk line is also used for nailing the laths and slates by; for cutting ridge tiles, chisels are used. The cripple (Fig. 7) is a triangular frame of wood for scaffolding on boarded or high-pitched roofs; they are fixed about 10 ft. apart by ropes from the ridge, and scaffold boards laid upon them, on which the slater stands; as soon as he slates as far as he can reach, they are drawn up, and so on till the slating is finished to the ridge. Machines for punching holes in the slates are also used, worked by the hand or foot.

Dressing Slates.—The whole of the slates required should be brought to the works before commencing to dress them. The slater then fixes the cutting iron in a block of wood, and, sitting at one end of it, commences to square and dress the edges of the slates with the slate knife, laying the slates on the cutting iron while using the knife; he then, with a gauge made to the correct length, marks each side of the slate, and holes it with the point on the back of the knife, or with the point of the slate hammer, and lays them down bed upwards in three piles—thicks, middles, and thins; the thicks are nailed at the lower part of the roof, the middles next, and the thins at the top. The eave slates are short slates, and the course next the ridge are short, and are called "tops"; the under side of the slate is the bed, the top side the back, the top end the head, and the lower end the tail. Westmoreland slates are squared and holed in the same manner, but as nearly every course is of a different size, they are piled in courses, the largest courses being laid at the eaves, gradually diminishing to the ridge.

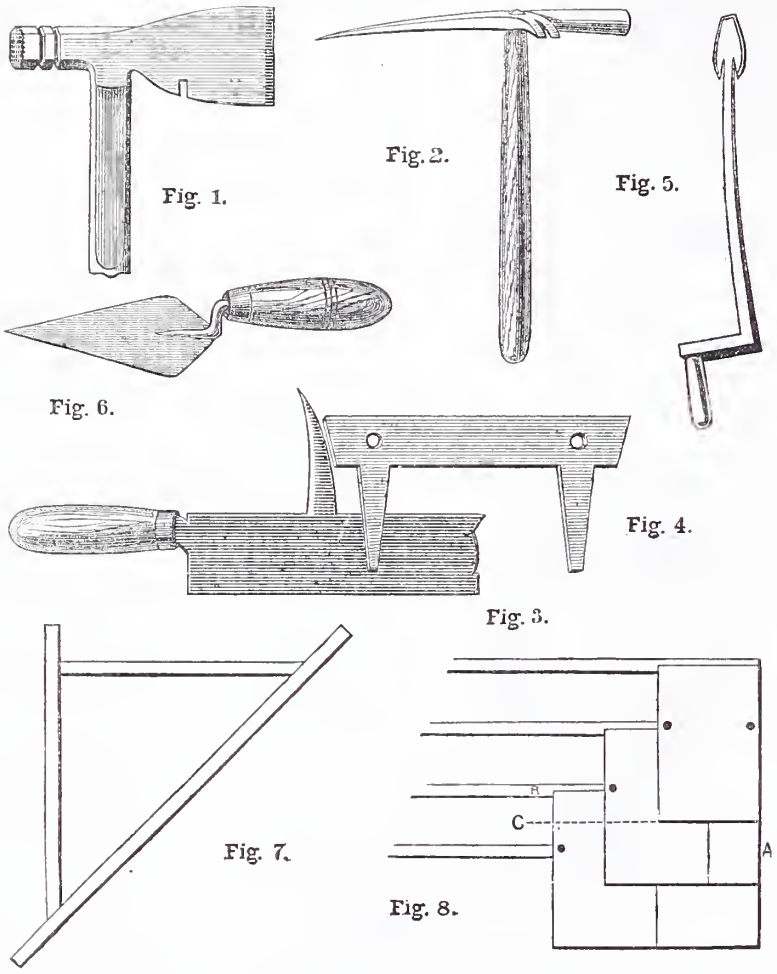
Grey slates are squared with a chisel, and a $\frac{1}{2}$ in. hole made in the top end, except the slate is very large, when two holes are made; they are piled in courses, and laid in the same order as Westmoreland slates.

Laying on Slates.—In commencing to lay on slates, the gauge for the laths must be ascertained; the gauge is half the length of the slates after deducting the lap, which is from $2\frac{1}{2}$ in. to 4 in.; the lap is the distance the tail of the third slate covers the head of the first, and is shown at B C, Fig. 8; then mark each end rafter, and drive a nail a short distance in at each mark; a line is then stretched between the nails, and the laths nailed to it; the laths are about $1\frac{1}{2}$ in. wide and $\frac{3}{4}$ in. thick. The slates are nailed with copper or zinc nails with clout or flat heads. Iron nails should not be used, as they soon rust and loose their hold. If the roof does not project over the walls, the rafters are set back 3 in. to throw up the eave slates; if they project, a lath $1\frac{1}{2}$ in. thick, called a tilting fillet, is nailed at the eaves. The slater stands with his right leg at the lower part of the roof, kneeling on his left knee to nail the slates on, unless the roof is boarded or very steep in pitch, when a scaffold must be made; the eave slates are nailed to a line, and generally project about 3 in., to throw the wet well into the spouts; the next course is laid upon them, and so on to the ridge, keeping the lower edges perfectly straight and parallel, and the vertical joints in each alternate course exactly over each other; this is accomplished by inserting a half slate in every alternate course, as shown at A, Fig. 8. The slating is commenced from the right hand, working towards the left hand. The tails of the slates should fit close down on the backs of the slates underneath them, to prevent the wind getting under and blowing them off. When a slate is twisted, or does not bed solid, it is laid out, to be used for cutting or on another place.

In slating up to hips or valley gutters, the slates must be cut to the slope of the hip or valley, the cutting iron being fixed on one of the rafters.

When the roof is boarded, chalk lines are struck on the boarding as a guide for nailing the slates, and they are bedded in fine lime and hair mortar; sometimes felt is laid on the boarding, and laths nailed upon the felt, the slates being bedded; and sometimes the spaces between the ordinary lathing are filled with plasterers' laths, and the slates bedded on them. A scaffold is required when slating in this manner. When a roof projects at the gables, the slates are sometimes projected $\frac{1}{2}$ in. over the outside rafter, and sometimes finished flush with it, and a moulding is fixed level with the top of the slates, and a piece of strong hoop iron projecting over the slates is screwed on the top edge of the moulding to form a cap, and prevent the wind blowing the slates off. When the projections are boarded, the slates should be bedded in mortar.

In laying Westmoreland slates, as nearly every course is of a different length, the gauge of the laths must be altered to suit. The largest slates are laid on at the eaves, gradually diminishing to the ridge; the



Slaters' Work. Fig. 1.—Lath Hammer. Fig. 2.—Slate Hammer. Fig. 3.—Slate Knife, or Saixe. Fig. 4.—Cutting Iron. Fig. 5.—Ripper. Fig. 6.—Pointing Trowel. Fig. 7.—Cripple for Scaffolding. Fig. 8.—Band and Lap of Slating.

laths should be wider and thicker, and the nails stronger and heavier.

In laying grey slates, as they also vary in size, they are laid in the same manner as Westmoreland slates, except that an oak pin is put in the head of the slates to hang them to the laths. When grey slates are to be cut, they must be nicked with the chisel and broken off with the hammer. On large sheds, workshops, etc., with iron roofs, the laths are sometimes of iron, the slates being fixed by lead nails clinched on the underside of the laths, and as they are not pointed, the slates have extra lap: generally 4 in.

Sometimes the slates have the two lower corners cut off or the tails rounded; this is called ornamental slating, and sometimes bands of different coloured slates are used on one roof to break the monotony.

GRAPHS, AND HOW TO MAKE THEM.

BY W. GLEDHILL.

During the last few years this once popular system of copying has been considerably on the wane. The copying machine known by the names of centograph, and various others of a like nature, will be found beneficial in saving a great amount of trouble when a large number of copies of plans, letters, circulars, etc., is required without calling in the assistance of the printer. Its only drawback is its expense, but as the whole machine may be easily made for a trifling cost, this disadvantage is not so great as would at first be imagined.

The process of working is a most simple one, and cannot fail if the instructions which I shall give are carefully carried out.

The apparatus required is very limited, and easily obtainable. You should first procure an old tin biscuit-box of moderate depth with sound corners. Then get a short rod to stir the composition, and also get the ingredients themselves. And finally you should procure a shallow tray to hold the composition. Your tray should be a metal one, and the lid of your biscuit-box will serve you for this purpose.

Next as to the ingredients, which will be as follows:—Glycerine (common), 18 ozs.; water, 12 ozs.; powdered loaf sugar, 3 ozs.; sulphate of barium, 6 ozs.; Nelson's gelatine, 3 ozs. Most of these are procurable at any chemist's shop, and each should cost about one penny per ounce. Nelson's gelatine you will be able to get at any respectable grocer's shop in one ounce packets for fourpence-halfpenny each. The total cost, therefore, will be trifling.

Having got everything ready, put the ingredients into your biscuit-box, taking care, however, that the proportions are carefully measured; and when this is done, place your box on a shelf for twenty-four hours to allow its contents to macerate. When you examine the box again, you will see that the gelatine has assumed enormous proportions, and has absorbed most of the water. However, to make the mixture perfect, you must resort to heat, and the best thing you can do is to place your box over a stove and leave it there for two or three hours until the gelatine has dissolved. Care should be taken, however, that the heat is not too intense, or your composition will in all probability be spoiled.

At intervals of about half an hour the contents of your biscuit-box should be well stirred, in order to thoroughly amalgamate them. And when they are reduced to a thick, creamy-looking liquid, pour the mixture into your tray, which should be placed ready to receive it.

In all probability a number of air-bubbles will be formed on the surface of your liquid. These should be destroyed immediately, or your copies will not be clearly printed. To do this, you should procure a stout carpet-needle, and after heating it to a red heat, prick each bubble with the point. This will burst them, and afterwards the composition will begin to set. For half an hour it should be left alone on a level surface, and at the end of that time it will be ready for use.

Your apparatus is now ready for use, and all that remains for you to do is to write your circular, or letter, or whatever you may require, with the special ink, as neatly as you can, taking care to make your up and down strokes as nearly as possible of the same thickness. The writing should always be left to dry; and when it is perfectly dry, it should be laid with the writing downwards upon the graph.

Now lightly rub your fingers over the paper in order to be sure that every part of it lies in contact with the composition. After leaving your sheet of paper on your graph for about a minute, remove it with the greatest care, lifting it by one corner, and you will have a reversed copy of your writing upon your graph.

Then lay a blank sheet of paper upon the writing, rub as before, and remove carefully after five or six seconds. An exact copy will have been transferred to your paper, and by repeating this process, any number of copies up to sixty or seventy can be obtained. When you have printed sufficient copies, you should sponge your graph with cold water, and afterwards rub it lightly with a piece of clean rag until your writing has almost disappeared. Then allow your graph to dry, and put it away until it is required for further use. It should always be washed immediately after you have taken your copies, or the ink will sink into the composition, and in process of time your graph will assume a violet hue.

After you have used your graph a few times, its surface will most likely become rough and uneven, and totally unfit for further use. When this happens, you should cut the composition with a knife and melt it down again, pour into your tray, and destroy the bubbles as before.

The ink which you will require can be obtained of almost any stationer, and will cost about eightpence per bottle. Preference should always be given to violet ink, as it will be found to be the most powerful, and to give more impressions than red or black inks.

HOW TO LEARN DRAWING OFFICE WORK.

BY ARTHUR BOWES, A.M.I.C.E.

Drawing-Papers, their Qualities—Tracing-Paper and Cloth—Rendering Drawing Paper temporarily Transparent—Sizes of Papers—Drawing-Boards: Danger of Contraction and Warping—How to Treat Indentations—Boards Fitted with Appliances for Stretching Paper.

Drawing-Papers.—The papers which are most in use in the drawing office may be divided into two classes—"cartridge," which is a machine-made common quality of paper, used for work where a fine finish is not required in the draughtsmanship; and a better quality, hand-made, generally of "Whatman's" make, for superior work. One side of the "cartridge" is generally, though not always, finished to a smoother surface than the other, and the smooth surface is the one usually adopted for drawing on. This paper is not suitable for colouring on, as it is soft in texture, and absorbs the colour like blotting-paper. "Whatman's" paper is of a much finer and stronger texture and hard surface. Both sides are much alike in appearance, but the correct surface for drawing on may be ascertained by holding the paper up to the light. Each sheet contains a water-mark, which reads in the right direction when looked at through the working surface. For drawings which have to be submitted to much handling, or which it is desired to preserve in good condition for many years, it is usual to use drawing-paper mounted on holland or linen. The standard sizes of paper are to be bought ready mounted, or if a specially large plan has to be prepared, either "cartridge" or superior paper can be bought by the roll in various widths up to 60 in.

Tracing-Paper and Cloth.—Tracing-papers are made in a great variety of thicknesses, tints, and textures. They have usually one side smoother than the other, and are sold in continuous rolls, 21 yds. or 22 yds. in length, varying in width from 30 in. to 44 in. Tracing-linen or tracing-cloth is obtainable in about the same sizes. It is made with one side glazed and the other rough, or occasionally with both sides glazed. The question as to which side is to be used for drawing upon is one which must be left entirely to the discretion of the draughtsman, some preferring one side, some the other. The rougher side is easier to work on, inasmuch as it takes both ink and colour easily, but a much neater and more effective tracing is produced by using the glossy side, and doing the colouring only on the rough surface. The rougher surface of the paper, it is also worthy of note, is more easily soiled than is the smooth surface.

The statement has lately been made that in some continental offices ordinary drawing-paper is made temporarily transparent by being saturated with benzine, and is then used for tracing purposes. The benzine is applied with a dabber of cotton-wool over the small portion of the paper which it is intended to use at once, as the evaporation of the benzine soon leaves the paper in its natural opacity.

Sizes of Drawing-Papers.—The standard sizes of drawing-papers are as follows:—

SIZES OF DRAWING-PAPER.

	Ft.	In.		Ft.	In.
Emperor	5	6	×	3	11
Antiquarian	4	4	×	2	7
" extra ...	4	8	×	3	4
Double elephant... ...	3	4	×	2	2
Atlas...	2	9	×	2	2
Columbia	2	10	×	1	11
Elephant	2	3½	×	1	10½
Double-crown	3	6	×	1	8
Imperial	2	6	×	1	9
Super-royal	2	3	×	1	7
Royal	2	0	×	1	7
Medium	1	10	×	1	5
Demy	1	8	×	1	3

Drawing-Boards.—Much ingenuity has been expended in devising improvements, or supposed improvements, in drawing-boards, and the various forms of this appliance are innumerable. For practical use, one of the best is almost the simplest in construction. The drawing-board shown in Fig. 6 is cheaply and easily made, and will be found to answer its purpose better than many of a more elaborate description. It consists of two or more well-seasoned boards screwed to stout battens,

which raise the board two inches or more from the desk, and allow the T-square to be used with freedom. As all wood-work in process of time shrinks to a greater extent across the grain than it does in the direction of the grain, it is advisable for the screws securing the battens to the board to work in slots, as shown on an enlarged scale in Fig. 7. By this means the board, in contracting, draws the screws along with it without unduly straining the screws or battens. Naturally, if properly seasoned timber has been used, the liability to shrinkage will be very slight, and care should be used in the first place to secure suitable wood for the purpose. An old mahogany table or shop counter will provide excellent material.

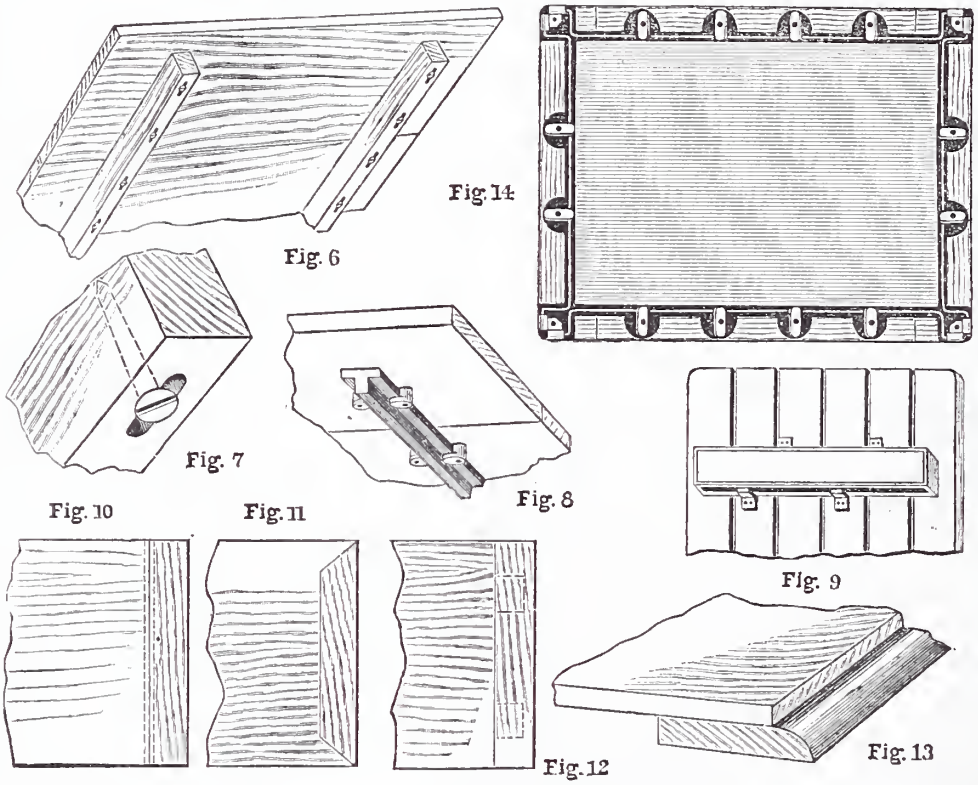
With the object of allowing for the above difference in the contraction of the parts, several modifications of the above idea have been applied. Instead of fastening the battens by screws to the back of the board, wooden turn-buttons may be used, as in Fig. 8, working on rebates in the cross-battens; or the battens may be grooved, and secured to the board by bent brass clips, as shown in Fig. 9.

In the above cases the end of the drawing-board is formed by the planed ends of the boards forming the top, and as this does not form a perfectly smooth surface for the head of the T-square to work against, it is customary in some boards to clamp on end pieces, either simply tongued and grooved straight across the width of the board, as in Fig. 10, or mitred at the corners, as shown in Fig. 11. Sometimes the end pieces are mortised, as in Fig. 12. From what has been said above, the objectionable feature in all these forms will be seen to consist in the fact that the various parts cannot shrink without straining and warping the drawing-board. The simple form of construction shown in Fig. 13 has the merit of protecting the edge of the drawing-board from injury To provide a smooth bearing surface for the head of the T-square, some makers insert a slip of ebony across the end of the drawing-board.

It may be worth while here to point out that should a drawing-board suffer from rough usage and become indented, the grain of the wood can be raised by placing on the dents several thicknesses of brown paper previously soaked in hot water. On the top of these is placed a piece of dry paper, and then a hot flat-iron is laid on the whole until the vapour has caused the wood to swell. When the board is dry, a shaving or two can be taken off with a smoothing-plane, and the board will be as good as new.

Several arrangements have been devised for stretching drawing-paper on the board without the use of glue or drawing-pins. One of these, Wigzell's patent, is shown in Fig. 14. In using this board, the bent wires round the edges are to be turned back from the grooves into which they fit. The paper, after being damped all over, is placed on the board with its edges overlapping the grooves, and the wires are then turned down and secured by the turn-buttons. The paper is securely held in the grooves, and the superfluous edges can be trimmed off. The turn-buttons and wires are sunk below the surface of the board, so as not to interfere with the free use of the T-square.

In my next paper I shall hope to deal with such requisites of the drawing office as the instruments used; viz., T-squares, set-squares, parallel rulers, etc., and give some preliminary teaching on straight-edges, etc.



Drawing Office Work. Fig. 6.—Battened Drawing-Board. Fig. 7.—Detail of Slot for Screws in Fig. 6. Fig. 8.—Battens with Turn-buttons. Fig. 9.—Batten with Slot and Brass Clips. Fig. 10.—Straight Clamp. Fig. 11.—Mitred Clamp. Fig. 12.—Mortised Clamp. Fig. 13.—Batten projecting at end of Board. Fig. 14.—Secured Drawing-Paper Arrangement without Glue.

CARVED OAK JACOBEAN TABLE CONVERTIBLE INTO A HALL SEAT.

BY M. M.

It is not an infrequent experience among seventeenth-century carved oak furniture collectors to meet occasionally with tables which, when not required to do duty in that capacity, were so constructed as to be adapted to the purposes of chairs; and in the present paper will be found instructions and the necessary drawings for making such a convertible piece of furniture. The design given being quaint, and by no means commonplace, will doubtless be acceptable to some who are on the look-out for artistic novelties; it has, besides, certain good points of a practical character which may make it worth attention. As an occasional table, it has a strength and solidity not to be attained by the ordinary pillar stands, and if used as a writing-table or a work-table, the chair-seat beneath it forms a decided convenience; moreover, whereas the ordinary stand-table is, when not in use and turned up, merely an unsightly encumbrance, this article, when not wanted as a table, is both serviceable and ornamental as a seat for the hall. In the perspective sketch (Fig. 1) it is shown in this latter state.

Although the present design is an original one, the idea on which it is based is as old as the reign of James I., and in style and decoration the taste of that period has been pretty closely adhered to. The carving is not elaborate, or such as will offer any difficulties to amateur workmen. That pattern which, in its chair state, decorates the back of the "combination," is so slight, that it will in no way weaken the board for the uses of its other side as a table-top. The carving on the frame is little beyond mere gouge-work.

As a table, our convertible piece of furniture stands 2 ft. 4 in. high, and has a top 2 ft. 6 in. square, its frame measuring 2 ft. by 1 ft. 6 in. As a chair, the seat is 1 ft. 6 in. high, the arms 1 ft. 11¼ in. high, and the back about 4 ft. 9 in. In Fig. 1 we have a general perspective view, the table top being turned up to form the back of the chair. This is, of course, drawn to no precise scale, but the reader will easily grasp its dimensions.

For shaping the legs, it will be seen that the lathe has to be called into requisition. These (*a*, *a*, *a*, *a*, in the section, Fig. 5) are made from stuff 2 in. square; their length is 24½ in., exclusive of the tenon for entering the mortise in the arm, which will demand an additional inch and a half. There is a little ornament on the legs—two rosettes on the outer sides of each—which are carved in sunken medallions; these are of a very ordinary Jacobean type, but at Fig. 7 is one somewhat reduced in size. It will be observed that these rosettes figure on all the legs alike, since all are alike supposed to show when the "combination" is in use as a table. Each leg has mortises ½ in. wide, ¾ in. deep, and 3 in. long to receive the tenons of the cross-pieces, as is shown in the section, Fig. 5.

These cross-pieces are of 1 in. stuff, 4½ in. wide; those for the back and front are 20 in.; those for the ends 14 in. long, exclusive of the tenons, which are ¾ in. long at each end. The line of gouge-work ornament running along them seems too simple to require any explanation. The lower edge of each in the part hollowed out has a hollow moulding worked with the gouge instead of a chamfer. The cross-pieces are marked *b*, *b*, *b*, *b*, in the section (Fig. 5) where these tenons are shown.

On these cross-pieces rests the seat (*c*,

Fig. 5), which is of ½ in. wood. The proper "Jacobean" way of fixing this down to the cross-pieces would be with wooden pegs, but the more modern inventions of screws or brads may perhaps be preferred. I have drawn the seat as coming just flush with the frame (24 in. by 18 in.), and slightly rounded off on its upper edge, but some might choose to gain a little relief by making it project half an inch on every side and finishing off with a moulding. We should then need a seat 25 in. by 19 in., and in this latter case it will be desirable to cut away the projection in the centre of the back where the turned-up table-top touches against it, or, when in use as a chair, the upper part of that member will tilt forward objectionably.

The arms, on which the table-top rests when turned down, are cut from stuff of the same thickness as the legs, namely, 2 in., but in depth they are 2¾ in. They are, as shown in Fig. 3, hollowed on their upper face; this adds to the comfort of the chair, and the table-top is rendered more firm by resting on four points only. Below a corresponding curve is given, and the edges of both the upper and lower curves are chamfered off. These arms are 19¼ in. long, for it will be seen that their front ends project 1¼ in. beyond the general line of the frame. The rosettes carved on the outer sides of the arms are similar to those on the legs, and are given at full size in Fig. 7. On its under-side each arm has a mortise 1¼ in. long by ¾ in. broad, and 1½ in. deep to receive the tenons of the legs.

The shape and ornamentation of the table-top on its under side are shown in Fig. 4. This figure being intended to show decoration rather than construction, is not drawn to scale. The top is of ¾ in. board, and is 2 ft. 6 in. square. The moulding round its edge is alike above and below, as is shown in the section (Fig. 6). In this section is also indicated something of the depth to which the carved decoration should be cut. The carving here shown is mere surface decoration, an adaptation of the band-work so often met with in seventeenth-century panels. The interlacing bands are marked out by a line on each side incised with the V-chisel, whilst down their centres a shallow hollow is run with the gouge, which hollow is afterwards enriched by using the grounding-punch at intervals, or by dots or markings made with other gouges, as the fancy of the carver may direct. The top is shown to be fixed to the arm by ornamental hinges, and these should be let in so as to come flush with the surface of the wood.

None of the drawings are given to scale, but should any difficulty arise on this score, the matter can be soon set right through the welcome columns of "Shop."

In the very heading of this paper I spoke of oak as the material for this piece of furniture, and indeed we could have nothing better or more suitable. We are accustomed to look upon oak as the one wood appropriated to the style. Unquestionably it was the wood most in use in the Jacobean era; it is, however, a mistake to suppose that it was used exclusively. True it is that fancy woods with the art of inlaying were little employed in English furniture till much later in the century—till post-Restoration times, in fact—yet Spanish chestnut was extensively used in this country throughout the Tudor period and in the early Stuart both for ecclesiastical and domestic work. This wood has scarcely less endurance than oak. I have worked up and carved some, certainly not less than 200 years old, which was as sound as ever. It is well suited for carving, and, as a matter of fact, we find a reasonable amount of old carving executed in it, some of which is highly elaborate. Other woods were also used at that date—in my own possession is an arm-chair of the time of Elizabeth in English yew. This timber, however, was but rarely employed, and then only slightly carved. I mention these matters to show that carrying out a design like the present in some other wood than oak need not necessarily be inconsistent.

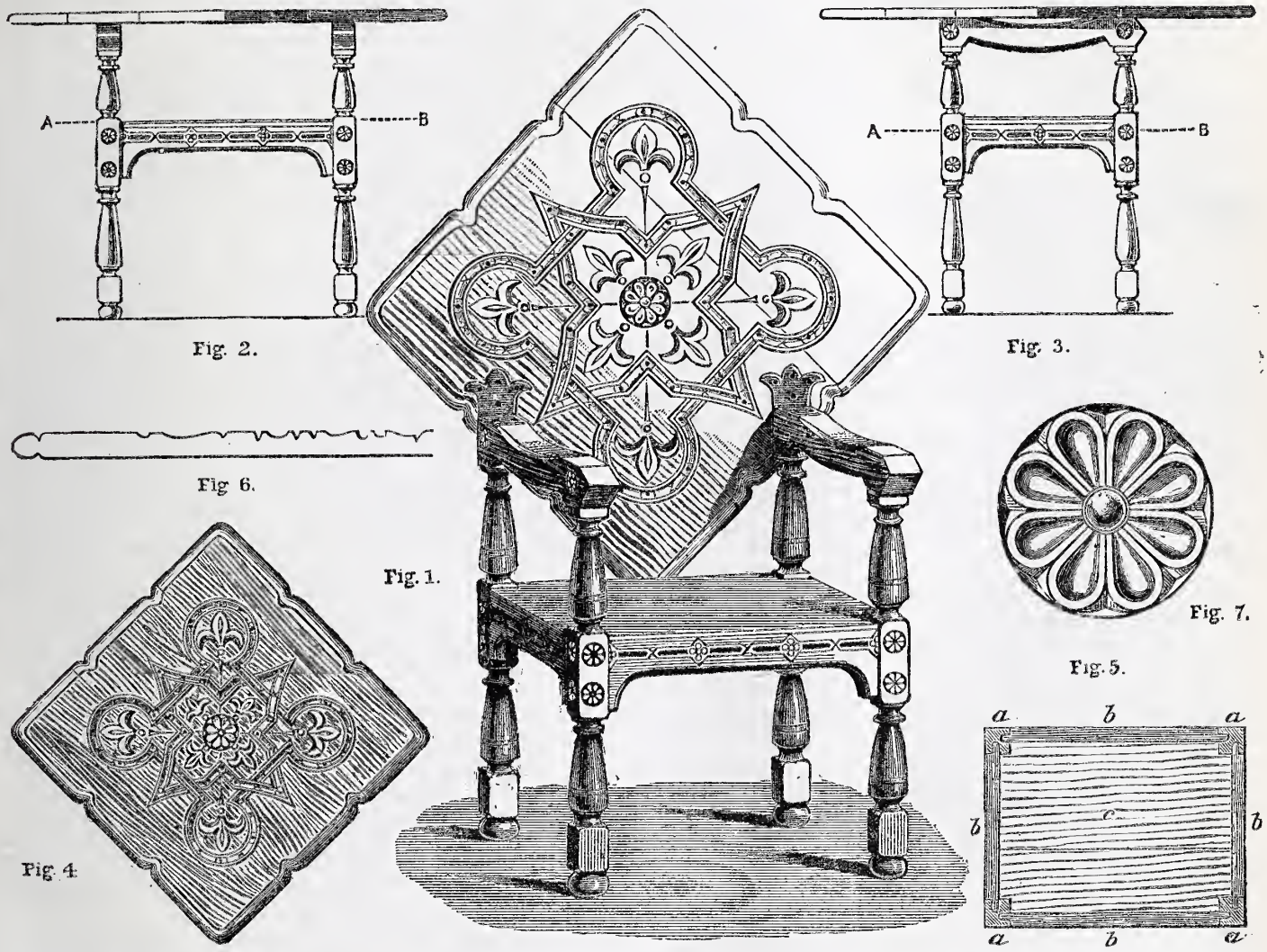


Fig. 1.—Jacobean Convertible Table. Fig. 2.—Front Elevation. Fig. 3.—End Elevation. Fig. 4.—Under-side of Top. Fig. 5.—Horizontal Section on Line *a b* from below. Fig. 6.—Section of Top. Fig. 7.—Rosette on Legs and Arms.

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FOREIGN COMPETITION.—It appears that the pencils used in the Post Office and other Government departments come from abroad, and once or twice questions have been asked in the House of Commons why the Government should not give the work to our own manufacturers, and so tend to the increased employment of our own people. We have never yet seen a satisfactory answer given to these questions, which suggest the advertisements of many firms who appeal to the public to purchase their commodities and so encourage British industries. There is a most satisfactory and conclusive answer to such questions, however, and we make a present of it to any member of the Government who may hereafter be challenged about these pencils. The answer is, that the consumption by this country of foreign pencils, or foreign anything else, does not rob our workers of one single hour's labour. To understand this, think for a moment how we get these foreign pencils or foreign anything else. Do the foreigners give them to us for nothing? Clearly they do not—no one would say that they do—yet everyone in speaking of this subject seems to imply that they do. Well, if they don't give us them for nothing, they must take something from us in exchange for them. What do they take? They take our gold, you say. Well, suppose they did take our gold, how do we get that? Do we get that for nothing? Clearly not; we must give something to get it. What do we give? What can we give but the produce of British industry? Thus, when we consume foreign articles, even when we have given gold for these articles, we are really consuming the produce of British industry. But it is not true that we give the foreigners gold for these foreign articles; on the contrary, so successful are our international commercial transactions, that the foreigner, besides sending us his produce to liquidate his obligations to this country, has also to send us *his* gold. This is shown by the return of the imports and exports of the precious metals in bullion and specie—the excess of the imports over exports during the period 1886-90 being the difference between £121,465,469 (gold and silver imported), and £110,989,696 (gold and silver exported), or £10,475,773. Alas! the wealth of this country.

CONCILIATION BOARDS.—Apropos of the Labour disputes in Birmingham, district rules have been prepared for a proposed conciliation board. In the present arbitrary attitude taken up by both masters and men, we see a standing menace to the industries and the domestic peace of the country. If the colliers take a week's holiday, the coal owners, in an equally arbitrary fashion, propose to reduce wages. That some thousands of engineers should strike work on account of a trivial dispute with their fellow-workmen, the plumbers, has aroused feelings—not too justifiable—against their arbitrary conduct, on the part of the masters, throughout the country; and, in the present serious decline of the engineering trades, it would be no marvel if the masters were to attempt reprisals. If the men have their Unions, it must be remembered that the masters have their Association, both for offence and defence. If we read the signs of the times aright, the struggle between associated labour and associated capital tends to become more bitter, more severe. Boards of conciliation are one remedy for these eternal industrial disputes. Their operations as yet have been very limited, but they are well worth an extended trial. A large proportion of labour disputes arise from want of knowledge on both sides. Workmen cannot know the points of business workings, and employers seldom take their workpeople into their confidence. Bare unsupported statements are not believed, but the statements officially made by a board of conciliation, whose members were representatives of *employers and employed*, would be received with implicit confidence, and prevent disputes which harass industry, and inflict untold misery on the lower grades of unskilled labour, and on dependent families.

PATENTS.—The number of inventors and aspirants to that title increases in fair proportion to the population: even the perpetual motion illusionists are not extinct, and their offerings are accepted at the English Patent Office. By the way, we can scarcely wonder at the unenlightened enthusiast paying for a patent for an impossibility, so long as the educated officers of the Patent Office will grant it. If anyone thinks he, or she, has invented something, a model should be made, no matter how rough, so long as it is a working model; this course will settle the practicability of the alleged invention, and, in a majority of cases, will save money, time, and protracted waiting for ultimate disappointment. An inventor who makes a model before depositing his provisional specification will satisfy himself as to the essential features of his apparatus, and therefore not run the risk of subsequently invalidating his patent through discrepancies of principle between the provisional and complete specifications. A more general knowledge of the first principles of physics and mechanism will close the era of impossible inventions, but in the meantime the making of a model is the antidote, though it would be much better if the granting of patents were restricted to possibilities. The large profits of the Patent Office would then afford the employment of competent technical examiners and clerks.

ABOUT BORDER ORNAMENT.

BY CHARLES KELSEY.

Fret or Key Borders.

Introduction — Antiquity and Extent of Usage — Archaic Greek Work — Utility and Applicability of these Patterns—Essential Principles—Description of the Diagrams — Hints on "Setting Out"—Ancient Labyrinths — Garden Mazes — Labyrinthes de Pavé—Conclusion.

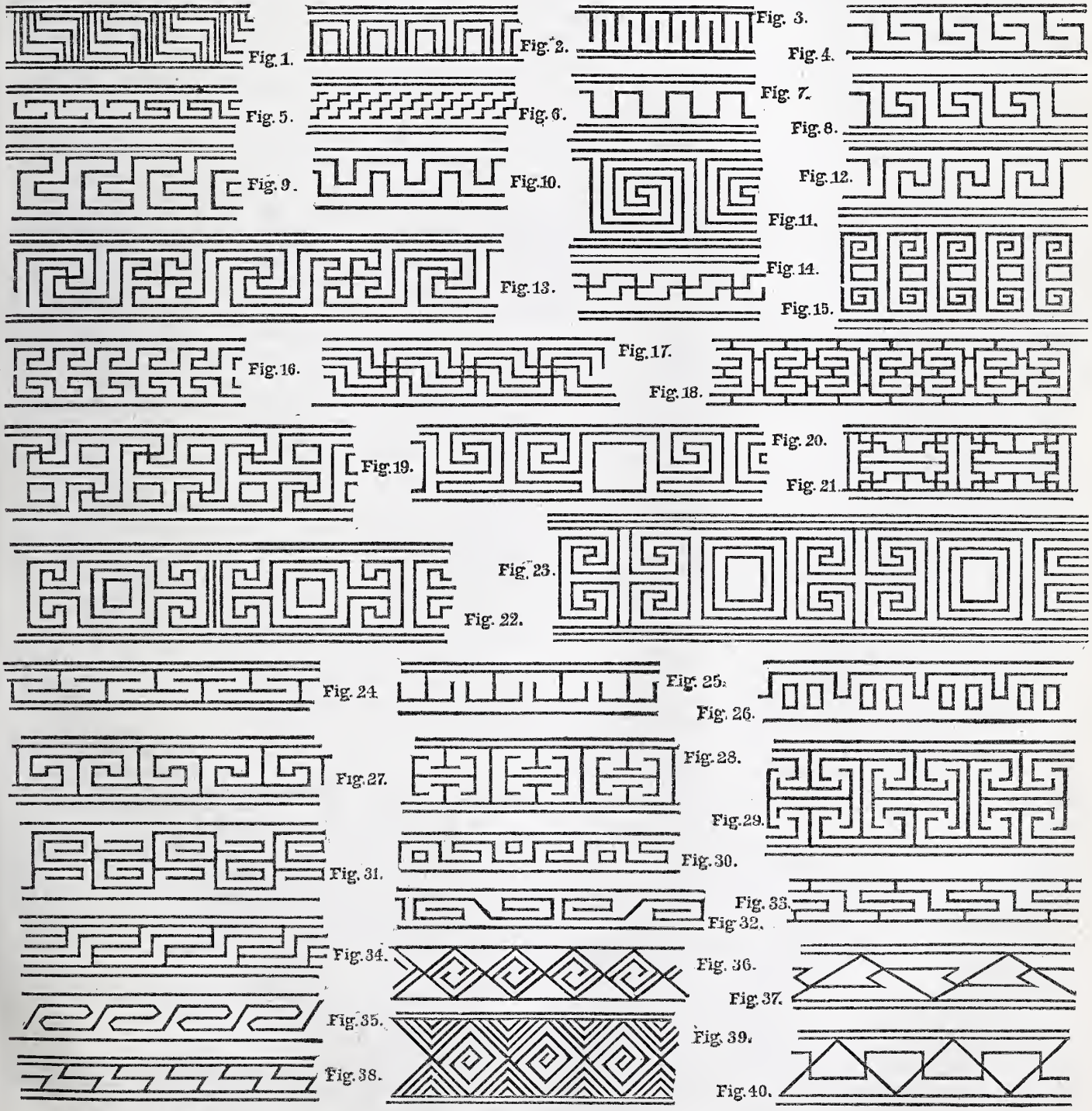
Introduction: Antiquity and Extent of Usage.—In a prominent position in the Octagonal Hall which forms the centre of the National Gallery in London appears the following axiom :—

"Those works which have stood the test of ages have a claim to our respect and veneration to which no modern work can pretend."

This motto refers primarily to the examples of painting by old masters which are exhibited within these walls, but it is quite as applicable to the series of patterns which are illustrated with this article. Indeed, on the score of antiquity, even the oldest of the paintings—dating, though they do, from the thirteenth century—appear modern when compared with many of these patterns, which can boast of twenty-five centuries of continued use, and yet still form "stock patterns" with the designers of modern articles.

Most of the Greek examples here given appear to have been developed by the potters working early in the fifth century before Christ; they were subsequently used by the Greek architects and the workers in other materials.

Many of the Chinese examples can no doubt lay claim to as great an antiquity, for their ornamental forms are highly traditional; and it is a well-established fact that they were expert workers in many of the arts at a period prior to the date of civilisation in the West. These fret or key patterns—the latter term referring to their resemblance to the wards of a key—have been used, modified, and developed by artists and decorators of every age, clime, and faith, and show no signs of ever falling into disuse. Indeed, it is surprising how frequently they are used upon modern work. Ample evidence of the extent of this usage



Examples of Border Patterns—Frets. Figs. 1-16, 19, 20, 22-24, 27, 30, 36.- Greek. Figs. 18, 21, 25, 26, 31, 33, 39.—Chinese. Fig. 17.—Italian. Fig. 35.—Arabian. Figs. 28, 29.—Mediæval. Figs. 32, 34.—Mexican. Figs. 37, 38, 40.—Persian.

may be gained by observing the articles in any modern day furnished room : it will be almost remarkable if our old friend is not met with in some one of its forms.

In the examples illustrated, I have selected many unfamiliar specimens—many which have not been previously published—and at the same time those which appear most likely to bear within themselves suggestions for further variations.

Archaic Greek Work.—It is a singular fact—one which may be observed in all Greek art-work of this character—that the earliest examples are much more suggestive than the later ones. In archaic times the fancy seemed more free to rove than at the later periods, when the skill of the Greek worker seemed to be directed more towards the perfecting of established forms than to the development of new ones. For this reason, the Greek ornamental forms are at once very few and almost perfect.

Utility and Applicability of these Patterns.—This collection of patterns will be found useful to many of the busy readers of WORK ; to instance the methods of decoration, and the articles to which they may be applied, would be to specify almost every known craft and article. As a general rule, it may be said that the Greek examples will be most appropriate to the decoration of simple-shaped, solidly constructed, and stately articles, whilst the Chinese and Persian examples will be most suitable, from their quaint character, to less formal articles, fancy goods generally, and the like.

Frets are most suitable for the decoration of flat surfaces, fasciæ and fillets, or used as borders. On sharply-curved surfaces they will be more difficult of execution, and will be likely to appear distorted ; but this objection does not extend to surfaces of a gentle curvature, on which the slightly curved form given to the component lines will be rather pleasing than detrimental.

Their "setting out" needs only a little exercise of patient observation ; and as all the lines may be ruled, ability in drawing is not essential to success.

They will be found, perhaps, most useful to that large class of persons who possess skill in the construction of articles, but who experience a difficulty in the last stages of ornament and decoration. How frequently we meet with well-constructed articles, spoiled by the addition of ornament of a most puerile description ! Little wonder may be expressed at this, if we consider for a moment that the ornamentist requires certainly not less study and application than is necessary to acquire perfection in other crafts. To such workers I would say, it is much better to borrow or adapt an old good thing than to use ornament which has only novelty to recommend it : such cannot do better than adapt some of the patterns given herewith.

Essential Principles.—To those more ambitious ones who desire to design their own ornament, many lessons may be learnt by studying a group of patterns like these. The "survival of the fittest" evidenced by their long-continued use indicates that there are here present principles which are essential to good ornament, and the object of the study should be to discover and absorb these principles, to serve as guides in designing ornament of our own.

The late Owen Jones strongly advises this method of study, and lays it down as an axiom that until the existence of these general principles is more fully recognised, little improvement will take place either in the individual or the national taste.

He also says : "The principles discoverable in the works of the past belong to us." We shall be indeed foolish if we do not seek diligently for them, and employ them to the best advantage in our own work.

Let me endeavour to point out some of these principles. First, notice the contrasting of the vertical with the horizontal, and in some instances the inclined, lines. This principle of contrast is an ever-present one in all good ornament, in some of its forms : contrast of vertical with horizontal and inclined lines, as in these examples ; contrast of straight and curved lines or forms ; contrasts of broad masses and fine details ; contrast of light and dark ; contrasts of bright and subdued colour, and so on. Next, observe the symmetrical proportion in the length of the various component lines : this, too, is a valuable principle. Now notice the square stability of the patterns : the use of the straight lines produces this. Ornament composed wholly of beautiful curves always has a flaccid and flabby appearance, and needs a few straight lines to supply the desirable principle of strength and stability. The parallelism of the lines with the bounding edge is also a valuable feature ; it echoes and emphasises the primary duty of a band or border, which is to bind and confine the more loosely arranged centre patterns.

If these four principles are thoroughly grasped, these works of old designers will not have been reproduced in vain, and our own work in which these principles are acted upon will be found to please even those who, most likely, are unable to explain the reason of this satisfaction.

Description of the Diagrams.—To return to the illustration, the Greek specimens have been culled from the Greek pottery in the British Museum, many of the articles from which they are taken having been produced about the year 500 B.C. The examples show a gradual development from simple to complicated varieties. Fig. 1 is a very early specimen—possibly the parent of the more complicated examples ; it is executed simply as a series of impressions made by some sharp-pointed instrument upon the clay shape before firing. Figs. 2, 3, and 6 are also early examples, which served as the basis for further developments. Nearly all of the examples are executed with some dark-brown pigment, upon the natural red or buff colour of the pottery. Fig. 11 shows a fret with the working lines displayed. The more complicated specimens seem to have been arrived at by adding extra lines or limbs to the simple varieties, by interlacing two frets, and in some cases by the addition of intervening square features.

Most of the Greek specimens are continuous, but some few are fragmentary in character. Nearly all consist solely of right-angled lines. Fig. 36 is an exception, and it is singular how close this corresponds with the Chinese example shown in Fig. 39.

The Chinese examples are from articles in the British and South Kensington Museums. The elongation, as in Fig. 33, and the fragmentary character, as in Figs. 18 and 21, are typical of Chinese frets.

Fig. 17 is from the decorations in the Vatican, carried out by Raphael and his assistants.

Figs. 28 and 29 are from mediæval illuminated manuscripts of the tenth century.

Figs. 32 and 34 are from ancient Mexican pottery in the British Museum. The inclined line in Fig. 32 is suggestive of further modifications.

Fig. 35 is an Arabian example. Its raking lines and diagonal-formed ends led to the production of many elaborate interlacements by the followers of Mahomet.

The Persian varieties are from illuminated manuscripts in the British Museum. Figs. 37 and 40 show the fret combined with the chevron or zig-zag, suggestive of further variations.

Hints on "Setting Out."—In "setting out" frets, a sort of unwritten law prevails that the dark and light spaces shall be equal, but this is not essential or altogether desirable. If the one portion is made less, as in the rendering of the present examples, where the black is thinner than the intervening white spaces, the fret comes out clearer, and with, perhaps, a better effect. Any of the frets may be elongated ; this, in some instances, is an improvement. The direction in which the pattern should run is almost immaterial. By repeating the patterns on some geometric basis, they may be developed into diapers to cover larger superficial areas than bands or borders.

Ancient Labyrinths.—Portions of such patterns were anciently used as symbols of the ancient labyrinths, which were constructed on similar plans. The oldest of these was an Egyptian construction, the ruins of which still exist near the Lake Mœris. The best known in classic history is the legendary labyrinth in Crete, famous as the prison of the Minotaur, and for the fable of Theseus. The Athenians sent yearly fourteen victims, who were doomed to lose their path in its intricate windings, and to be destroyed by the monster. Theseus is credited with the destruction of the monster, and with obtaining egress from the labyrinth by a clue furnished for that purpose by Ariadne, the daughter of Minos.

Garden Mazes.—In later times garden mazes were constructed on similar plans. Most Londoners are acquainted with the one now existing at Hampton Court.

Labyrinthes de Pavé.—In some French Cathedrals—notably the one at Chartres—similar patterns were executed in marble mosaic, in the nave pavement. They were a symbolical allusion to the Holy City—perhaps a reminiscence of the places of worship of the Early Christians in the Catacombs, and certain prayers and devotions accompanied the perambulations of their intricate windings. In that at Chartres, a person following the various turnings of the figure would walk nearly eight hundred feet before arriving at the centre, although the circumference does not exceed forty.

Conclusion.—The many other instances of the past use of these patterns cannot here be referred to ; but sufficient has been said to intimate what a wealth of association lies behind the familiar Greek key pattern.

[In furtherance of this all-important subject of Decoration in Design, our next number will include the first of a series of valuable papers on Ornament and Decoration of all Nations, which our readers will, doubtless, make known to their friends. —Ed.]

HOW TO SPLICE LADDERS.

BY CHOPSTICK.

I DARESAY every man in the building trades has, at some time or other, found it necessary to tie two ladders together in order to get to a higher elevation than he could

manage to do with one only. In some places this is rarely necessary, as a good supply of long ladders is kept; but the long ones cost a great deal of money, and it is also a difficult matter to rear them; and I think it is a much better plan to splice two short ones, if it can be done safely and quickly, than to trouble with a long one. A good many men do not like going up on the ladders when spliced, on account of their liability to slip as the cord stretches; and when a man is forty feet from the ground, it gives him a "turn" if the ladder only slips an inch—a fact I can speak of from experience, as I have had to catch for my life sometimes. But with the ladder spliced as I am about to describe this never happens; and I have no hesitation in saying that I would prefer going up on two ladders spliced together, to going up on one long ladder, for the reason that the two would be much stiffer and would not sway about so much as the one. I think I have now said enough by way of introduction, so in a very few lines I will give instructions to enable anyone to try my way for themselves.

We will, by way of illustration, suppose that we have work to do thirty feet from the ground, and have a 25 ft. and a 15 ft. ladder to do it with. In the first place, we must have two ropes—ordinary scaffold ropes will do—then place the longer ladder in position against the wall, and the shorter one in front of it (as shown in Fig. 1); then double one rope in half, and pass the loop under the bottom stave of the hindmost ladder, and pass the two loose ends through it, thus fixing it to the round in the centre, and leaving two ends of equal length. Pass these ends upwards between the two ladders until you get to the proper height (in this case it will be the eighth stave), then bring them through to the front.

We have now got as far as shown in Fig. 1, and must now mount the shorter ladder, while our mate lifts up the hindmost one until the bottom stave is on a level with the stave which the rope is passed over; then give the two ropes, or rather the two ends of the rope, a twist, and bind one round the two ladder sides as many times as the length will allow, finishing it off by passing the end between the rope and the ladders; then bind the other side the same. You have now only to put the other rope on in the same way at the top of the shortest ladder, and the appearance will be as shown us in Fig. 2; and on trying it you will find that it will not slip in the slightest manner, while the time occupied in making the splicing will be found to be far less than that occupied in rearing a 30 ft. ladder. I have shown in Fig. 3 details how to bind and fasten off the rope, and I think no one will fail to understand this short but, I hope, useful paper. To those workmen who are in the habit of tying and requiring to use rope knots, I cannot do better than recommend a careful study of the series on "Knotting and Working Cordage," which appeared in Vol. III. of WORK.

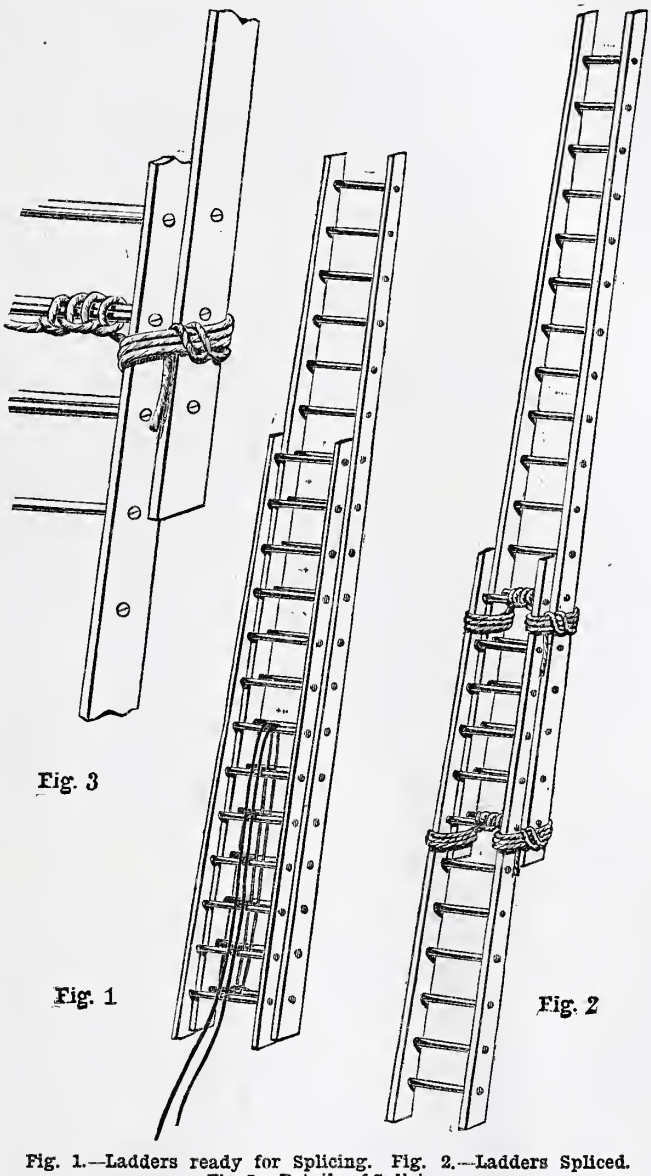


Fig. 1.—Ladders ready for Splicing. Fig. 2.—Ladders Spliced. Fig. 3.—Details of Splicing.

NOTES FOR WORKERS.

DR. WOLF, of Heidelberg, has discovered two minor planets by means of photographic plates taken on the 22nd and 23rd of December, 1891.

THE art of stellar photography has made rapid strides of late years, and has now become a powerful instrument in astronomical research.

THE effect of the earthquake on the beautiful cone of Fujiyama, in Japan, is that the south-western slope of the summit is wholly destroyed, there being a subsidence 4,000 ft. long, 2,000 ft. wide, and 1,000 ft. deep.

AN electric fog bell has been erected at the port of Ravenna, in the Adriatic. A current is conveyed to it from a battery in the lighthouse, about 1,000 yards distant.

A GALLON of distilled water contains 277,274 cubic inches, and weighs 10 lbs.

ONE horse-power equals 33,000 foot-pounds per minute. This is a purely arbitrary quantity, and was adopted by Watts on the supposition that an ordinary horse could raise 33,000 lbs. through a height of 1 ft. in one minute.

THE American navy have adopted for use for heavy guns a smokeless powder, the joint invention of Professor Munroe and Commander Jewell.

A PARISIAN electrician has succeeded in forcing violets by the aid of electricity, and sent a bunch of these flowers, only four hours old, to the ex-Empress Eugénie.

SCIENCE TO DATE.

Halogen Salts of Cæsium.—A remarkable series of eight compounds of the metal cæsium with the halogens have been discovered by Messrs. Wells and Penfield in America. The formulæ of these compounds are CsI_3, $CsBrI_2$, $CsBr_2I$, $CsClBrI$, $CsCl_2I$, $CsBr_3$, $CsClBr_2$, $CsCl_2Br$. They are all prepared by adding the requisite quantity of iodine, bromine, or chlorine to a haloid salt of cæsium, and cooling or evaporating to the crystallising point. The salts are perfectly stable. They are very interesting theoretically. We cannot suppose that cæsium is trivalent, for that would be opposed to the Periodic law of Mendelejeff, and hence they must be regarded as double salts.

Dust in the Air.—Mr. Aitken, who some time ago invented an apparatus for counting the number of dust particles in a given volume of air, in a paper before the Royal Society of Edinburgh has come to the following conclusions after two years' observations: The air in inhabited districts is always impure, and the dust is carried by the wind to enormous distances. Dust is found in the air even on the summits of mountains. When there is much dust, fogs are thicker, and great humidity gives great density to the atmosphere when it is accompanied by a great quantity of dust. Further, there is more dust the higher the temperature, and a great quantity of dust reduces the transparency of the air.

March of Electricity.—The beautiful experiments of Mr. Tesla, which were recently shown to crowded audiences at the Royal Institution, indicate what a wonderful advance has been made in electrical science. It seems that the light of the future will be a soft phosphorescent glow, the colour of which may be arranged to suit any taste. Our rooms will be electrical fields in a state of rapidly alternating electrical stress, in which, though nothing is sensible to the occupant, vacuum tubes and phosphorescent globes will shed their light wherever they may be placed, no connecting wires or any attention being necessary.

Chlorobromides of Carbon.—There are three chlorobromides of carbon indicated by theory—viz., CCl_3Br, CCl_2Br_2, and $CClBr_3$. The first was prepared some time ago by heating bromine and chloroform together in a sealed tube to 170° C. M. Besson has now succeeded in preparing the remaining two by simply carrying the operation further. The sealed tube is opened at intervals to allow of the escape of the enormous volumes of gases produced, and then, being re-sealed, is heated to a higher temperature. The reaction is complete at 275° C., and then the three substances may be separated from the product by fractional distillation. CCl_3Br is a liquid, while the other two are solid substances.

Velocity of Electricity in Submarine Cables.—Recent experiments have shown that the velocity of electricity in submarine cables is 8,000 miles in 1·05 seconds.

Collection of Chemical Elements.—Prince Lucien Bonaparte has bequeathed to the South Kensington Museum a valuable collection of the chemical elements. All the elements, with the exception of one or two—the existence of which is doubtful—are represented, even to the one most recently discovered—viz., germanium. They are on view in the Science Collections, and our London readers, at least, should examine the collection. It would well repay a visit.

New Star in the Milky Way.—A new star has been discovered in the Milky Way about 2° south of χ Aurigæ. It has a yellow tint, and is of the sixth magnitude.

Action of Water Vapour on Magnets.—A Swiss paper is responsible for the following: Magnets, when heated in steam, lose from 27 to 67 per cent. of their magnetic power, but after re-magnetising them and submitting them to the same action, the loss of magnetic power is insignificant, and diminishes continually as the operation is repeated.

TRADE: PRESENT AND FUTURE.

**** Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

PAINTING AND DECORATIVE TRADES.—Trade in the provinces generally is much better than in the metropolis. In the leading South Wales centres, Cardiff, Swansea, and Newport, it is very good. From the north also the report is satisfactory.

BUILDING TRADE.—Owing to the fine weather, building is going on rapidly on the outskirts of Liverpool; large numbers of houses are being built, and a great deal of jerry work is being done. These houses have "all the latest improvements," many including electric bells throughout. As far as the latter are concerned, owing to bad connection, they prove mere ornaments, and will not ring. Work is progressing on the new University College, and in a short time plans will be issued of a new General Post Office for Liverpool, so that the building trade promises well. There is very little change in the prices of materials; the only figures I can now give are: Spirit of turps, 26s. 9d. to 27s. per cwt.; refined petroleum, American, 5¼d. to 6½d., Russian, 4⅜d. to 4½d. per gal.; Manilla hemp, £26 15s. to £27 per ton.

HARDWARE TRADE.—Messrs. Charles Cammell & Co., the armour plate manufacturers, have declared their *usual* annual dividend of 12½ per cent. The net profits for the year were £175,712 19s. 5d.; the balance from last year being £38,496 16s. 5d., making a total of £187,959 15s. 10d., from which an interim dividend of 5 per cent. was paid last October. Happy shareholders! At the close of the meeting, the shareholders were invited to witness the rolling of a monster armour plate. One of the turreted warships the Government are having built is the *Ramillies*, which will have two barbettes, one fore and one aft, and each barbette will be composed of twenty-two plates. These are being manufactured at the Cyclops Works, and the plate rolled on this occasion for the fore barbette is 17 ft. long, 6 ft. 8 in. wide, and 17 in. thick. The weight in the rolled state was 51 tons; when planed and fitted, it will be reduced to 33 tons. In Birmingham and district, the coal crisis has had disastrous results, some of the ironworkers not having yet got over its effects. One large order for £3,000 worth of iron has been sent to Belgium from Wolverhampton, the ironmaster claiming that, by so doing, he can gain £1 per ton more profit than if he starts his own works going.

CYCLE TRADE.—In Australia, there are nine months in which this pastime may be indulged in, the remaining three months being too hot for cycling. As to the trade, a number of the British houses are represented there. Marriott & Cooper, as also Singer & Co., of Coventry, have long had a dépôt there, while one of the Jennings Brothers, of Glasgow and Manchester, opened a dépôt in Melbourne some five years ago, and holds agencies for new Howes, Swifts, Bayliss & Thomas, Sharral & Lyle, etc. Other houses are also represented, as the Humber and Raglan. The trade, however, is not likely to develop quickly, as the Australian roads, except in or near the towns, are bad for cycling. An authority says if the roads there were as good as our own, Australia would soon "lick creation" as a cycling country. In Wolverhampton, the state of the trade may be gleaned when it is mentioned that the Humber Co. have nearly as many orders on their books at the present time as they executed during the whole of last year. The works are going till ten o'clock at night, and this to fill almost entirely foreign orders, two of which may be mentioned—one for an American house, 750 machines, and one for a German house, 550 machines. With regard to the home trade, they declare they never had so many inquiries so early in the season.

IRON TRADE.—At the Middlesbro' market it was expected there would have been a substantial rise in the price of iron, but Middlesbro' warrants, which still continue to regulate the price of iron, were lower. The immediate decreases, both in make and stocks, are more likely to be much heavier even if the strike of Durham miners were to terminate at once, but it may continue another month. As I write it seems probable that not more than seven furnaces will shortly be in operation. The merchants are not willing to sell any No. 3 Cleveland GMB at less than 37s. 6d., though small lots were procurable at 37s. 3d; makers were asking 38s. and 40s. Middlesbro' warrants were quoted 37s. cash, grey forge at 37s. 3d. The shipments are very small, and owing to the strike, a large proportion of the spring business with the Continent is being diverted to other districts. Iron founders and engineers have been able to stock coal, and are mostly working pretty regularly, but shipbuilders are beginning to be affected for want of iron and steel. Some consumers are sending to the Midlands for supplies. A fair supply of coal is being brought from other districts, chiefly for household purposes.

SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

**** In consequence of the great pressure upon the "Shop" columns of WORK, contributors are requested to be brief and concise in all future questions and replies.*

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of WORK in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given.

I.—LETTERS FROM CORRESPONDENTS.

Artist's Easel.—W. S. (*Woodbridge*) writes:—"I beg to submit to the readers of WORK sketches of artist's sketching easel I designed and made for myself several years ago, and which I have found very useful. Fig. 1 is a sketch of the easel as standing ready for use, and Fig. 2 shows it folded ready to carry off. I think it will be plainly seen from sketches that the two front legs are screwed to block just wide enough apart to allow the back leg, when folded, to come between them, and far enough down to allow the two front legs to open out to a convenient width. The back leg is hinged to block with ordinary butt hinge, and three more are used to form joints in legs. If small hasps are put on legs as shown, they will make it quite strong and rigid when in use. All other details are the same as in the one described by A. CONWAY (No. 143, page 614)."

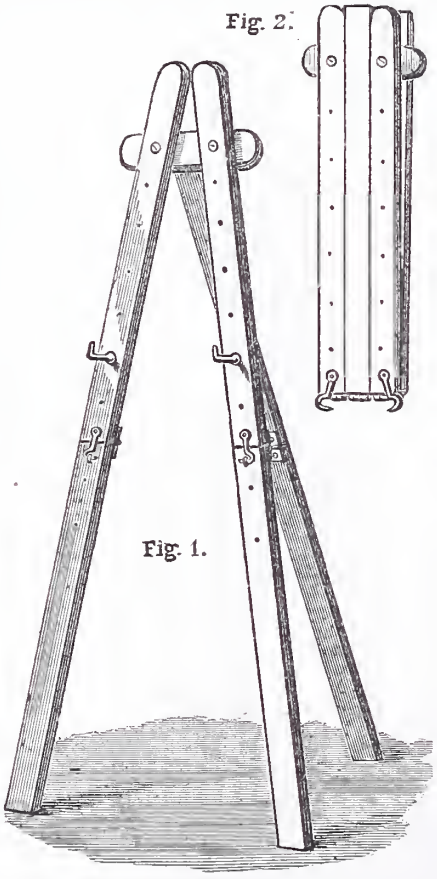


Fig. 1.—Open Easel. Fig. 2.—Closed Easel.

Two Armourers' Hammers.—C. J. F. (*Eastbourne*) writes:—"I was pleased to see the above article in WORK (see page 807, No. 155, Vol. III.). It is interesting to readers, whatever their occupation may be, illustrating, as it does, tools of former ages, which are also works of art. The sketch of No. 1 does not show, nor does the writer state, the shape of the pane. Supposing it to be straight, like a carpenter's hammer, both it and the face would be suitable for curving the strips of steel at the waist and joints of a suit of armour, just as a cooper stretches and curves hoop-iron for casks, etc. If the pane is curved instead of straight, it could then be used for sinking edges in the crease and for wiring, as at the neck and arm-holes of a breastplate; the broad square face being also used for smoothing and planishing. No. 2, strictly speaking, can hardly be called an armourer's hammer, though used for the decoration of armour. I might suggest that it was used for damascening, the short, slight handle being only suited for dealing light blows—the curved pointed beak for shaping and curling the wire into the channels prepared for it, and the diamond-shaped face for finishing off, and for use in corners, etc. The head, being of bronze, would be unsuited for any other work. Both it and the handle, being inlaid with wire, seem to point to the purpose for which it was intended, and could be shown as specimens of the owner's skill, just as the smith with chisel and punch ornamented his hammers, or the carpenter with gouge and knife carved and decorated his tools. I should like to know where they may be seen, and also to become acquainted with CAROLUS REX. I am a sheet-metal worker by trade, and the subject of armour is one I am particularly interested in."

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Chilled Steel.—MAGNET.—You can make use of it for the purposes you name. Send it to Crompton and Co., Chelmsford.—J.

Boiler.—G. H. B. (*No Address*).—I should not like to say, but certainly very little. It is too thin, and it should have been brazed, not soldered. Do not venture on more than eight or ten lbs. per inch.—J.

Blacklead to Iron.—J. T. (*Biggleswade*).—The ordinary blacklead (plumbago) of commerce is prepared with sufficient binding qualities to stand, when mixed with water, a fair amount of rubbing without being detached from the surface so coated. The only addition the writer can suggest to increase that adhesive quality would be of the nature of beer, vinegar, or a weak solution of shellac. Blacklead can also be used as a wash by diluting with gum-water. If you go beyond this degree of binder, it is a question whether the pigment or mineral would not lose other properties of vital value. For instance, if the particles are encased in any skin, however thin and imperceptible, it stands to reason the friction could not produce a proper polish. Besides this, nothing that heat will affect would answer the purpose, for reasons which are self-evident. *Berlin black* is a lustreless black fluid, with which hammered art metal-work (iron) is usually coated. Upon this blacklead will doubtless "take" much better than upon the smooth iron. Turpentine could be used to spread the blacklead with instead of water, and you might try the binding effect of a little Berlin black into it.—F. P.

Removing Varnish Coats.—W. G. (*Bruton*).—There are several "patent" pastes and solutions on the market for effecting the removal of oxidised paint and oils. Their nature must be strongly alkaline, and their action is to *saponify* the hardened films—that is, to break and dissolve the paint by chemical action. Common hot lime and soda, say, in equal parts, dissolved in water to a thick paste or batter, will answer the purpose equally as well as the "6d. per pound" patent mixtures. Get an old paint brush to put the "pickle" on with. Let it stand for a time, but not long enough to dry, and then scrape off with a plumber's shave-hook, or other suitably shaped tool. If all the paint does not come off first time, repeat the process. When all old stuff is removed, and before the surface has time to dry, well wash off all remaining traces of paint, and pickle with cold water and hard brush. Don't unnecessarily soak the wood with water. When thoroughly clean and dry, coat with vinegar all parts so treated. This kills any remaining trace of the alkalies. Two coats are safer than one. If you omit this, the new work may be destroyed by minute traces of the pickle. When thoroughly dry, glass-paper down, and treat with paint or varnish just as if it were new wood.—F. P.

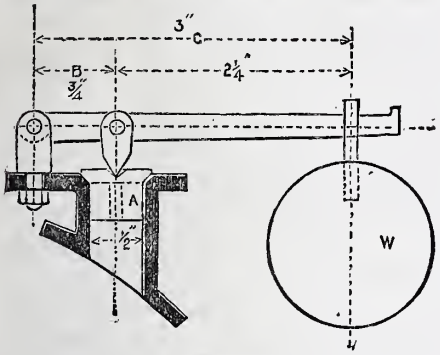
Iron Scroll-work.—G. M. (*Swaffham*).—The subject has not yet been treated *in extenso* in WORK. A series is, however, now appearing (Nos. 157, 159, 162) in the present volume, and in this a very fair representative selection of examples of bent iron-work will be illustrated and explained.—J.

WORK in Australia.—S. L. (*Sydney, N.S.W.*).—Thanks for your encouraging letter. Amateurs like yourself shall be well provided for, and we shall be glad to hear from you occasionally as to matters at the Antipodes. Our publishing and publicity departments will attend to the points alluded to in your letter.—ED.

Water Motor.—R. B. T. (*Frome*).—I cannot gather from your letter what type of motor you refer to, but suppose it to be a turbine. If you want a reply to be of any use, you must send a clear sketch of the "wheel" and the rest, and repeat your questions along with the sketch.—J.

Soldering.—J. W. (*Leeds*).—You will find full instructions for making solder, and also how to apply it with the iron, and also how to use resin and spirits of salts, if you will procure Nos. 17, 23, and 32, Vol. I. of WORK, as well as much more on the same subject. If you have any difficulty in procuring the back numbers from your newsagent, write for them to the publishers.—R. A.

Copper Boiler.—E. C. (*Birkenhead*).—The pressure your boiler will stand safely depends on the workmanship. The metal is stout enough to stand 100 lbs. pressure to the inch without risk. But then, you may have injured the metal by brazing; and, further, I very much doubt if you will make steam-tight joints with bolts, as you propose to do. Riveting and caulking are the proper and only sure methods. If this were done, I think I could advise you to work at 40 lbs. pressure, and then you might manage to drive a ¼ h.-p. engine. But if you blow up, I shall get the blame, and so I shall say do not work beyond 20 lbs., unless, indeed, you have the boiler tested first by hydraulic pressure to double its intended steam pressure. The safety-valve for 20 lbs. pressure may be made to the proportions



Copper Boiler.

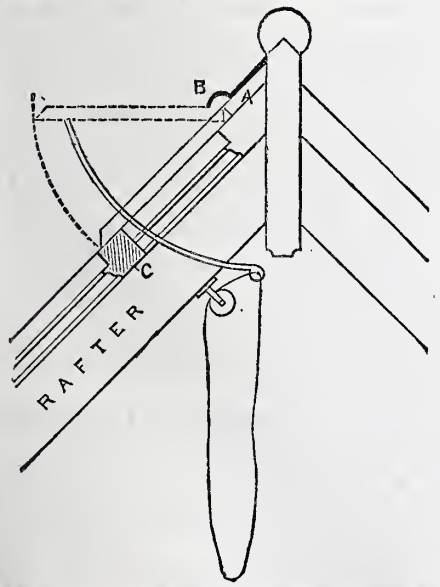
shown in the figure. Let the valve, A, be ½ in. in diameter, the length of fulcrum, B, ¾ in., the length of lever, C, 3 in., then by formula

$$W = \frac{\text{area of A} \times \text{B} \times \text{pressure}}{\text{C}}$$

you will have— $\frac{\cdot 1963 \text{ in.} \times \cdot 75 \text{ in.} \times 20}{3 \text{ in.}} = \cdot 98$ lbs.

That is the weight W will be, ·98 of a lb., and that will be the weight of a cast-iron ball—roughly, 1⅞ in. diameter. You ask about cross-tubes in up-take. Do not put them in. They would be too short to be of much service. And exposed as they would be to the direct heat of the gas flame, they would become burned, and leak. You cannot carry out the details of a large boiler in a workable manner in a model. —J.

Sash.—W. R. J. (*Camberwell*).—If you had only sent a section through the part of light you consider the best for ventilating your plants, I could have told you exactly what to do, but I have assumed there is nothing out of the ordinary about it. The simplest and cheapest method I know of is to cut out about 9 in. of glass on either or both sides of ridge, and put in a new top rail, as shown; then take a piece of wood about 3 in. longer than the square of glass is wide, and hang it to the fillet, A;



Sketch showing Method of forming Ventilator in existing Span Light.

this flap or ventilator should be strengthened and kept from warping with two pieces of galvanised iron screwed on either on top or underneath, about ¼ in. thick by 1½ in. wide. The joint at B should be covered with a piece of 4 lb. lead, as shown by thick black line. The ventilator can be as long as you like, embracing two, three, four, or even six squares; but if you do not want to alter the construction of your light, do not cut the bars, but insert the new top rail (C) between them. The ventilator is opened by means of a pulley, and quadrant and cord, or by means of one of the many patent fanlight openers (Ball's, for instance). You will find an exhaustive treatise on House Painting in Nos. 27, 29, 35, 36, 42, 43, 44, 46, 50, and 52 of Vol. I. —E. D.

Fret Photo Frame.—W. W. (*Wokingham*).—We do not believe photo frame in fretwork, submitted by A. D. (*Monkwearmouth*) in No. 152 of WORK, is to be bought. The pattern was given for you and other fretworkers to make use of.

Fountain.—WOODBINE.—Your proposed arrangement will certainly not work. By no mechanical contrivance can water be caused to raise itself above its own level. According to your sketch, you expect the water to pump itself up to a higher level, and overcome the friction of a water-wheel and pump in so doing. To raise water or anything else, energy, or work, must be expended, and no such work is provided for in your scheme, which is, in short, an attempt at perpetual motion, and one that has often been proposed before. Do not waste any more time or thought over it, but if you have leisure time, read up some sound work on mechanics, then you will not again fall into a similar error.—F. C.

Workshop Erection.—J. W. B. (*Brixton*).—From my reading of an abstract of the Factory Act—if you do not employ boys, have no machinery in the shop, and only have one man in it—I think you will not come under the provisions of the Act; but as there may have been some alterations lately, it might be advisable for you to get a copy, which you can do from Messrs. Eyre & Spottiswoode; or any local bookseller would procure one for you. But there is another point on which you may be liable to a penalty. If you have built the workshop in the yard, and have not submitted a plan to the local authority or vestry, or if it has been made inside the house you may be required to give notice. If you have not done this, you had better see the engineer or surveyor, and offer to submit a plan or give notice (if it is required). When you are at the office you may be able to ascertain if you come under the Factory Act at the same time, as they will most probably have a copy. I know that this is required in the country, and suppose there will be a similar regulation in London.—M.

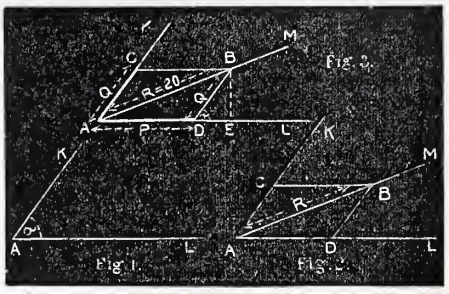
Laggings.—OLDHAM ENGINEER.—(1) You had better rub off the old paint or varnish with glass-paper, firing it first, if necessary. (2) To find the pressure on a safety-valve in pounds per square inch, add half the weight of the lever to the weight of the ball; multiply this sum by the length measured horizontally, from the centre of the ball to the fulcrum; divide the product by the horizontal distance from the centre of the valve to the fulcrum; add the weight of the valve, and divide the result by the area of the valve in square inches. An example may make this clearer to you. Let the valve be 3 in. diameter = 7 sq. in. area at its seating; distance from weight to lever-fulcrum = 26 in.; distance from centre of valve to lever-fulcrum = 4 in.; weight of ball = 50 lbs.; weight of valve = 4 lbs.; weight of lever 5 lbs.; then

$$50 + \frac{5}{2} = 52\tfrac{1}{2} \text{ lbs.}; \; 52\tfrac{1}{2} \times 26 = 1365; \; \frac{1365}{4} = 341\tfrac{1}{4};$$

$$341\tfrac{1}{4} + 4 = 345\tfrac{1}{4}; \; \frac{345\tfrac{1}{4}}{7} = 49\tfrac{9}{28} \text{ lbs. per sq. in.}$$

This is the pressure at which the valve will blow off; but it will not shut, if it has a conical bed, until the pressure is somewhat less, because while it is open the steam is pressing against a larger area than it does when the valve is closed. For this reason it is desirable to make the seating as narrow as is practicable, so that the pressure may not fall much below that to which the valve is set.—F. C.

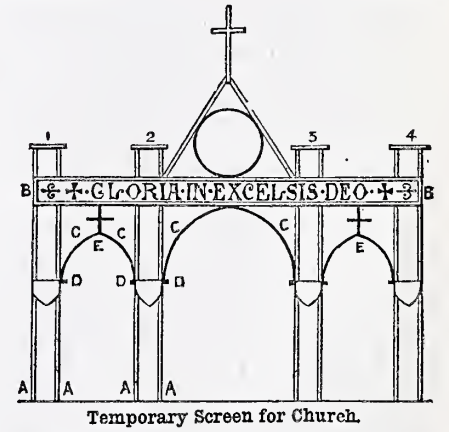
Resolution of Forces.—CORKSCREW.—You will have to use a general formula. Take any two lines, A K and A L, making an acute angle α between them. Through A draw any straight line, A M, and cut off a part, A B, equal to the resultant, R. Through B draw B C parallel to A L, and meeting A K at C, and also B D parallel to A K, meeting A L at D. Then A C is one component, say Q, and A D is the other component, P. From B drop a perpendicular, B E, on to A L. Now note that because A C is parallel to B D the angle B D E is equal to the angle C A D: *i.e.*, to α (by Euclid I. 29); and also that, by the properties of parallelograms, B D is equal to A C: *i.e.*, to Q (by Euclid I. 34). As angle α is an acute angle, then angle B D A is an obtuse angle, and the triangle A B D is an obtuse-angled triangle. By Euclid II. 12, in obtuse-angled triangles, the square on the side opposite the obtuse angle (*i.e.*, the square on A B) is equal to the sum of the squares on the sides containing the angle (*i.e.*, the squares on A D and B D) and the rectangle contained by the side (A D), on which, when produced, the perpendicular (B E) falls, and the part, D E, between that side and the perpendicular. Thus, $(AB)^2 = (AD)^2 + (BD)^2 + 2\,AD, DE$—*i.e.*, $R^2 = P^2 + Q^2 + 2\,P, DE$. Now $\frac{DE}{BD}$ is a trigonometrical ratio called the cosine of the angle B D E, or, shortly, cos. B D E, *i.e.*, cos. α. Then if $\frac{DE}{BD} = \cos.\ \alpha$, then $DE = BD$, cos. α; but $BD = Q$, and, therefore, $DE = Q \cos.\ \alpha$. Therefore our formula becomes: $R^2 = P^2 + 2\,P, Q, \cos\ \alpha$. This formula is universally true for all forces. In your case, $R = 20$, $\alpha = 60°$, and if we call $P = x$, then Q will $= (22-x)$, because $P + Q = 22$. Thus: $20^2 = x^2 + (22-x)^2 + 2\,x\,(22-x) \cos.\ 60°$. On referring to a table, you will see that the cosine of an angle of $60° = \frac{1}{2}$: thus our sum now becomes, $400 = x^2 + 484 - 44x + x^2 + (44x - 2x^2)\,\frac{1}{2}$—*i.e.*, $400 = x^2 + 484 - 22x$, and *i.e.*, $x^2 - 22\,x + 84 = 0$. Now, to solve this quadratic, write the expression thus: $x^2 - 22\,x = -84$, and add the square of half the co-efficient (22) of x to each side of the equation, thus: $x^2 - 22\,x + (\frac{22}{2})^2 = -84 + 121 = 37$. Now $(x^2 - 22x + 121)$ is the square of $(x-11)$, and so by taking the square root of each side of the equation, we get $x - 11 = \pm \sqrt{37}$, and, therefore, $x = (11 + \sqrt{37})$, or $(11 - \sqrt{37})$. Now $P = x$, and, therefore, P, one of your forces, is either $(11 + \sqrt{37}$ lbs.), or $(11 - \sqrt{37})$ lbs. $Q = (22 - x)$; and if you take $x = (11 + \sqrt{37})$, then $Q = (22 - 11 - \sqrt{37}) = (11 - \sqrt{37})$, or if $x = (11 - \sqrt{37})$, then $Q = (22 - 11 + \sqrt{37}) = (11 + \sqrt{37})$. Thus your two forces are $(11 + \sqrt{37})$ and $(11 - \sqrt{37})$ lbs., which together



The Resolution of Forces.

equal 22 lbs, and, acting at an angle of 60°, have a resultant equalling 20 lbs. You can see this by noticing that $\sqrt{37}$ is just over 6, and so the forces are just over 17 and just under 5. Draw your figure to scale, and try. This is a very difficult problem to those not used to mathematics, but I do not know a simpler method for the figures you give. Had one of the forces been given instead of their sum, you could have drawn a diagram to scale, and not used mathematics at all.—F. B. C.

Temporary Decorative Screen for Church. —SCREEN.—Annexed is a sketch for the wooden skeleton or framework of such a screen as you appear to require—scale, ½ in. to 1 foot. The uprights, A, are of the scantling used for rafters, say, 4 in. by 2½ in. They are about 12 ft. high, and to them is nailed the board, B, which carries the text. The curves of the arches, C, are of ¾ in. board, 2½ in. wide, "sprung" or bent into position, and there fixed. This easy way of forming an arch is described in the articles on "Temporary Decorations" (Vol. II., p. 161, No. 87). The bottoms of the sprung boards rest on strips of wood, D, nailed to the uprights; their tops in the side arches are fixed by the shaft of the cross, E. The circle in the pediment at centre is a wooden (dry cask) hoop. On the top of each pair of uprights is nailed a round piece of board (1, 2, 3, 4), to serve as a pedestal. On this may be set plaster figures 2 ft. or 2½ ft. high. Nos. 2 and 3 should have SS. Mary and John, whilst Nos. 1 and 4 should have angels. Such figures may be bought at the plaster shops. Failing figures, vases of flowers may well fill these pedestals. In dressing this frame, evergreen wreathing is wound pretty closely round the uprights and the pieces which form the pediment. A lighter wreathing



Temporary Screen for Church.

would be used for the curves of arches, hoop, etc. Wreathing would also be used as a border for the text-board, on which the letters would be of white paper on a red ground. The crosses would be covered with ivy-ribbon, with flowers disposed upon it either in bosses or in lines along centres. If flowers are abundant, they can be used at the junctions of woodwork. Sprays of evergreen should be arranged so as lightly to fill up the spandrels of the arches and circle, but a frequent error in this kind of work arises from overdressing with evergreens, and thus hiding the design. The shields, of course, suggest their own ornament. Church banners, if used, should come over the side arches. The evergreen dressing will probably be much the same on both sides, but the front only will have flowers.—S. W.

Self-threading Needles.—W. H. (*Northwich*).—We should not have supposed that difficulty could have been found in getting these at any good draper's shop, but W. H. appears to find such a difficulty. The side-slit needles are produced by various Redditch firms; those threading at top (the calyx-eyed) are only made by Hy. Milward & Sons, Washford Mills, Redditch. Stamps forwarded to them would doubtless bring a sample packet; or try W. Woodfield & Sons, Easemore Works, Redditch, for a sample packet of side-slits.—S. W.

French Polishing Painted and Grained Furniture.—S. S. (*Salford*).—If the painting and graining has been done in oil colours, it is not usual to finish by French polish, nor can it be recommended. It should be finished by what is known as oil varnish, such as oak, copal, or carriage. The use of spirit varnish on such a foundation, though it may look well at first, will ultimately result in a cracked surface. To make the work look perfectly smooth and bright with oil varnish may require two or three coats, allowing each coat to get perfectly dry, and flatting—*i.e.*, smoothing and dulling down by means of powdered pumice or pumice-stone rubbed to a smooth face, and water—before the next coat is applied. But this is not the usual plan adopted by the trade, either for painted or polished cheap furniture—it is too costly, except for really first-class work. If you will refer to No. 116 of WORK, Vol. III., p. 187, you will find a reply, "Graining Cheap Furniture," and in No. 134, p. 476, "Staining and Polishing Cheap Furniture." Read these carefully, and adopt the plan you think most likely to suit you.—LIFEBOAT.

Staining and Polishing Pine Drawers.—T. W. (*Silloth*).—The work being well cleaned off, and free from dust, stain by means of one of the walnut stains frequently recommended in "Shop" (see p. 254, No. 120, and p. 537, No. 139). You will do well to experiment on odd pieces of wood similar to that your drawers are made of—especially as you have two kinds of wood—till you gain the required tones. To make the carcase match the red wood of the drawers, you will require a tinge of red stain in the polish, omitting it when doing the drawers, unless you wish the drawer fronts to show up red as a contrast. When the stain is quite dry, wipe all over with linseed-oil, then "fill in" with a mixture of finely-crushed dry whiting, made to somewhat match the wood by the addition of a little brown umber; make into a paste the consistency of thick cream by mixing with turpentine. Rub well on your work with rag crossways of the grain; wipe off clean. It is then ready to polish at any time. Your inquiry as to the use of "finish"—which is merely a trade term for methylated spirits—suggests that you are not thoroughly conversant with the subject of French polishing. Read carefully through the articles on polishing with which Volume III. of WORK abounds, and take special note of a reply in "Shop," p. 476, No. 134, "Staining and Polishing Cheap Furniture," and adopt the hints therein given by using spirit varnish in conjunction with your polish; it will save you much trouble, and be more likely to lead you to be satisfied with your work.—LIFEBOAT.

Phenomena in Vacuum Tube.—H. McM. (*Bootle*).—This correspondent writes: "In experimenting with a vacuum tube I noticed that if one of the wires only was connected with it, and I brought my hand near the outside of the tube, a faint but quite perceptible glow was discernible in the tube. Would you kindly explain this?" Precisely similar phenomena have been observed by Prof. Crookes, Mr. Tesla, and others. The luminous effects are due to an electrostatic charge of the vacuum tube, such charge being given to it by the condenser of the coil, which is, as you are aware, highly charged with electricity. The charge becomes dissipated on the approach of a hand or other conductor of electricity, and the faint discharge becomes apparent in the vacuum tube. Similar effects have been observed in incandescent lamps placed near a spark coil, as between the poles of the secondary wires, but not in actual contact with them.—G. E. B.

Elements for Batteries.—H. McM. (*Bootle*).—(1) As I have no data to guide me (either my own or other person's experience), I cannot say how a mixture of pulverised coke and sulphur would behave when subjected to heat and cast in a block whilst the sulphur was in a liquid condition. I do not think the blocks would be of the slightest use as carbon elements for bichromate batteries. Carbon plates are cheap enough to preclude the necessity of making them in this or any other way at home. (2) Cast zinc is not nearly so effective as best annealed and rolled sheet zinc for the positive elements of bichromate and other batteries. Cast zinc is porous, contains hard nodules, and is liable to hold impurities, all of which tend to promote local action in the battery, with a consequent loss of power.—G. E. B.

Consumption of Coal by Marine Boilers.—NEW READER.—Your first query is very vague, but I think I can give you the information you require. The sizes of the fire-grates being known, and the quantity of coal burnt per square foot per hour ascertained, the consumption in twenty-four hours is readily calculated. The quantity burnt will, of course, vary with the quality of the coal; but it may be taken that—with good stoking—20 lbs. of coal can be burnt per hour with ordinary funnel draught. In very favourable circumstances this quantity may rise to 25 lbs. In the mercantile marine about 15 lbs. per square foot is the average useful consumption, and although 20 lbs. may be *consumed* when the fires are forced, they should not be supplied with more than 15 lbs. to obtain complete combustion, without which economy is lost. With a steam blast in the funnel, from 20 to 30 lbs. of coal can be burnt per square foot of grate surface; but this is a wasteful plan. When "forced draught" is used under a pressure of 3 in. of water, 62 lbs. per square foot may be burnt, and 96 lbs. of coal at a draught pressure of 6 in. As an example, suppose we have three fire-grates, each 2 ft. 3 in. clear width, and 5 ft. 6 in. long, then their total area will be—$2{\cdot}25 \times 5{\cdot}5 \times 3 = 37{\cdot}125$ square feet. If the consumption of coal averages 15 lbs. per square foot per hour, that for twenty-four hours will be—$37{\cdot}125 \times 15 \times 24 = 13{,}365$ lbs. = 5 tons, 19 cwt., 1 qr., 9 lbs. Extra allowance must be made for emergencies; and you must, in determining what the consumption per square foot will probably be, consider what is required of the engines, and whether it may be necessary to force the fires in order to properly supply them. In regard to your second question as to entering for examinations, you should apply for particulars to the Marine Department of the Board of Trade.—F. C.

III.—QUESTIONS SUBMITTED TO READERS.

**** The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Monogram.—J. McD. R. (*Leith*) will thank any reader for a monogram of A. M. M. for fretwork.

Black Crayons.—J. H. M. (*Longsight*) writes:—"I should be glad if some kind reader would give me a recipe for making black chalk crayons, about 3 in. long and ½ in. thick. I want them for drawing rough, rapid cartoons on white paper. Something like the ordinary white chalk sticks commonly used in schools would be just the thing."

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Adhering Compo.—A. G. (*Sheffield*) writes to F. W. (*South Darenth*) (see No. 152, page 765):—"Try ordinary bicycle tire cement."

Glass Blowers.—M. (*Bishop Auckland*) writes to DROFSABA (see No. 156, page 830):—"You can procure glass tubes, rods, and chemical and scientific glass-ware from Messrs. Orme & Co., Barbican, E.C.; but any local chemist will procure them for you."

Varnish.—W. S. (*Batley*) writes:—"If your correspondent J. A. (*Patricroft*) (see No. 152, page 765) will write H. O. Milnes, Leeds Road, Bradford, he will get any kind of varnish he may require at a cheap rate. I have done business with the above, and have been very well satisfied."

Staining and Varnishing.—M. (*Bishop Auckland*) writes to J. T. S. (*Sheffield*) (see No. 149, page 718):—"You will find a good deal of information on this subject in Vol. II. of WORK, or in 'House Painting,' by Ellis A. Davidson, published by Crosby Lockwood."

Electricity.—M. (*Bishop Auckland*) writes to P. L. (*Selly Oak*) (see No. 154, page 798):—"You will find Jameson's 'Manual of Magnetism and Electricity,' published by Charles Griffin & Co., Exeter Street, Strand, a very useful book. It is in three small volumes, price 4s."

Enamelling Fretwork.—W. I. (*Laurencekirk*) writes to G. F. R. (*Bournemouth*) (see No. 149, page 718):—"Try limewood or any similar wood that does not show the grain. It is better to stain fretwork with a good water stain—such as Stephens'—and, when thoroughly dry, varnish, if black stain, with white spirit varnish or, better still, French polish, and you have a clean finished article. I have used successfully Ardenbrite metallic enamel, and find it excellent for fretwork, as it does not clog in the cuttings, as ordinary enamels do."

Fret Machine.—H. L. H. (*West Hampstead*) writes, in reply to W. M. (*Brixton Hill*) (see No. 145, page 654):—"For a light machine you cannot do better than the Dexter C. If you want a machine of greater capacity and power, then the 'Empire.' Much has been said and written about 'true vertical stroke,' to the detriment of machines with swinging arms; but, speaking from twenty years' experience, during which I have tried every machine in the market, I believe the distinction is theoretical rather than practical. A true cut may be made with any well-made machine *in which the saw-blade maintains a position vertical to the plane of the work.* This condition is fulfilled by the Empire, Dexter, Windsor, Lester, and scores of others; but, of course, excellence of workmanship must be paid for. One hint more: Most fret-saws, like most lathes, are sent out with stands and fly-wheels much too light. Buy the machine separately, and mount it more substantially. In the matter of easy running, the swinging arm machines can give points to the machines which work in 'guides.'"

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—FIRST START; GOLFING BAD; H. C. (*Old Charlton*); F. H. C. (*Slingsby*); H. N. W. (*Greenock*); E. B. (*Manchester*); ROOFING; W. C. (*Bulwell*); A. EDISON; W. H. (*Fraserburgh*); "WORK" ADMIRER; T. M. (*Torquay*); J. W. P. (*London, W.C.*); HOROLOGICAL; W. H. R. (*Peckham*); J. P. (*Hull*); A. E. P. (*Victoria*); H. F. P. (*Guildford*); S. B. C. (*Birkenhead*); T. W. (*Kendal*); H. A. (*Ipswich*); H. A. H. (*Tunbridge Station*); W. W. (*Keighley*); J. W. H. (*Edinburgh*); E. E. W. (*Dublin*); W. T. (*Cardiff*); VICTOR CYCLE CO.; POLISH; W. B. (*York*); R. W. W., JUNR. (*Camberwell*).

NOTICE TO READERS.

As noted in another column, the next number of WORK (*i.e.*, No. 163) will contain the first of the series of Valuable and Original articles, *fully illustrated*, promised in the prospectus of this Volume, and entitled "Design and Decoration of all Ages." The Editor desires to call special attention to these papers, as they embrace such a wide and exceptional research, both in their matter and illustrations, that they cannot fail to be of the greatest interest and value to all ornamental and decorative craft workers whatever be their particular occupation. Readers and friends of WORK would do well, therefore, to make this series known, either by taking an extra number of this issue, or by forwarding this intimation to friends who are not already subscribers.

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Buyers of Gas or Steam Engines, Machinery, and Tools, should call at Britannia Co., 100, Houndsditch, London, or send 2d. for the Tool and Machinery Register, containing 4,000 lots wanted and for sale. Address—REGISTER, Britannia Co., Colchester. [8 R

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The Climax Screw-chasing Lathe Attachment for 3 to 6 in. foot lathes. Enables a novice to cut perfectly true threads of any pitch from 8 to 30 per inch; seen working. Price 57s. 6d.—DRESSER, Swan Cycle Works, Lewis Grove, Lewisham, S.E. [11 R

Fretwork Designs.—12 large Brackets, Photo Frames, Wheelbarrows, etc., 1s. 1d.; 40 small, 7d. Saws from 1½d. dozen, 1s. 2d. gross. Lists free.—TAYLOR'S Fretworkeries, Blackpool. [14 R

Picture Moulds.—15 to 25 per cent. saved. Send for wholesale list, one stamp.—DENT'S, Importers, Tamworth. [12 R

Wanted.—To Manufacture or Repair for Trade or Amateurs. Any description of mechanical work. Models for Patentees executed from drawings. Terms moderate.—J. SUMMERS, 17, Regent's Row, Dalston, N.E. [1 S

Model Electric Lights, 5 and 8 c.-p. dynamos, and can be used as motors, price 20s.; also 10 c.-p., 30s.; or send one stamp for list. Guaranteed best make.—W. WELLS, Electrician, Tooviesworth, Crawley, Sussex. [3 S

The Model Typewriter, 5s. 6d. Specimen of writing, one stamp.—WALTON, 9, Queen Anne Street, Stoke, Staffs. [4 S

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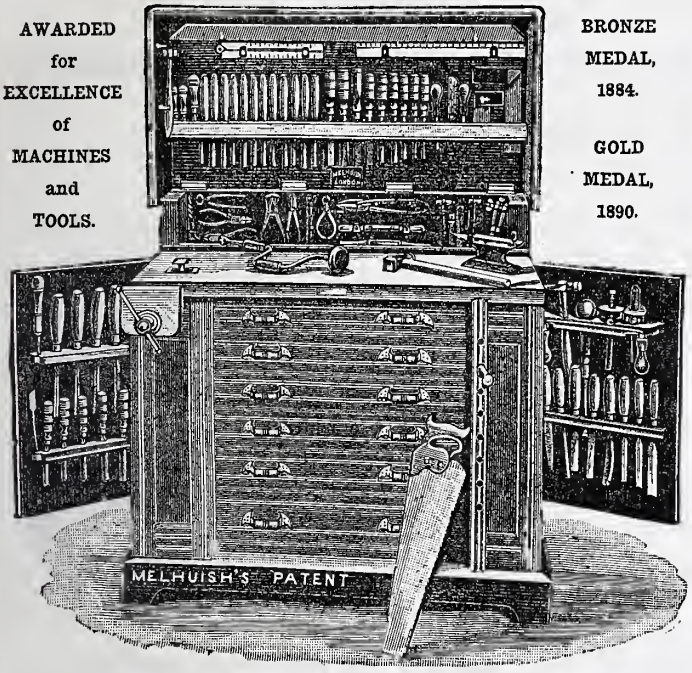

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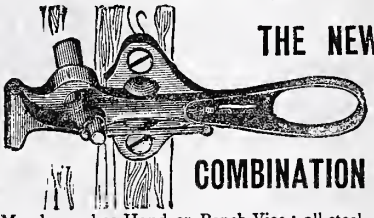

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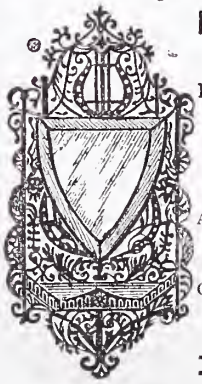

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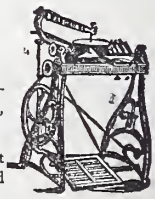

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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Vol. IV.—No. 163.] SATURDAY, APRIL 30, 1892. [Price One Penny.

WORK WORLD.

Women are employed in fishing tackle manufacture to make the flies, and although some branches of this industry are overstocked, it is stated that women able to tie a fly fit to captivate a trout or salmon can earn £3 to £4 a week. This branch of women's work, then, is not underpaid!

* *

At the South London School of Technical Art, the students for wood engraving have for some reason fallen off, although the occupation offers exceptional advantages to women, the highest rate of remuneration for this class of work being about £3 a week. Why is this?

* *

An ingenious Belgian has patented a simple arrangement by which two blocks of cork can be securely clamped into an ordinary horse-shoe. The cork, it is stated, lasts as long as the shoe itself, and renders slipping on greasy or frosty pavements impossible. The L. G. O. Co. should be here.

* *

A new primary electric battery has been made in which carbon derived from small coal is used instead of zinc; the other element is a preparation of nitrate of potash. If this is found reliable in practice, it will overcome the great objection—expense of working—where zinc is consumed.

* *

Delta metal appears to be growing in favour. It has been before the public now about five years. It possesses the great advantage of being readily cast, forged, or stamped; and of being scarcely affected by sea water. It is now coming into general use. Five launches have been built completely of this alloy, and it has been used for casting several screw propellers for large steamers.

* *

A new and useful departure in the direction of hot-water apparatus work is met with in some new coils, or radiators, which, being cast in one piece, save a vast amount of trouble in making, and avoid the chance of leaky joints after being fixed. The coils can be made in sections, and any number of them joined in length or grouped together as desired. Altogether, the invention is a good one, and seems to mark a definite advance in heating by hot-water pipes.

* *

Over two hundred regular sea-going steamers are laid up on the Tyne alone through the coal miners' strike, and shipowners are attempting to take advantage of the scare, to reduce the wages of seamen and firemen in their employ. This is, however, strongly resisted by the Seamen's and Firemen's Union. Another standing inconvenience from the same cause is the withdrawal of part of the North Eastern Railway Company's passenger train service.

* *

Petroleum is being used as fuel on the Argentine Great Western, and it will probably supersede all other fuel on that road. The oil used is a heavy petroleum found at Mendoza, near the line of the road, which answers the purpose of fuel fairly well, although it has been found impossible to refine it so as to make a good lamp oil. The economy is very considerable, as the railroad company can procure this oil at present at a cost of 12 dols. paper per ton—equivalent to about 3 dols. gold—while English coal, which has been used on parts of the line, costs 20 dols. gold per ton.

* *

Finely divided aluminium has previously been suggested as a substitute for magnesium as an actinic light for photographic purposes. Now that it is cheaper than magnesium, the following formula for a mixture, which is recommended by a French contemporary as giving a powerful flash, may be of use to those of our readers who are interested in photography:—100 parts aluminium powder, 25 parts lycopodium, 5 parts ammonium nitrate. This powder can be used for flashing in an ordinary spirit lamp, but gives a brighter and more powerful light if the powder be flashed into the flame by means of a jet of oxygen gas.

* *

A patent has been granted for a method of solidifying steel ingots. The process consists in pouring molten steel slag on the molten steel immediately after the latter has been poured into the mould, and before it has had time to set. The steel castings thus treated are dense and homogeneous, and free from pipes and blow-holes. The process is adapted to the pouring of all classes of steel ingots, but has been used mainly in the production of annular ingots for tire blooms, to be rolled into tires by a patent process. A tire ingot 10 in. high, on which 2 in. of slag has been run, falls $2\frac{1}{2}$ in. in the centre, which shows how much the ingot condenses. It is noticed that the slag continues liquid after the steel has set. The slag is easily removed afterwards, as it has no tendency to unite with the steel. Not more than one-half as much metal is required to be sheared off the top of ingots treated in this way as compared with those poured without the slag covering.

* *

Anyone who has attempted to cut a curve in a sheet of metal with a pair of tinsmith's shears—or even in cardboard with ordinary scissors—must be aware of the great difficulty of the operation; how the sheet twists and twirls, bends and hangs on to the shears, greatly increasing the power that has to be expended, while it is absolutely necessary to begin the cut from the edge of the sheet. Prompted, no doubt, by the bevelled discs used in machines for cutting out the bottoms of pots and pans from block tin, a M. Lachaume has lately adapted the system to a pair of hand shears, which have the advantage of making a cut without necessarily beginning at the edge, provided only that a sufficiently large incision be made in the sheet to enter one jaw of the shears, which may also be held either above or below the metal to be operated upon. Each jaw of the new tool is fitted with a bevelled disc of hardened steel, ground to an edge, sharp, without presenting an acute angle to the work, and, of course, with the cutting edges in contact. The handles are kept apart at their greatest extent by a spring, as in what the French call a *sécateur*, or pruning shears. On their being brought together by the hand of the operator in the action of cutting, they put in motion a lever which, engaging in the teeth of a ratchet wheel fast on the axis of one cutting disc, causes the latter to revolve and cut the metal, the other disc simply revolving through friction. It is stated that the Lachaume shears will cut sheet iron up to $\frac{3}{4}$ mm. thick, zinc and brass up to 1 mm., and cardboard up to 4 mm., the greatest thickness ever required in practice. The invention should prove valuable in a variety of trades.

In ladies' and gentlemen's button boots, it is found, after they have been worn a little time, that the front seam on each foot will run away to the inside. Now it is usual, in this class of work, to stay the outside quarter to the inside one by felling it to the lining at the edge of the fly-lining, so that in lasting there is no strain upon the buttonholes. The advantage of this, however, does not counterbalance the evil of the seam running on one side, for this it is which is the cause of the above-mentioned fault. When the stretch is taken out of the quarters only, as a natural consequence, the fly stretches in wear, and throws the seam out of its proper centre.

* *

Sir William Gordon-Cumming, Bart, is about to have extensive alterations made in the houses of his estates in Morayshire. About £12,000 or £13,000 will be spent on Altyre House alone. Local labour will be employed, which will be a great benefit to the building trades in the North, where things have been rather quiet for a long time. Gordonstown, also, is to be modernised and added to.

A CHAT ABOUT CHAIRS.

BY F. JERMAN.

Introduction — Rational Dining-room Chair—Library or Study Chair—Fixed Seats for Bars and Railway Carriages — Curved Backs — Hall Chairs—Draught Flaps and Arms—Decoration—Common Faults in Ornament—Conclusion.

In making any kind of chair or seat the human figure should be considered, and the resting surface should be modelled so as to fit the average body properly. The first object of a chair is use, and it ought not to be regarded merely as a vehicle for ornament. We often see grave errors committed with regard to the form of chairs. The back and seat are sometimes made straight, and at right angles to one another. In consequence of this absurd form, no one can obtain comfort from them except by the employment of cushions, etc., and even then the fault is rectified only in a small degree. A common wooden chair, designed so as to fit the human frame properly, is more healthy and comfortable than a straight-backed chair, although the latter may be made endurable by using cushions and padding.

Fig. 1 is a section of a rational dining-room chair. The total width of the seat is 15 in. Beginning from the front, the edge of which is rounded, the seat is level for $1\frac{1}{2}$ in., then it falls 1 in. or $1\frac{1}{4}$ in. in $9\frac{1}{2}$ in., and for the remaining 4 in. it rises half an inch. This outline will be found very comfortable in comparison to the ordinary flat seat. The height from floor to upper surface of seat at the back is $16\frac{1}{2}$ in.; from thence the back rises perpendicularly for $4\frac{1}{2}$ in., and in the remaining 12 in. it slopes backward at the rate of 1 in. in 4 in. If cushions are intended to be placed on the seat, the latter should be made 1 in. lower, and 1 in. added to the upright portion of the back, making it $5\frac{1}{2}$ in. This upright part gives support to the frame of the loins, and the slope above it helps the natural movement of the respiratory organs. The rail between the perpendicular and sloping part is very important, as, if placed where shown, help is given to the small of the back. The total height of the chair is 2 ft. 9 in. The top of the rail being placed at this height gives support underneath the shoulder-blades, which is the weakest part of the back.

Fig. 2 shows the same principle applied to a library or study chair. The $1\frac{1}{2}$ in. piece in the front is omitted, and the seat is formed of two pieces of 10 in. and $4\frac{1}{2}$ in. wide, with a hollow $\frac{3}{4}$ in. deep. The back rises from the seat perpendicularly for 4 in., and from thence slopes back 1 in. in 5 in. The hollow in the seat is not required so deep as in a dining- or drawing-room chair. By making the hollow of the seat rather slight, and raising the hind legs, greater facility is given for writing purposes or for use at study; and by shortening the hind legs, sloping the back, and sinking the rear part of the seat more, the chair will become suitable for repose. In benches for theatres, schools, and public halls, the dimensions in the section (Fig. 2) will be found to be convenient in most cases, but they can be altered to suit existing circumstances.

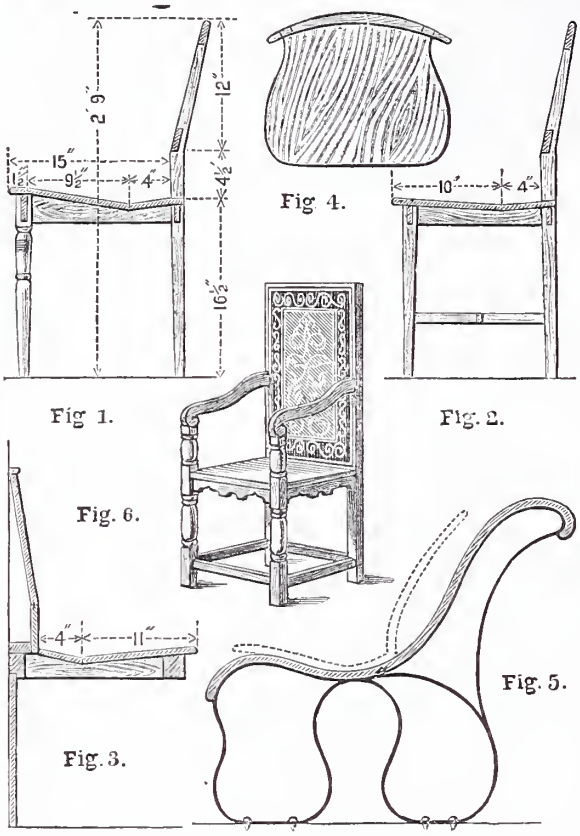


Fig. 1.—Dining-room Chair. Fig. 2.—Study Chair. Fig. 3.—Fixed Seat against Wall. Fig. 4.—Plan of Seat with Curved Back. Fig. 5.—Garden or Park Chair. Fig. 6.—Hall Chair.

For seats in bars and restaurants or railway carriages, or any place where they may be fixed against a wall, the section in Fig. 3 is recommended. The slope of the back is not so great as in the former sections. The seat is constructed of pieces of 4 in. and 11 in. wide, with a hollow between of 1 in.

Fig. 4 is the plan of a curved backed chair. A little reflection will convince the reader that this, as a rest for the back, is not a healthy form, as it tends to contract the chest and push forward the shoulders—which latter ought, of course, to be kept back in order to expand the chest and give room for the action of the lungs. A flat-backed chair will be found to do this much better than any other outline can. Unfortunately, these curved backs can be seen in almost every house, in the best furniture of the past century and this. Money is thrown away on ugly curved pieces, which are neither useful nor ornamental. Some old chairs, in which the plan of the back forms a semicircle, have even a more unhealthy tendency than the example shown here.

Fig. 5 is a sketch of a garden or park chair, consisting of a light iron frame with rounded battens forming the seat. At first sight the latter appears to be very inviting and comfortable, but when tried and analysed many faults will be found in it. It has too great an inclination backwards, and the curve at the back of the seat is too large. The curved part at the top is of no use whatever, neither is that at the front part of the seat. The seat is much too wide, and the curve in it is not correct. The dotted lines show the seat remodelled to fit the body properly. The perpendicular part of the back, which should never be absent in a chair, is shown here, and the other faults are rectified.

This kind of seat is the very opposite to a typical hall chair, shown in Fig. 6. The latter has straight lines and right angles throughout, while the garden seat is formed wholly of curves. However, it is difficult to determine which is the most unhealthy. The defects in the hall chair may perhaps be pardoned, as the seat is only intended for the temporary accommodation of visitors; but in the garden chair, where whole hours may be whiled away, it should certainly have not the mere semblance of comfort, but be designed for rest and ease.

It will be seen that the hall chair in Fig. 6 has a very high carved back. This is a favourite feature in old oak chairs. Some have a flap on each side, hinged to the back, to close against the arm in order to keep out the draught. These chairs came into general use in the thirteenth century. As the halls in buildings of that period were spacious, and gave free access to the wind, the high backs and draught flaps were very useful, and gradually became ornamental features. It may be remarked that the arms in Fig. 5 are much too high—another defect in the old chairs we should not imitate: 7 in. or $7\frac{1}{2}$ in. from the seat to the top of the arm will not be found too low. If placed at 9 in. or 10 in., as is sometimes done, they will not rest the forearm in a natural position, but help to produce round shoulders and other unnatural habits of body.

A few words may be said about ornament; but, of course, this is a mere secondary consideration. A natural form is the first thing to be desired. When this is obtained, we may round off the angular parts and clothe it in a tasteful exterior—just the same as the bony frame of man has a covering of flesh and skin. In the same way we may hide the construction of a chair, but we ought still to feel that it is present, and that the chair is designed on proper principles, by the comfort obtained from using the seat.

Carved projecting ornament, which is in the way and is liable to get broken off,

should be eschewed. This fault is very common in French designs of the style of Louis XIV. The celebrated Chippendale and Sheraton chairs, although undoubtedly some of their carved backs are very beautiful, cannot be regarded as models of correct taste. The same may be said of Hepplewhite's, which are known by their shield and oval backs. The spindle-like filling and carving, in some examples, are very liable to be broken off by merely leaning against them. Chippendale's elegant "ribbon" chairs are condemned on the same ground. This maker borrowed some ideas of his furniture from the French, and introduced legs of double curvature for the front of his chairs, while at the back the legs remained square in plan. Loudon strongly condemns this fashion of loading the legs in front with ornament while the back supports remain square and devoid of decoration; but, of course, individual tastes differ in such matters.

This paper must now come to a close, but the writer sincerely hopes that the above remarks on the proper and natural outline of chairs may be found of use by the readers of WORK—to some in choosing their furniture of tradesmen, and to amateurs in constructing, or trying to construct, their OWN.

EASILY - MADE BATTERIES.

BY J. BROX.

INTRODUCTION — CARBONS—LEAD CAPS—FRAME — ZINCS — DRY BATTERIES — CELL CASES — CARBONS — MIXTURE — SEAL FOR TOP.

Introduction.—As a continuation and ending to my paper, showing how to construct a small model electro-motor, which appeared in Vol. III., No. 154 of WORK, I now propose to help you to make your own bichromate, or chromic acid, batteries and carbons in the simplest and easiest manner, with a short description of making a dry battery cell: which seems, somehow, to be a trouble to not a few. I have several of the double carbon single fluid batteries, which I now propose to illustrate, made exactly as shown, which give every satisfaction; they are not, I am sorry to say, things of beauty, but their simplicity of construction excuses that. The dry battery, on the other hand, is a very neat little article indeed, two of which have been ringing a small bell for the last ten months, and work as strong as when I first made them.

Carbons.—You must not, of course, expeet that these carbons that you make yourself will be as nice-looking as the bought ones, but they are quite hard and close enough for all practical purposes. You will not also find very good results if you try to make them larger than, say, about 7 in. by 4 in.; but even taking this as a limit, there are many useful sizes coming below that measurement.

The first thing to be done is to make a wooden model of your carbon, then from some thick tin—the thicker the better for large sizes—cut out a square the size of your wooden model, plus its thickness, as in Fig. 7; cut the corners diagonally up to the wood, and with a hammer turn up the edges all round neat and square, turning in the corners as you would in making a simple card-tray, shown in Fig. 8; repeat this process again with another square of tin, but this time using the first tin, with the wooden model inside as a mould, so forming a lid. You must now go on a voyage of discovery into the coal and coke cellars, and get equal parts of coal and coke dust—you had better keep these separate for the present; sift these as fine as you can. I make my last sifting through a small sieve, made of gauze muslin. Take equal parts of each by volume, and mix them up together with treacle—a putty-knife is a good tool—on a flat stone; you must mix all well, and as stiff as you can get it: so stiff that you can hardly work it. If you have mixed it rightly it will have a little of the same trick as cold fresh-mixed starch; it will not stand violence, but will yield to gentle persuasion.

You must now fill the inner of your tin boxes, working in as much as you can, and well into the corners; put on the tin lid, and bind round and round both ways with thin iron wire, and fasten. Watch for a nice clear fire; the best is a hollow one: the kind that an old woman says "there is a parting" in. Put the tin mould in flat—as flat as you can; putting it in anyhow won't do. I spoilt one or two at first by doing so; the carbons came out all soft one end, and grand and hard the other. Let it stay in the fire until it is a bright red all over, and until there are no more little blue flames round the laps of the tin: a thing which you can't prevent with a tin mould; this will be in about a quarter of an hour or ten minutes after it is red hot; take it out, and let it cool slowly by leaving it close to the fire.

You can use your tin mould only three or, at the most, four times; the first two are always good. Of course the first is the best, but No. 3 is generally aldermanic, No. 4 Henry VIII. without a doubt; but still, Nos. 3 and 4 do very well for dry cells, where they are not seen, but as the tin moulds are so easily made, this does not much matter. I never use one more than three times. Any old tin will do as long as it is flat and turns up true.

Lead Caps.—To make the lead caps, make a good stout wooden box, as in Figs. 9 and 10, making the inside to the size you require; also see that the inside of the joints fit close and well. One side of this box must be put on with three or four wood screws, as in Fig. 10, so that you can slack it off when you take the casting out. To cast the heads on I cut a couple of shreds of lead, and place them in the bottom of the mould to rest the carbon on, as it is very hard to hold it steadily so that the lead runs underneath without support. Pour in the lead steadily, and do it in once; if you stop, it will leave an unsightly crack or join.

To each lead head, on one end of it, solder a piece of cotton-covered copper wire, the end of which you have previously flattened out well. In soldering on the copper wire, you will find the lead cap has become quite hot; while in this state give it a good coat of Brunswick black, working it well into the junction between the lead and the carbon, and down the latter for about ½ in. Fig. 5 shows a carbon and cap with wire tag. Of these carbons you will want two for each single fluid cell that you think of using.

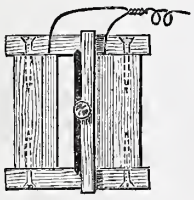


Fig 1.

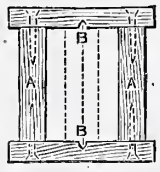
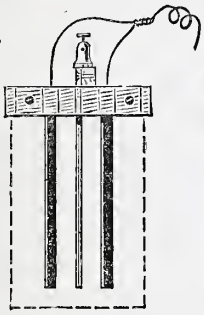


Fig. 2.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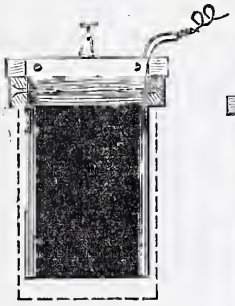
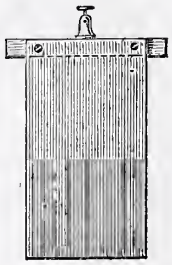


Fig. 4.

Fig. 5.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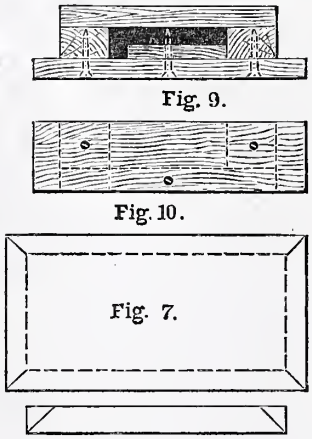


Fig. 7.

Fig. 8.

Fig. 9.

Fig. 10.

Fig. 11.

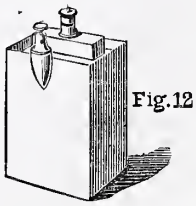


Fig. 12

Fig. 1.—Plan of Frame and Elements complete. Fig. 2.—Plan of Frame—A, A, Struts; B, B, Grooves for Zinc. Fig. 3.—End View of Frame and Elements. Fig. 4.—Side View of same. Fig. 5.—Carbon complete. Fig. 6.—Zinc complete. Fig. 7.—Tin Sheet marked for turning up. Fig. 8.—The same turned up. Fig. 9.—Plan of Lead Cap Mould. Fig. 10.—Side View of same. Fig. 11.—Small Zinc Cover-Plate. Fig. 12.—Dry Battery Cell.

Frame.—The frame to hold one set of carbons and the zinc plate for one cell, you will make with four pieces of wood, a plan of which you will see in Fig. 2. Fig. 1 shows the same with the carbons and zinc in their places. Fig. 3 is an end view, and Fig. 4 a side view, both with carbons and zinc. The size of this frame will depend upon the size of the jar you are going to use. The two strut pieces marked A, A, in Fig. 2 ought to be made very slightly shorter than the length of your lead caps, so that when these are in their places—viz., one close up to one strut, and the other close to the other—you can screw the whole up tight by the four wood screws, and the carbons will be held firm in their places.

On the two side pieces, in the middle, and on the inside, are two grooves, cut of a suitable width and depth, to slide your zinc plate down, shown at B, B, Fig. 2. The two copper wires will now stand up between the frame and the lead caps; one of these wires should be cut half as long as the other, and in

the middle of the longest untwist some of the cotton cover; and join the end of the shortest to the bare place, thereby making connection between the two carbons, and a means of joining up to the next cell; this is shown in Figs. 1, 3, and 4. The whole frame and lead caps should now have two or three coats of Brunswick black.

Zincs.—These should be cut out of rolled sheet zinc, not less than $\frac{1}{8}$ in. in thickness, however small the battery may be you mean to make, well cleaned and amalgamated. In the two top corners of your zinc drill two holes, and screw it on to a small strip of wood long enough to rest on the sides of the frame when the zinc is slid into the two grooves. Fig. 6 shows a zinc.

Between the wooden strip and the zinc at the top make a hole with a bradawl, and screw in an ordinary binding screw; the strip and the zinc for about 1 in. below the wood should have two or three coats of Brunswick black.

This simple way of treating the zincs is handy, for the reason that when they are nearly used up one end, it is little trouble to take them off, clean them up, etc.; drill holes in the other ends and reverse them.

The fluid mixtures—so many times given in this paper—and the jars I leave to your discretion. The sketches are to no scale, as you may have observed; all I have endeavoured to show you is an easy and simple system of making the elements for double carbon and zinc batteries in general.

Dry Batteries.—As regards dry batteries, I have noticed that they are somehow or other a thorn in the flesh to many. Not so long ago a man with an electric hobby came to me in great trouble; he had made a dry cell, a very neat little box one, and beautifully finished; but not a vestige of current would it produce. I asked him how he had made it, and he told me. Everything seemed as it should be; his mixture was a good one, but still, it would not work. I told him all I could do was to cut out one side and have a look at it. This he did not seem to relish; but I wanted to have a look at the inside without disturbing the contents. This soon brought the trouble to light: his carbon plate was resting tight on the zinc bottom, thereby short-circuiting the cell. His dry battery works well now.

Cell Cases.—The box cell, shown in Fig. 12, is made of rolled sheet zinc, neatly soldered up together, with a binding screw soldered on to the outside of the top; and to give a finished appearance, a small cover-plate of zinc, made in shape like Fig. 11, is soldered round the tag of the binding screw. After you have dressed up the outside of the box smooth with a file, put it in an oven, and get it so hot that it is *just* unpleasant to hold; then give it a coat of Brunswick, going over the top and down the inside for about $\frac{1}{2}$ in.; after this is dry, give it two more coats.

Carbons.—You can use for the carbon, if you like, one of the aldermanic ones which came out of your tin moulds, and was not good-looking enough for the other purpose; but have a nice lead cap on the top. You can have a copper wire tag on the head, but a small binding screw in the middle looks much better, and is more useful, as in the sketch, Fig. 12. A hole is easily drilled, and the screw soldered in.

Mixture.—There are several mixtures for filling dry cells, some of which are secrets; some are complicated, others simple. The one I shall offer to you is a very simple one. I have used it myself; and as it works well—in fact, better than I expected when I first made it—you can, I think, use it with advantage.

I took some ordinary killed spirits of salts—viz., common hydrochloric acid saturated with zinc; this I slightly warmed, and again saturated with sal-ammoniac. With this simple solution I made a thin mixture with plaster-of-Paris; then putting two stout small indiarubber rings in the bottom of the zinc box to insulate the carbon, I held the carbon in its place, and filled up the box to within $\frac{1}{2}$ in. of the top with the creamy mixture. When this had somewhat set, two pieces of wood a little thinner than pen-holders were run down to the bottom on each side of the carbon plate, and left there.

Seal for Top.—The seal that was used for the top was some old Brunswick that had got hard, which was melted in a tin, and then run over the top. When this was nearly set hard, the two sticks of wood were given a twist and carefully pulled out, leaving a hole on each side of the carbon for the escape of gas. Two little cells made like this, as I said before, have been ringing a small bell for the last ten months through about twenty-four yards of wire; how much longer they mean to go I cannot say. When they do show signs of weakness, I shall stand them each a small drink of the same solution I made them of, which they can take into their inner selves by their small breathing holes, and I doubt not but that they will revive again.

HOW TO MAKE AND WORK THE SPECTROSCOPE.

BY CHARLES A. PARKER.

Prisms—Quality of Glass used for Prisms—How to Make a Bisulphide of Carbon Prism—Cutting and Grinding Glass—Cementing Sides of Prism together—Filling Prism—Bisulphide of Carbon—Wooden Framing for Prism.

A prism for spectrum analysis should invariably be made of the best dense flint glass, which, by the way, has nearly double the dispersive power of crown glass. An ordinary dense glass prism as usually employed for this purpose will have a section which is an equilateral triangle, giving an angle of about 60°. The angle should not be smaller, otherwise the spectrum is too short; and, on the other hand, if it is too great we shall get no spectrum at all, as the light will be reflected back without emerging from the second refracting surface. Flint glass possesses a much greater dispersive power than water, and bisulphide of carbon more so than flint glass.

A very useful hollow glass prism (similar in appearance to Fig. 4) can be formed by enclosing a liquid between glass surfaces suitably inclined and cemented together, and provided that the plates employed for this purpose have perfectly parallel surfaces, the refraction of the rays will be entirely due to the liquid itself. Assuming that the student will be desirous of constructing his own prism, it may be desirable to describe the practical construction of a bisulphide of carbon prism of this description which will be eminently suited to the requirements of spectrum analysis.

The refracting surfaces of the prism are formed of three pieces of glass accurately ground and cut to a uniform size of 2 in. by $1\frac{1}{2}$ in., using for this purpose the best patent plate or, better still, plate glass. The edges should now be accurately ground by being rubbed on a piece of iron plate with fine sand and emery powder until they are all three of a uniform size. It is best to grind the edges with sand, as this will give a coarser surface to the glass, which will hold the glue more firmly in the subsequent operation of cementing the prism together. When these three pieces have been prepared for the sides, a couple of triangular pieces of thinner glass should be cut and ground to the plan of Fig. 5 to form the top and bottom of the prism. They may, with advantage, be cut from a piece of ground glass, and it will be necessary to provide one piece with a small hole, through which the prism may be filled; the hole can be readily bored by means of a rat-tailed file with the extreme point broken off. The file, which should be held in the right hand, is rapidly rotated in a slanting direction, with the thumb close against the glass, in order to increase the pressure, and likewise to prevent the file from pressing through the glass when the hole is finished. The drilling may be done much quicker if the point of the file is occasionally lubricated with water or, better still, oil of turpentine; and, if necessary, the orifice may be afterwards enlarged by working the file in the usual manner. The hole should be bored before the glass is cut and ground, in case the glass should happen to crack during the operation and be rendered useless.

The prism constructed by the writer is formed of three pieces of good plate glass 2 in. by $1\frac{1}{2}$ in. by $\frac{1}{4}$ in., accurately bevelled on their inner sides, so that they fit together in the manner shown by the plan of the prism in Fig. 6. Although there is much more labour attached to making a prism of such thick glass, yet it is in the end an advantage, as the bevelled sides afford a firmer hold for the cement, and render the prism much stronger and more rigid than can be obtained by the use of thinner glasses. If the sides are made of thick glass, the top and bottom will not require to be increased in thickness, as thin glass will answer the purpose quite well enough; in fact, it is really better to use thin glass for the purpose, owing to the necessity for boring a hole through the top piece.

The greatest difficulty experienced by the amateur will, doubtless, be in the cutting and bevelling of the glasses, and, as it is absolutely needful for this to be done accurately, it becomes an awkward task to accomplish without the necessary appliances. It may, perhaps, be possible to get such a job performed at a glass grinding and polishing works, although, as a rule, these people do not care to undertake such small work. It is, however, comparatively easy to get a job of this description done in London. When the five pieces of glass have been prepared in the above manner, they will be ready for cementing together to form the prism. As carbon bisulphide is capable of dissolving all resinous substances, it will be impossible to put the prism together with ordinary glues or any similar cement. The writer considers Le Page's fish glue to be the best cement to use for this purpose.

The three pieces of glass which form the sides of the prism should be carefully cleaned, and then glued in position on the triangular piece of glass which forms the bottom of the prism, care being taken not to smear the glue on the glass, but to get just a thin unbroken line of it floated along the junction of the bottom with the sides *inside the prism*, the same care being exercised with regard to the apex of each of the

sides. It is by no means an easy matter to get the glue to flow in an even line along all the joints of the prism, but still it can be accomplished by the exercise of a little care and patience. On no account should too much glue be used at a time, otherwise it will be apt to run away from the joint before it has had time to dry. If thin glass has been employed for the sides, it will, doubtless, be advisable to hold them together temporarily at each apex by means of strips of postage stamp edging stuck along the outside of each joint, removing these when the glue is dry, and filling up the spaces with fresh glue. While the glue is drying, and until the top is put on the prism, the inside should be protected from dust by loosely covering the open end with a piece of paper; or, if preferred, it may be stood upside down, as it is absolutely important that the inside should be kept clean and free from dust.

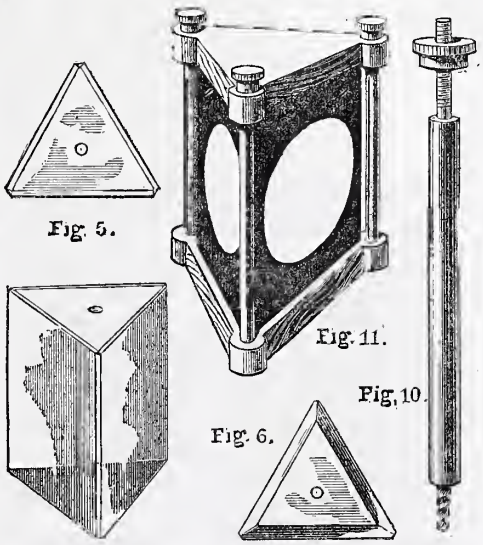
When the glue has become quite dry—and not till then—the top piece of glass with the hole drilled through may be glued on to the top of the prism. When doing this, it will be found the best plan to put the glue, not only on the top edge of the prism, but draw a thin, unbroken line of it all round the inner edges, so that when the top glass is pressed into close contact the whole can be turned upside down, thus causing the glue to sink slightly and, consequently, run completely round the edges. The prism should now be put in a cool place so that the glue may dry slowly, as, if the drying is forced by the aid of heat, it will cause the glue to crack and leave chinks between the two surfaces. When the glue is quite dry, all the joints on the outside should be carefully looked over and levelled with glue wherever necessary, after which the prism will be ready to be filled with about $\frac{3}{4}$ oz. of pure bisulphide of carbon. This may be done by pouring the liquid through a small pipette, which takes the form of a short length of $\frac{3}{8}$ in. soft glass tubing drawn out at one end to a fine point in a gas flame, thus forming a kind of small funnel. The prism should be filled as quickly as possible and the aperture immediately closed with a small piece of cork previously cut to fit the opening tightly, after which the cork is cut off short and then covered with several layers of glue, in order to make it air-tight, each succeeding layer being allowed to become quite dry before the next is laid on.

The reader should be particular to obtain the bisulphide of carbon chemically pure, as the ordinary commercial quality, which generally has a yellowish tinge, is unsuited for that purpose. As bisulphide of carbon emits a particularly obnoxious odour, it will be found advisable to fill the prism in the open air; or, if it is done in the house, the windows should be opened after it has been done, in order to get rid of the smell. The student should also be very careful to keep clear of any naked flame when using this liquid, as it is highly inflammable.

Should the prism be found to be leaking at any time, it will be necessary to empty the liquid back into the bottle, and then cover the leak with some fresh cement, any defect of this kind soon making itself apparent by the smell. Sometimes it may happen that the leak is on the inside, in which case it will be needful to take the whole of the prism to pieces; in the event of this being requisite, the glass plates may be loosened by soaking the empty prism in warm water for some time, after which the softened glue is scraped away, and the whole cemented together again with the greatest possible care.

When the prism is not in use it will be found advisable to keep it in the dark, as pure bisulphide of carbon, which is a white, transparent liquid, becomes slightly yellow by the action of daylight, more especially so when it is placed in direct sunlight.

It will be found to add considerably to the appearance of the prism if the sides are covered with a piece of thin black paper, which is carefully pierced with three openings, each the size of a penny-piece, and



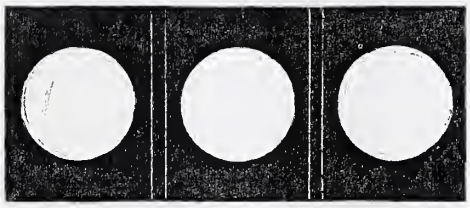
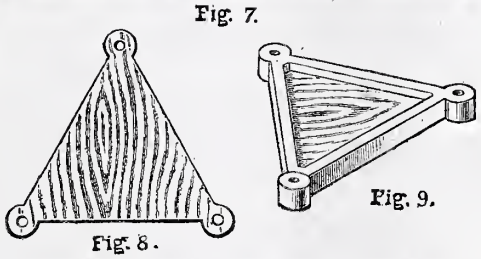


Fig. 7.



Spectroscope. Fig. 4.—Hollow Glass Prism. Fig. 5.—Plan of Prism. Fig. 6.—Plan of Hole in Prism of Plate Glass with Bevelled Edges. Fig. 7.—Black Paper Mask for Sides of Prism. Fig. 8.—Plan of Wooden Frame for Prism. Fig. 9.—Framing showing Mortise to take Prism. Fig. 10.—Brass Pillar with Nut. Fig. 11.—Prism mounted complete.

suitably arranged so as to occupy the centre of each of the sides when the paper is cemented on to the glass with fish glue, or, better still, with some strong shoemaker's paste. This paper mask is shown in Fig. 7. Nothing remains now to be done but to provide the prism with a wooden frame, as shown in the illustration. The seating for the top and bottom is formed of a couple of pieces of $\frac{1}{4}$ in. mahogany, ready polished and fret-cut to the shape of the prism, but just $\frac{1}{8}$ in. larger on all sides, with a semicircular curve at each angle, as shown in Fig. 8. The top and bottom of the prism is made to bed into a mortise prepared for its reception in each piece of wood by the aid of a keen chisel, in the manner shown in Fig. 9; the polished sides naturally being uppermost. A hole is bored through each angle of the wood by means of a fine gimlet, or, better still, a red-hot wire, as there will be less likelihood of the wood splitting if this course is pursued; and when this has been done, three $2\frac{5}{8}$ in. lengths of $\frac{1}{4}$ in. brass rod should be reduced in diameter at each end by means of a file, after which the upper end of each one is tapped with a screw thread, and then provided with a small screw nut, as shown in Fig. 10; the lower end of each one being afterwards cemented into the holes in the bottom seating of the prism by means of Prout's elastic glue, after which the top wooden cover is slipped on and secured in position by means of the screw nuts. The sawn edges of the wood will, of course, be required to be trimmed up with a file, and then varnished; and it will also be advisable to lacquer the rods and nuts. The appearance of the prism when complete will be seen by reference to Fig. 11. It is always advisable to make the prism first before starting upon the construction of the spectroscope itself, as it will sometimes happen that a bisulphide prism, made in the manner above directed, will appear to be perfectly sound for a week or two, and then start leaking in consequence of some slight defect in the cementing of the joints. In the case of the prism constructed by the writer, a mishap of this kind occurred at the end of a week or so after filling, in consequence of which it had to be taken to pieces and refilled, only to leak again in a few days; but after being again filled, with that extra care which is the outcome of experience, it has remained perfect ever since.

In the next paper I shall describe the preparation of the adjustable slit. In the meantime, the reader will find ample employment in the construction of the prism just described.

PHOTOGRAPHIC EXPERIMENTS.

CURIOUS, AMUSING, AND INSTRUCTIVE.

BY WALTER E. WOODBURY.

INTRODUCTION—PHOTOGRAPHING THE INVISIBLE—TO MAKE PLATES THAT WILL DEVELOP WITH WATER—PHOTOGRAPHS WITHOUT LIGHT—TO MAKE SILHOUETTE PORTRAITS—LUMINOUS PHOTOGRAPHS—TO MAKE A STRONG PRINT FROM A WEAK NEGATIVE—COMICAL PORTRAITS—TO RESTORE FADED PRINTS.

Introduction.—The beautiful art of photographing is rapidly becoming more and more popular as a pastime. It affords an endless amount of instruction and amusement. The number of amateur photographers in this country is already incredibly large. It is to be regretted, however, that the majority of those who practise the art for pleasure content themselves with the simple routine involved in the making of a negative and from this a silver print.

With a knowledge of the art a thousand different experiments can be made, which not only afford considerable instruction, but are, in some cases, very amusing and entertaining.

I have in the following collected a number of instructive experiments, useful formulæ, and amusing dodges, which I hope will be of use to many of the readers of WORK who already understand and practise the black art. With the aid of expensive apparatus it is, of course, possible to produce many other beautiful effects; but as I fear that all readers of this Magazine are

not troubled with an abundance of superfluous cash, I have only included those which can be conducted without much trouble or expense.

Photographing the Invisible.—The following is a curious and interesting experiment, based upon the peculiar property possessed by fluorescent substances of altering the refrangibility of the chemical light rays. Take a colourless solution of bisulphate of quinine, and write or draw with it on a piece of white paper. When dry the writing or design will be invisible, but a photograph made of it will show them very nearly black.

To Make Plates that will Develop in Water.—Some time ago dry plates were placed on the market which would develop, apparently, with water and a little ammonia only. The secret of the method was that the backs of the plates were coated with a soluble gum, containing the developing agents, and, of course, when the plate was immersed in the water, they instantly dissolved and formed the developer. Plates thus prepared are useful in travelling, where it is not always possible to get the necessary developing solutions. To prepare them the backs are coated with the following mixture :—

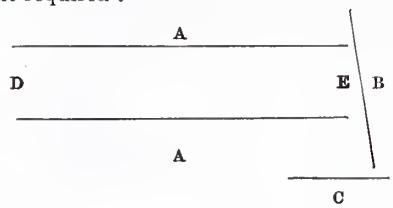
Pyrogallic acid	...	154 grains
Salicylic acid ...	...	15 „
Gum or dextrine	...	154 „
Alcohol ...	...	1 fl. dr.
Water	...	5 „

This is allowed to dry at an ordinary temperature. After exposure, all that is necessary to develop is to immerse the plates in water containing a small quantity of ammonia.

Photographs without Light.—A curious experiment, showing that a photographic dry plate can be otherwise affected than by light, so as to form an image upon it, is the following :—

An image of copper in relief is necessary—a penny will do for this purpose. Place an unexposed dry plate in a normal pyro-developer, and on it lay the copper coin. After about five minutes or so, remove the penny and wash the plate, when a perfect image of the penny will be found on it.

To Make Silhouette Photographs.—Silhouette photographs were at one time very popular. Some very curious and pleasing results can be obtained with them, and very simply. Hang up a white sheet at one end of a room, near a window, and then improvise a dark tunnel. The accompanying diagram will serve to illustrate the arrangement required :—



B is a white sheet, and A, A, the sides of the improvised tunnel; C is the window, D the camera, and E the subject to be photographed.

Focus the figure as accurately as possible, and expose very rapidly for the background only, as no detail is, of course, required in the figure. Develop as usual, preferably with a hydroquinone developer, as a blacker negative can be obtained. The weak shadows of the feet can afterwards be touched out with a pencil. When properly printed the effects are very good, and serve to remind one of the old portraits cut out of black paper which were so much in vogue in the days of our grandmothers.

Luminous Photographs.—There are several different ways of making these. Obtain some Balmain's luminous paint, and coat a piece of cardboard with it. Place this in the dark until it is no longer luminous; place this behind a glass transparency and expose the light, either daylight or, if at night-time, burn a small piece of magnesium wire. Return to the dark, remove the transparency, and a luminous photograph is obtained on the prepared card. A simple plan is to merely expose a piece of the prepared cardboard to the light and place it behind a transparency; then retire to a darkened room. The luminous paint, showing through it, will have a very pretty effect. If no glass transparency is at hand, a silver print can be used, if previously oiled and rendered translucent by vaseline or any other means.

To Make a Strong Print from a Weak Negative.—Amateurs, as a rule, are very liable to get a number of weak, thin negatives, which, apparently, have no printing qualities. To remedy this a very effective plan is to place over the printing frame containing the negative and paper a sheet of green cathedral glass. This has the effect of retarding some rays and allowing others to pass through, and, by this means, a much more brilliant print, with greater contrasts, is the result.

Comical Portraits.—The tyro's first attempts at portraiture usually result in a lot of comical effects; but, as they are not intended to be humorous, the effect is not so good. Better it would be to endeavour to make really humorous effects. These are very simple. If the amateur is a bit of an artist, the matter is simple enough. A good plan is to obtain a large piece of cardboard; cut a round hole out of it sufficiently large as to just allow an ordinary-sized person's head to go through. Underneath this hole a small grotesque body is drawn or painted. The sitter's head is then pushed through, and the whole photographed. The effect is very funny, especially if the body is well done. A hundred different ideas will at once form themselves, such as a little man sitting in a balloon or flying in the air on a broomstick, etc.

To Restore Faded Prints.—Prints that have faded and gone yellow can be restored in the following manner. Two solutions are required.

Solution No. 1: Tungstate of soda, 3½ ounces; distilled water, 175 ounces.

Solution No. 2: Carbonate of lime, 62 grains; chloride of lime, 15½ grains; chloride of gold and sodium, 62 grains; distilled water, 14 ounces.

Solution No. 2 must be prepared in a yellow glass bottle, well stoppered, and allowed to stand twenty-four hours before use. It is then filtered into another bottle of yellow glass, and well corked to preserve it. For use, take 6 ounces of No. 1 and from 1 to 2 drachms of No. 2 solution. The prints, having been well washed, are placed in this solution one at a time. The strengthening should not be too rapid. In summer ten minutes should suffice, nor should the bath contain excess of gold chloride. If correctly used, a clear purple colour is obtained. The next operation is to fix. For this, take 6 ounces of No. 1 to 4 drachms of hyposulphite of soda. The prints are well washed, placed in this solution one at a time, and soaked in it until the yellow colour has entirely disappeared. This will, in some cases, require three or four hours. When it has entirely disappeared the restored picture is well washed and dried.

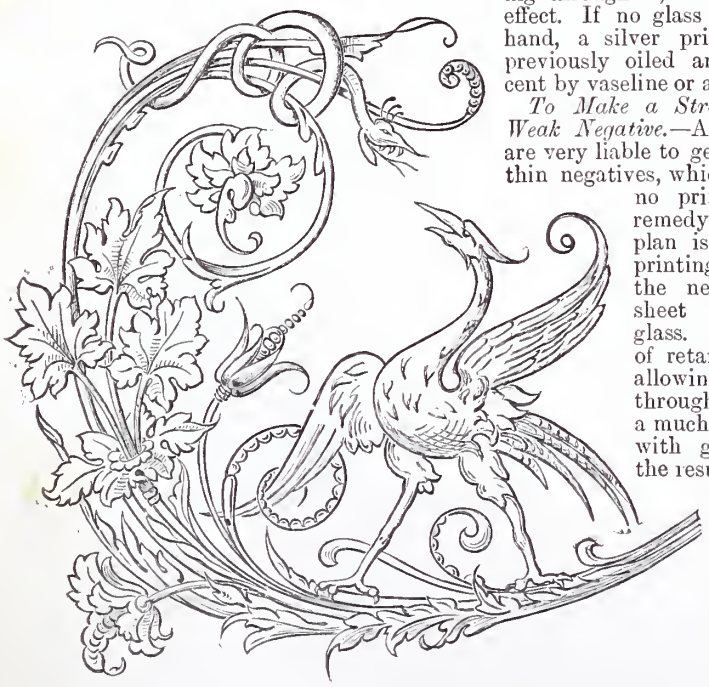


Fig. 5.—Italian Renaissance Design for Panel or Screen.

MEANS, MODES, AND METHODS.

A Strong Liquid Glue.

Take of clear gelatine, 100 parts; the best Scotch glue, 100 parts; alcohol, 25 parts; alum, 2 parts; with 200 parts of 20 per cent. acetic acid, and heat in a water bath for six hours. An ordinary liquid glue, also well adapted for uniting wood and iron, is said to be made by boiling together, for several hours, 100 parts glue, 260 parts water, and sixteen parts nitric acid. This glue will join wood to metals.

Stopping for Nail-holes, etc.

Take fine sawdust and mix into a thick paste with glue, pound it into the hole, and when dry the wood will be found to be as sound as new wood. It is said that this mode of stopping has been adopted with complete success in repairing bellows, which is the most severe test known. Often, by frequent attachment of new leather to the boards of old bellows, the wood becomes so full of holes that there is no space left to drive in fresh nails, and even if there were, some of the holes that had been already made, and had found their way to the interior, might allow the air to escape. This treatment with glue and sawdust paste invariably produces the desired effect. To all woodworkers and cabinet makers also this should prove useful.

POKER WORK, AND HOW TO DO IT.

BY JULIE NÖRREGARD.

The dolphin, in our next pattern (Fig. 3), can be used for a variety of articles, but would, perhaps, look best finished off with a small border all round on a square box for pocket-handkerchiefs; boxes are used so much now, many ladies preferring them to the soft sachets; they can be ordered at the art stores in white wood, and in any size. No. 4 of our illustrations is a very effective pattern, which would give a highly decorative character to a shelf for the wall. These little shelves form an important part in our wall decoration, and are seen nowadays in almost every drawing-room, loaded with china or bits of old silver. I saw one the other day made in perfect proportions; the shelf itself was 9 in. wide, and it was finished off in front with a low balustrade about 1½ in. high, just to guard all the little knick-knacks without hiding half of them; a piece of wood 15 in. deep was screwed into the wall, thus giving support to the shelf; on this plain piece of wood a pattern, something similar to the one given in our columns, was beautifully done in wood etching, and it looked simply lovely; the background nearest the griffin was burned very dark, being toned gradually down to a pale shade, so that the long, elegant-shaped flower stood out from the natural colour of the wood.

I have heard people talk about wood etching somewhat with disdain, just because they have happened to see some rubbish in that work, as they might in any other form of art; but I think it is rather unjust for that reason to dislike the work itself, for when it is properly done by a thoroughly artistic person, it is really most effective, and should be regarded as true art. With this, however, as with every other branch of *les beaux-arts*, one must learn "to walk before one can run," as the saying is.

The design in Fig. 5 is not quite so easy; but when you have practised on a good many other things, and can handle the red-hot tool as easily as a pencil or brush, it might be attempted, and on a panel or screen the pattern would look very beautiful. The first difficulty lies in all the fine lines, which, to look well, must run smoothly and evenly; the next consists of the shading, which represents many tones of colour, from the darkest walnut to the palest cream. As the design is in the rich Renaissance style, it must never be used on any Oriental shaped table or screen, this mixture being atrocious to the artistic eye.

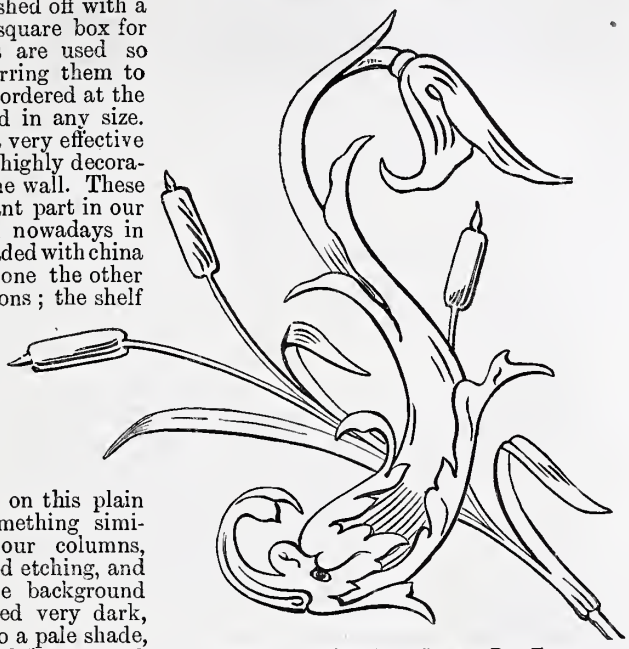


Fig. 3.—Design for a Square Box Top.

My readers will see that the designs which have been selected are all in the so-called conventional style; this must not, however, give the impression that no other styles are suitable for poker work; far from it, for some of the most lovely patterns consist of flowers and birds, of which any number of beautiful specimens can be hired at any art shop for a few pence, whereas the conventional designs are considered much more difficult to obtain, unless you are a subscriber to one or two of the art papers.

To the highest cultivated artist in pyrography everything will come in as a motive, and in this art there are landscape as well as portrait painters, who cleverly and successfully make their living by etching scenes from human life on their wooden "canvas."

I must give a few directions about finishing touches. If much time and trouble has been spent, the work should be polished; as this is not such an easy matter, I should advise the article being taken to an authority, who will understand how to heighten its value and beauty. But should the work be in a coarse style, effective, but without claiming to be first-rate art, it will be sufficient to use French polish; two or three coats of this should be applied with a soft brush, but it should be allowed to dry between each coat. I have seen some people use a combination of beeswax and turpentine, but, although it looks nice for a short time, it soon loses its effect. If the work should lose its fresh appearance, getting black from the London smoke and fog, it can be perfectly well cleaned by slightly rubbing it with indiarubber and bread-crumbs; this, however, should only be done when absolutely necessary. Many students of pyrography like to do the ground part of the work in various patterns, and for this purpose tools are made with separate points, in different shapes, such as stars, half-moons, and flowers. But this is a style which must be accepted with care, for in many cases it is apt to give a common and rather inferior character to the work; and, for my part, I think that the work with the softly shaded background is much more artistic.

I shall be glad if these simple lines have the effect of awakening an interest for this work, so that some new students may be added to the ranks of those who can already master the tool with skill and taste, but it must be remembered that one single piece of work done with love of art, and care, is much superior to a dozen articles executed in that half-hour style which spoils the good taste of both the worker and the admirers. All beautiful work requires time and labour, and when it bears an impression of haste it is no longer a thing of beauty.

Fig. 4.—Pattern for a Shelf or Panel.

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TECHNICAL TEACHERS.—*À propos* of obtaining teachers of technical classes, can we wonder that it is difficult to find capable instructors when all the bearings of the case are considered? If he is to be a successful teacher he must be well up in his particular trade. Then, leaving out the matter of payment, which, being often dependent on the results of an examination, may give him nothing at all, if it happens that the examiner sets questions quite unsuited to the master's view of the subject—a difficulty which the short syllabus issued by the City and Guilds Institute does not overcome—forgetting, we say, the financial point, are other surrounding circumstances such as would tempt a good workman to take upon his shoulders the burden of preparing lectures and supervising the practical work for classes? With many of his fellow-workmen he knows that his efforts will be harshly commented upon, while his employer will barely tolerate, if he does not altogether discourage, his teaching. Here he begins to speculate as to whether technical education is, or is not, the right thing. So much for the immediate environment. What help is he able to count upon from the leaders of his trade? Then, where is he to go for information as to the way in which such classes should be conducted? He knows that technical education has been in practice in France and Germany for years, and a knowledge of the way they do these things on the Continent would be an assistance. Where is such information to be obtained? At the Central Institute for the advancement of Technical Education, South Kensington? Nothing in the way of a special library, however, is in existence, there or elsewhere. Do these few considerations supply an answer to the question which has arisen in Birmingham, where recently it was suggested to send to the Continent for a teacher in bronzing and electro-plating. We feel sure that there are plenty of Englishmen quite capable of teaching this subject, but the conditions surrounding the work and the terms offered are not such as to attract suitable first-class men, and to let technical instruction drift into the hands of second or third-rate men is always a blunder. Technical propagandists should speak up.

SATURDAY AFTERNOON EXCURSIONS.—A very good proposal has been put forward in the daily press. It is that the railway companies should run cheap trains on Saturday afternoons, so as to enable workmen and their families to have a few hours in the country during the week-end half holiday. People of leisure, and with better-filled purses than the average workman, have little idea what a boon this would be. Too often the workman, finding himself a bit dull with nothing to do on these Saturday afternoons, is tempted to waste his time and money. The railway companies have it in their power to do much for the workers, and thereby to put money in their pockets. We have already had occasion to refer to workmen's trains on the G.E.R., where journeys of eleven miles are profitably given for a penny. Let excursions on something like this scale of charges be run, and the numbers that will flock out of town will make that class of traffic much more remunerative than any other railway traffic. Conveyance in these days of steam is cheap—cheaper than the railway companies have ever given us any idea of. A train with accommodation for 600 persons is not a particularly large train; yet the railway companies let the seats in the train at a penny each per mile—*i.e.*, at 50s. per mile for the whole train. Now, the total cost of running a train is 2s. 6d. per mile—that covers not only moving expenses, but maintenance of way, and stock, and stations; in short, everything. Thus the companies offer to the public at £2 10s. what costs them only 2s. 6d—a net profit of 2,300 per cent.! Of course, the public doesn't buy the article; it buys only what it absolutely requires, just as it does in the case of every other exorbitantly priced article, and instead of getting £2 10s. per passenger train mile, the companies get only a paltry 3s. 6d.—the rest of the train is wasted. To Brighton and back for 3s. is called a cheap trip. It is really a very dear trip. If 400 passengers go by such a trip, the company nets £60; its total outlay is £12 10s., at 2s. 6d. a mile for 100 miles. It thus nets a profit of close on 500 per cent. A *very* cheap trip this!

"WORK" POSTAGE.—Judging from the letters we are constantly receiving, there would appear to be misapprehension in the minds of some of our readers concerning the postal tariff for WORK. It cannot be too clearly stated that the postage for each weekly number is one halfpenny, whether the address be in the United Kingdom or abroad. In other words, a halfpenny postal wrapper will frank WORK weekly numbers to practically any point of the civilised globe. Though not registered as a newspaper, the weight of the weekly issue is under two ounces, which enables us to come under the privileges of the Post Office by which newspapers, or otherwise, not weighing more than two ounces can be posted in Great Britain or abroad for one halfpenny. This should prove a boon to those who, living at a distance from a town, prefer to order the journal from its publishers by post. Still more advantageous is it when it enables readers at home, with friends and relations at a distance, to keep in touch in a useful and practical way for the mere trifle involved in a duplicate copy of the journal each week.

DESIGN AND DECORATION OF ALL AGES.

BY M. H. C. L.

Savage Ornament.

It is a curious and interesting feature in the history of mankind that the decorative instinct is one of the first to assert itself. People put on ornaments before they learn to put on clothes. A thoughtful writer sees in this fact a suggestion that the right principle to go upon in educating children's eyes and fingers is to begin by teaching them to produce things ornamental, and thus to lead them on to the production of useful things. However this may be, it is certain that the early development of the taste for ornament and the universal desire to decorate whatever we see are matters well worthy of attention.

The result of the all-prevailing tendency to decorate is this: everything about us bears the impression of art—good or bad—and we are ourselves sure to produce, or cause other people to produce, a considerable amount of decoration. And thus, indirectly though it be, we shall each individually have our share in forming the taste of our age. And without knowledge to guide our fingers in whatever handiwork we undertake, even though it be but the simplest piece of embroidery, without the taste that is born of knowledge to guide our

Savage Ornament. Fig. 1.—Nicobar Isles. Fig. 2.—Andaman Isles. Fig. 3.—Fiji Isles. Fig. 4.—Peru. Fig. 5.—Guiana. Fig. 6.—Mexico. Fig. 7.—Assam. Fig. 8.—Samoan Islands. Fig. 9.—Borneo. Fig. 10.—New Zealand. Fig. 11.—New Guinea. Fig. 12.—Solomon Islands. Fig. 13.—North American Indian. Fig. 14.—Paraguay Indian. Figs. 15, 16, and 17.—Saibai Islands. Fig. 18.—S. Africa. Fig. 19.—Arctic American.

choice in furnishing and adorning our surroundings, we are certain to bring into existence more ugly things than beautiful, bad combinations, inharmonious colourings, and above all, barbarous applications of design. It is in the direction of design that we are most likely to fail, because it is here that the greatest ignorance prevails. In colour we have of late years had some general education. The work of our painters (work largely seen and appreciated), the introduction of Eastern fabrics, and the caprice of fashion, which for some time brought artistic shades into vogue in women's dress, have all done something in training our eyes to appreciate what is lovely in hue, and avoid the glaring bad taste of fifty years ago. The spread of education has disseminated general ideas of proportion and harmony, so that we should not be likely, for example, to put a ball-room chandelier in an old-fashioned cottage, or make other mistakes similar to that of the New Guinea chief who, having had a shirt given him for himself and a dress for his wife, put on both her garment and his own, and, with the addition of his usual barbaric ornaments, headed a procession of his warriors with splendid pride!

In the matter of design we make errors of taste exactly equivalent to these, though our sins against art escape general reprobation; in the first place, because everything that is made, being decorated somehow, the decoration is taken as a matter-of-course, and hardly noticed; and in the second place, because of those who do notice, very few have enough knowledge of what decoration should be to criticise.

The fact is, we live in an age of chaos, when the very abundance and variety of our materials prove our greatest difficulty. The decorated products of every foreign country are now poured in upon us, and we possess the art work of all past ages and schools, while we are without any living traditions to guide us in forming a nineteenth century school of design.

What we need is a definite knowledge of the subject—a knowledge not to be learnt from any one book, or indeed completely from any collection of books, but which must be acquired by patient and accurate individual study.

In architecture, where in modern days great confusion of styles and ignorant jumbling of disproportionate parts have been painfully prevalent, there is now a growing enlightenment. We have hold of the important principle that harmony of style is a first essential in a work of art, and that no beauty in the detached parts will compensate for a want of unity in the whole. It is this principle that we have to establish as a basis of practical work in all applications of decoration.

Just as a knowledge of the different styles of architecture belonging to other ages and other countries is needful for the architect before he begins to start on original work of his own, so before we attempt to produce original design we should make ourselves familiar with the decorative work of past periods and foreign lands. We must be able to classify, adapt, and arrange before we can make use of the heterogeneous mass of design which we find ready to our hands.

It is extremely interesting to trace out the first beginnings of design as they are found among savage nations in different parts of the world. The rudimentary efforts at artistic production generally consist in rough attempts at carving human heads to serve as idols or fetishes, and a simple form of surface decoration. This surface decoration is done in flat painting, generally red and black on a white ground, or more rarely by some process of burning on wood, or in the scratching of lines and dots. We may suppose that the first decoration of the third description was the tattooing of the artist's own person, and that, struck by the beauty of the result, he extended the process to his canoes, weapons, and domestic implements. The scratching, as it grows more skilful, and as the tools used for the process improve, becomes a system of elaborate etching and incising. The lines and dots, symmetrically repeated and adapted to cover a given space, are the simplest form of design—pattern-drawing. The space covered is almost invariably the whole of the decorated object, redundancy of ornament being the savage's chief idea of beauty, a point where he and his over-civilised brother, like most extremes, meet. A surface completely covered with a minute pattern repeated a thousandfold would be the barbaric notion of the perfection of decorative art.

When we speak of savage nations, however, it must be remembered that, in spite of certain features in common which enable us to generalise respecting them, the artistic gift is very differently developed in different races.

In the Nicobar and Andaman Islands, for instance, the attempts at decoration consist of rude smearing in some kind of mud on a light ground (Fig. 1) and painting of the roughest description (Fig. 2): the single idea in the way of design possessed by the inhabitants seeming to be the zigzag, this idea being most imperfectly carried out. The natives of the Fiji Islands, on the other hand, produce designs not lacking in actual beauty, and very accurately drawn and coloured (Fig. 3).

But little of the artistic instinct seems inherent in the African races. The pottery made in Northern Africa is painted in the rudest geometrical designs, so far from accurately that it is evident the decorators never learnt the art of ruling a line. In the work of Madagascar there are good bits of design, but a lack of idea in combining them. The West Africans, though some of their work in coloured leathers is rather pretty, show but little skill in pattern-drawing; while in the eastern part of Central Africa the decoration is of the roughest, and the designs are, as ornament, meaningless and very poor.

The same sort of apparently meaningless designs—an attempt at pattern-drawing without the perception of what forms the beauty of this species of art—symmetrical repetition—is remarkable in the painted bowls which come from Peru. But there is a curious glimmering of the Greek idea in the specimen sketched in Fig. 4. In Guiana, which is not far from Peru, the severe charm of the Greek borderings is almost reached in the patterns employed for the native basket-work (Fig. 5).

It is interesting to detect here and there the rudiments of some form which has been developed by civilised art into designs of rare beauty and intricacy. In Mexico we come across a simple guilloche (Fig. 6). In Katchyen, in Assam, we find a rude representation of the "vine" pattern, so universal in European work (Fig. 7). The curves are certainly execrable, in curious contrast with the delicacy and correctness of the etched pattern decoration from the same place, but there is an effort at the representation of growth.

According to one great authority on all that concerns savage races, every design had its origin in the copying of some natural form, though, through want of skill or constant repetition, all trace of the original may be lost. A very close and beautiful representation of the leafy stem is to be seen in some flat painting on a papery material from the Samoan Islands (Fig. 8). In Borneo and other islands of the Malay Archipelago which have no doubt come in contact with the art of the Eastern world the designs are of a high order (Fig. 9).

Perhaps the most beautiful of all savage design is that of the natives of New Zealand. While the work of the Australians is of the roughest and most meagre type, the carving of the New Zealanders is singularly advanced, and their incised patterns are lovely. There is one idea on which the best of them are founded—an idea which enters largely into the composition of Celtic work—the inverted volute. This is worked out into a variety of beautiful designs, gracefully adapted to the surfaces they are intended to cover (Fig. 10). The same form appears in the work of New Guinea, but less skilfully used, and without the same variety (Fig. 11). It is where a single form is thus produced in a variety of sizes, proportions, and positions that we have savage decoration at its best and in its most characteristic form.

The natives of the Friendly Islands have, like the New Zealanders, taken one idea, and theirs is the most primitive imaginable—namely, the zigzag. From this single form they produce surprisingly varied effects, and cover large spaces without any suggestion of monotony. The Solomon Islanders have also taken the zigzag, and with it again produce fresh varieties of pattern (Fig. 12).

The work of the North American Indians consists chiefly in the pictorial representations of natural forms, flowers and beasts, men and women. These are worked on birch bark in moose-hair, dyed the most brilliant colours, each hair forming a single stitch (Fig. 13). Their figures and flowers are more quaint than beautiful, but the decoration of their mocassins with bright-toned cloth worked in beads, and contrasting with the yellow leather, is very picturesque.

In the Ethnographical Gallery of the British Museum—a rich store-house of the work of savage peoples, where the student of barbaric art may spend many profitable hours—perhaps the most striking artistic efforts are those of the Arctic Americans (Fig. 19). There is a delightful grotesqueness in the odd beasts and birds painted on their flat wooden spoons, and the scenes from Arctic daily life, delicately etched on weapons and implements used for obtaining a light, are worthy of study. They are admirably drawn, and there is an immense deal of spirit in the little people, with black lines for legs and arms, engaged in building wigwams, spearing seals, rowing ark-like boats, and catching whales. Evidently, the dwellers in these frozen regions are a people endowed with the artistic instinct, and that even rarer gift, a sense of humour. Fig. 14 is a bit of rough incising by Paraguay Indians. Figs. 15, 16, and 17, ornaments on drum from Saibai Islands, Torres Straits. Fig. 18, S. African bird.

Patterns of the kind produced by savage art are applicable to all sorts of work in which a large surface is to be covered, and should—as in table-tops and stools—be kept flat. Some of the designs given might be

used for wood-incising, some for tiles, some for poker work, and others for embroidery. The border on the heading of the paper, for instance, might, enlarged, be worked in silks to form the border to a table-cloth, each line being represented by a stitch.

A NEW MARKING GAUGE.

BY PERCY C. RUSHEN.

As all mechanics know, or ought to know, the great secret in working wood or metal is to have the setting-out tools perfectly correct—and I sincerely hope that the gauge I am about to describe will go a long way towards assisting the setting out of work properly, and that you, reader, whoever you be, will set the example in your select clique by making and using one.

Here is a good idea, and one which I have never seen before. Fig. 1 is a side elevation, partly in section, taken on the line A in the figure of the improved gauge; and Fig. 2 is a plan of the same.

The stock and barrel are, as usual, made out of beech in the ordinary way, the barrel either having a fixing screw or wedges to fix it in its adjusted position on the stock. I have represented a fixing screw, as I think it is preferable and "real English." But instead of fixing the scriver a short distance from the end as usual, it is fixed at the extreme top. As seen in the drawing, it is a blade scriver, fixed by means of the countersunk wood screw, *a*. Or the screw may be screwed into an iron screw pummel, or box, or nut fixed in the end of the stock; but as the scriver is moved but rarely, I think a wood screw would suffice. By means of this screw working in slot *b*, the depth of the projecting part of the scriver (which marks or cuts the wood) is adjusted. The scriver consists of a small plate (*c*) of the size shown, either of iron or mild steel, afterwards hardened to a dark straw colour. It works in a slot cut in the head of the wooden stock. It is ground off from the inside of the stock, and may be either semi-elliptical or semicircular in plan. When finished, the edge of the scriver which cuts the wood ought to be perfectly flush with the rest of the end of the stock, no parts projecting further than this point, but perfectly at right angles thereto.

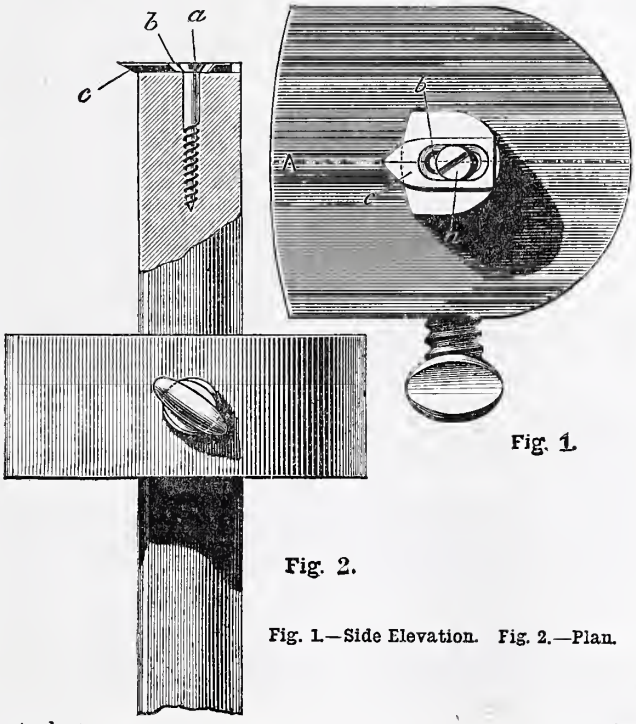


Fig. 1.

Fig. 2.

Fig. 1.—Side Elevation. Fig. 2.—Plan.

Its advantages are numerous; among others being that:—

1. It measures rebates and varieties of sunken parts perfectly.

2. It is of great use in circular saw benches, small planing machines—in fact, any kind of rotary or fixed cutter machine—for measuring from the fence or guide to the tool.

3. It may be held in position while a tool (*e.g.*, chisel) is placed against the end, and is driven without loss of time. Nails and screws may also be held there while being partly driven home. A pencil may be placed there to mark instead of the scriver (which may be fixed back) for those who prefer pencil lines for rough work.

Those who have seen and tried the tool speak well of it, and it is presented here for the benefit of all readers of WORK who may care to make one. Should any difficulty arise in the process I will answer through "Shop."

EMIGRANT FIELDS AND PROSPECTS.

MANITOBA.—Advantages—Farming—Railway Lands—Prospects.

FOLLOWING the information given by our Ottawa correspondent in No. 159, we have now the pleasure to print the personal testimony of one who can speak authoritatively upon Manitoba as an emigration field. Having spent many years in the Manitoba country, **D. B. C.** writes:—

It may be asked, "What advantage would there be in a man's exchanging work in England for work in Manitoba?" The chief advantage would be that he would lead a healthy life in the open air instead of being cramped up in an office. He would be more independent, and his chances of having a comfortable home within a reasonable time would be greater. If he went out during the summer, he would have no difficulty in getting work on some good farm at once. At first he would be paid from two to three pounds a month and his board and lodging; how much more he got than that would depend upon how useful he made himself. He would have to work hard—at first he would probably think too hard. By working for good farmers he would get a practical knowledge of farming not to be got in any other way, and, if he saved his wages, he should, in a few years, be in a position to take up land of his own (160 acres can be had on payment of a small fee). To get free land he would have to go a long way from the markets, as it is all taken up near to the railways and towns. The railway companies have a large amount of land that has been granted to them to induce them to extend their lines into unsettled districts. This land they generally will sell to settlers very cheaply, and at very reasonable terms of payment. Our young man would have to build himself a house and stable, and would want some farm implements, a pair of oxen, and some seed grain to start with. By only putting in a small crop the first year, he would have time to do some work for his neighbour with his oxen, and so get money to pay his current expenses until he sold his crop. If his first crop were a failure, he would have to work out again part of the next year. Anywhere in Manitoba the land is bound to increase in value as the country gets settled, and our young man, after a few years of economy and hard work, would find himself the proud possessor of a valuable farm, and his own master. I do not say that to get a farm in this way would be easy. The towns of the West are full of young Englishmen who have given up farming in disgust after a short trial, many of whom have had every advantage to start with; but, on the other hand, you constantly meet with prosperous farmers who started as farm labourers without capital. The climate of Manitoba is one of the most healthy in the world. The winters are cold, but the air is very dry, and cold that would be unbearable in our damp England is there bracing and not unpleasant. The Canadians are splendidly hospitable, and are always ready to lend a helping hand to strangers who they see are willing to work. My remarks apply chiefly to unskilled labour, in which class I include especially young men without capital who have not learned a trade or profession, and who, if they stayed in England, would have to take a clerkship in an office or shop, without much prospect of ever earning more than a bare living at that most dreary of occupations unless they have great ability or influence.

SCIENCE TO DATE.

Nitride of Lithium.—Quite recently we noted that nitrides of the alkaline earths and magnesium had been prepared. Lithium must now be added to the small number of elements which combine with nitrogen. Lithium nitride has been recently obtained by M. Ouvrard as a black spongy mass.

Aluminium Hydrate from Clay.—A simple process has been invented by Meyer, of Berlin, for preparing aluminium hydrate direct from clay. It consists in bringing superheated steam in contact with finely divided clay, dissolving the hydrates formed, and obtaining the aluminium hydrate from the solution by precipitation. This should be available for the cheaper production of aluminium.

The Camphor Tree in Florida.—Some time ago the camphor tree was introduced into Florida. The experiment has proved completely successful. The tree flourishes vigorously.

The "Aluminium" Light.—Magnesium ribbon is often burnt when a very intense light is required for photographic or medical purposes. M. Villon has found that aluminium may be utilised instead by burning it in a spirit lamp or, if a flame of greater brilliancy is required, in coal gas. Aluminium burns without emitting fumes, and is also cheaper than magnesium.

Saltpetre in East Africa.—Dr. Peters has discovered great deposits of saltpetre in the Kilima Njaro district, and near the Donjongai volcano there lie great swamps, from which soda is obtained. It is expected that German East Africa will compete successfully with Chili as regards the exportation of nitre.

NOTES FOR WORKERS.

THE poor in Germany live chiefly on rye-bread, but in consequence of the famine in Russia, whence most of the rye is imported, rye has gone up greatly in price. It has been found that by mixing maize-flour with rye-flour a very good and cheaper bread can be made. It is called "Murphy bread," after its maker.

THE entire tobacco crop in the United States amounted in 1889 to 488,255,896 lbs., the number of planters being 205,862, and the area devoted to tobacco culture being 692,990 acres. The average production per acre of the entire country was 705 lbs.

THE Sims-Edison torpedo has the power to dive under and cut through obstructions placed in its path, and can be steered from the vessel from which it has been launched.

A NEW star suddenly appeared in the constellation Auriga, in the Milky Way, at the end of January. The discoverer sent an anonymous postcard, announcing the fact, to the Royal Observatory, Greenwich, and, a search being made on February 1st, the anonymous announcement was found to be correct.

TRADE: PRESENT AND FUTURE.

*** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

TIMBER TRADE.—Dock deliveries show a further falling off over the corresponding period last year. Prices all round are very meagre, a large portion of goods having lately been sold at a price under the cost of import. It is to be hoped that the imports during the coming season will be low, and so give prices an opportunity of recovering themselves. Several vessels have already arrived. The hard wood trade is very quiet, although there is a demand for black walnut of good quality. The teak, mahogany, and fancy woods are just now very flat.

DYEING TRADE.—A dispute has arisen at a Bradford firm, where 600 *employés* have struck work for an increase of wages varying from 1s. to 2s. per week. Upon this, the master dyers of the town gave notice to 6,000 men to cease work unless this firm's hands gave in. A general lock-out seems inevitable.

BUILDING TRADE.—In Manchester and district, the building trade remains very firm and good. Masters and contractors report a promising influx of work in addition to jobs in hand. In Rochdale and district, the strike of bricklayers' labourers is over, the masters having agreed to the advance of ½d. per hour, while the men have withdrawn their demand that one labourer should be allowed to each bricklayer. The building trade section of the Liverpool Trades Council has apparently come to the conclusion that the carpenters and joiners of the district have now a right to demand a revision of an agreement entered into several years ago. Fifty-five hours now constitute the week in this district, and it is suggested that fifty or, if possible, forty-eight should be worked instead, while at the same time it is considered that the pay should be increased from 8d. to 8½d. per hour. The painters in this district are complaining of the action of the masters, who, it is said, employ apprentices as journeymen at apprentices' wages.

COTTON TRADE.—Through the dispute in the Lancashire cotton spinning trade, there is now a stoppage of 90 per cent. of the mills in the county. Some of the masters having good contracts in hand will continue to run their mills and pay the heavy fine which this course will involve to the Masters' Federation. Three large mills have also been closed in Bolton through bad trade, although cotton manufacturers there are not affiliated with the Manchester and District Masters' Federation. There are indications that others in the town will soon follow their example. Our Manchester correspondent writes:—Unless some very decided action is soon taken, it is not easy to see how a very serious stoppage in the cotton trade is to be avoided. Most of the mills in the Rochdale district are closed, a few of them for a week only, but the greater part for an indefinite period. The Operative Spinners' Association has raised the contributions by an extra levy of 2s. per week, in order to meet the extra drain on the funds through so many of its members being locked out.

TIN PLATE TRADE.—The closing of works and the general depression of trade amongst tin plate and galvanised sheet makers has thrown many men out of employment at Wolverhampton and the surrounding district.

ENGINEERING TRADE.—The tendency to increasing slackness in the engineering trades of the Lancashire district continues, and, with few exceptions, the local works are rapidly running short of work. In many cases, hands are being discharged or short time is being worked. Boiler makers, however, still continue fairly busy; indeed, this branch of the trade appears to be decidedly well off for work—actual and prospective. Machine-tool makers continue very short of work, and stationary engine builders are, in most cases, getting decidedly quieter. Machinists have a fair amount of work on hand, but the depressed state of the cotton industry is having the effect of checking new ventures, and the prospects in this branch of the trade are none of the brightest. Locomotive builders still report a decided absence of new work coming forward, but they have still a fair amount of work on hand. From the latest returns of the Amalgamated Society of Engineers it appears that, of the total membership of 7,000, 8½ per cent. are in receipt of out-of-work support, with 2½ to 3 per cent. on the sick list, while a similar proportion are superannuated. In the iron trade, little is being done, but still local makers have lately booked a fair weight of new orders as a consequence of the limited production of other districts. In the Tyne and Wear districts, there are a sufficient number of orders standing over until the engineers' strike is settled that will give the members of the Amalgamated Society of Engineers and their fellow-tradesmen, as well as those of the Boiler Makers' and Iron Shipbuilders' Society, employment, which will last for the remainder of the year. The masters have determined that engineers shall no longer be employed on brass work, but brass finishers.

SILVER CUTLERY AND ELECTRO TRADES.—The Sheffield silver and electro trades are generally dull, with little prospect of improvement. Some good orders have, however, been received by individual firms, including a magnificent candelabrum and centre-piece for the officers' mess of a crack regiment. In best cutlery there is very little business, nearly every market showing signs of stagnation, and the trade in common cutlery is proportionately worse. Ivory and pearl are quoted at high prices, notwithstanding the lessened output for handles of knives and the competition on the part of xylonite manufacturers.

CYCLE TRADE.—The Sheffield business in bicycle sections is greater than ever, great attention being given to pneumatic tires. Belgium has two cycle manufacturers, who hold that their wares are superior to anything imported from Britain. This may be doubted, as the fact remains that this country has done a very large business with Belgium this season.

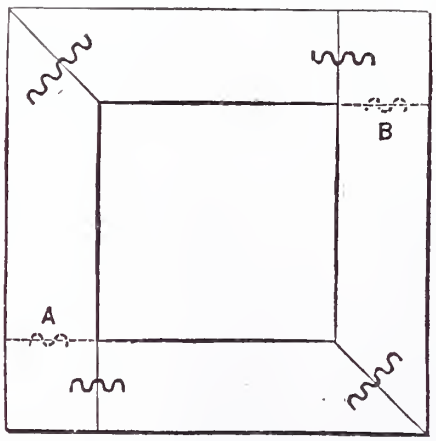
IRON AND STEEL TRADES.—In Sheffield, the producers of Bessemer steel are harassed by the strike in Durham. The coke obtained from that district is all but unobtainable except at high prices, and as this fuel is used almost solely by the makers of Bessemer steel, the effect on the trade may be imagined. Hematites have risen several shillings per ton during the past fortnight. Makers of railway waggon wheels, tires, and axles are full of orders, and, but for the unfortunate stoppage in the North, trade would be prosperous. The stove-grate trade is inactive, but as the builders advance with their many contracts a busy future is anticipated. Makers of agricultural tools and implements are busily employed.

SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

I.—LETTER FROM A CORRESPONDENT.

Framing by Coach-builders and others.—J. C. K. (*Lisson Grove*) writes:—"Messrs. Whittingham & Wilkins, the large coach-furnishing warehousemen, have introduced a simple 'cleat,' or joint fastener, to save the risk of nailing mitres, etc., as of picture-frames, in the edge, which sometimes splits the wood, and sometimes drives the sliding joint out of true fit, unless hored to allow for the hammering sliding the joint out of position. These 'cleats' are of corrugated steel ribbon, very sharp at one edge, so as to be self-penetrating into hard



Frame Cleats.

wood when driven with a hammer on a solid bearing on the under-side of the frame. Various sizes and lengths to suit various jobs are supplied at a small cost. The illustration given will show their application to mitre or lap joints. The dotted lines at A and B show that extra security of joint may be had by driving in others from the reverse side. In carriage window-frame making, and other light framings, they will be useful, as well as to joiners generally."

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Stage Carpentry.—W. H. H. (*New Delph*).—Articles on Stage Carpentry appeared in WORK, Nos. 140, 144, 149, and 154.

Patent.—T. L. (*No Address*).—In reply to question No. 1, no person can legally make any patented article without the licence of the patentee, as this would be an invasion of the patent right and an injury to the patentee. Lord Justice James has laid it down that "The sole right granted by the Crown to make, use, exercise, and vend the invention within the United Kingdom, and the right to have and enjoy the whole profit, benefit, commodity, and advantage accruing and arising by reason of the invention," includes a monopoly of the sale in this country of products made according to the patented process, whether the machine be made in this country or elsewhere. It may be added that the patent, in another part, expressly forbids any person directly or indirectly to make, use, or practise the invention; otherwise it would render the privilege granted by the Crown futile. In reply to question No. 2, a person may, under the new Act, demand a licence from a patentee to work under the patent, and if he demands a price as royalty which is too high, the party wishing to obtain one may apply to the Board of Trade to decide what sum shall be paid. All articles made under a patent must bear the word "Patent," so as to warn the public that it or they is or are made under an exclusive right or privilege, and so give them notice not to infringe.—C. E.

Electro-Plating.—P. L. (*Birmingham*).—In the article on electro-silvering small goods published in No. 112 of WORK, the weights given are troy, but the proportions will be the same if avoirdupois weights are employed. You may employ less silver than 4½ ounces to the gallon, and get good results for a short time; in fact, for silvering small goods with a light deposit of silver, the solution need only contain from one to two ounces of silver in the gallon. A solution thus prepared will cost less, but there is no cheaper method of making a good silver-plating solution than that given in the above-mentioned article. Other methods turn out to be more costly than that given by me.—G. E. B.

Dulcimer.—CAWD-HUD.—The jarring of which you complain may proceed from one or two causes. If you have set your blocks out properly, there ought to be no difficulty in keeping the wires apart, the tension of the strings themselves being sufficient for that purpose. It is as well to avoid notching, or in any way roughening the bridge wires over which the strings pass, as it increases the tendency of the latter to break at that point. If, however, your blocks are so set that the strings *will* get together, notch the bridge wires with a knife edge and a small hammer—a very light blow will suffice for the purpose. The most likely cause of the jarring will probably be found in the fact that the pressure bars are not high enough. You have perhaps made the grooves in which they rest too deep, and consequently the top of the bar is lower than the block itself, so that the strings, instead of taking their bearing *from* the bar, only rest lightly on it. If such is the case, you will be able to move the strings easily up and down, and the remedy consists in putting in a stouter bar, or raising the present one by placing a very narrow slip of stout paper in the groove under it. With reference to your second question, I should not advise you to make an instrument with less than three strings to a note. The dulcimer depends, in a great measure, upon the "sympathetic" notes given off by the strings which are *not* struck, and it is obvious that a reduction in the number of these means a corresponding falling off in the volume of tone. If you strike a single note, and immediately "damp" it by placing the finger on it, you will find you have set into vibration a number of other strings as well, which are, as it were, "joining in chorus," and this will explain what I mean by sympathetic notes. If you still think of making an instrument such as you describe, let me know the dimensions, and I will advise you about stringing.—R. F.

Overhead Motion.—BARBADOS.—The firm of Dell & Co., of Bristol, no longer make lathes. I have a letter from Isaac Dell, in which he says:—"We are not able to undertake the making of the frame for the overhead motion. In the absence of any name, we do not recognise the work indicated on your diagram." I had sent him your drawing, and your signed letter. I should say that the notches at the top of C are intended to catch the pin, D, and so hold up the bar, B, instead of using a weight to tighten the band. The notches in B may perhaps be intended for the neck of a shaft to turn in; I can't imagine what else they can be for. Shaft D is centred, so perhaps it is the one which receives motion from the fly-wheel, and lies right over the mandrel at E, between the tops of the upright standards, A. Then I imagine this shaft, D, might communicate motion to a second overhead shaft, with necks turning in the notches, F, F, in the bar, B, and thus allowing the band between them to be tightened. At G there may be a tie-bar to prevent the screws at E, on which D runs, from thrusting the tops of standards apart.—F. A. M.

Horizontal Engine.—SHOPITE.—Your particular engine of 3⅜ in. by 6 in. is three or four times the power of the ¼ horse-power engine described in WORK, and you may rate it as fully 1 h.-p. You should have a larger governor than the one for the ¼ h.-p. engine, and the one on page 294 of Vol. II. would be about right. You will require a boiler of, say, 22 in. diameter and 44 in. high, with seven vertical tubes, and about 16 square ft. of heating surface. As to your feed-pump, the bent eccentric rod would be a bad plan. I hope you will be able to avoid it by fixing the pump eccentric *outside* the

bearing, and altering the method of fixing the pump, which would be better fixed to the bed-plate that it may not abstract heat from the cylinder. As to the stroke of your pump, if it is *bored out* $\frac{3}{8}$ in., it should be 3 in., which will require a large eccentric; but I hope you mean the *cast* hole is $\frac{3}{8}$ in., in which case you will bore it out to $\frac{1}{2}$ in., and then the stroke will do $1\frac{1}{2}$ in. I reckon thus: area of $3\frac{3}{8} = 9$, 9×6 in. stroke $= 54$ cubic in. of cylinder capacity per stroke, or 108 per revolution. Steam at 38 lb. occupies 500 times the space of water, therefore $\frac{108}{500} = \frac{1}{5}$ gives the cubic in. of water to be thrown by each stroke of pump; as pumps throw about two-thirds their theoretical capacity, $\frac{1}{5} \times \frac{2}{3} = \frac{2}{15}$ cubic in. is the actual capacity, and since the area of $\frac{1}{2}$ in. is ·19 square in., and $\frac{3}{\cdot 19} = 1\cdot 5$, $1\frac{1}{2}$ in. is the required stroke of the pump. It would perhaps be more convenient to have it 2 in. for filling up more quickly.—F. A. M.

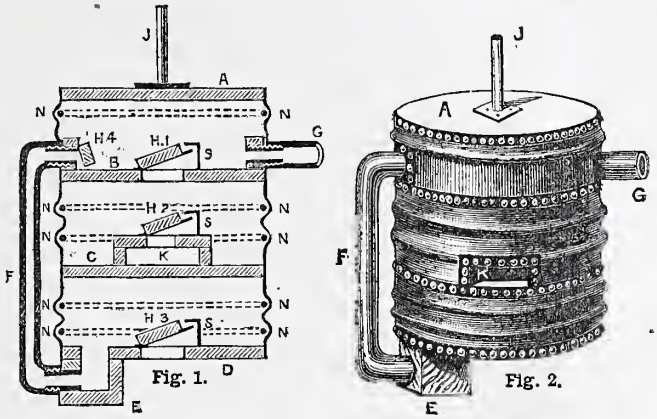
Ball Bearings. — W. D. (*Calne*). — Ball bearing cups and the fixed cones on axles are put in with tinman's solder. The process is thus: The cup to be fitted into the end of a hub should fit neatly, but easy enough to be pressed in with the hand without hammering. The parts must be thoroughly cleaned, then tinned (both socket and outside of cup) with tinman's solder, using as a flux spirit of salt or resin. Then the cup is entered in the socket, and the flame of a blowpipe applied, when the cup will slide into its place, helped, perhaps, by a little pressure. If it does not appear to sit evenly all round, re-heat, and press the high edge. They should be set truly, otherwise the balls will not run freely. The process is the same for a cone on the driving axle.—A. S. P.

Saddlery. — Apprentice to the Trade. — As soon as we can find a thoroughly trained workman capable of writing upon this trade, we shall be prepared to consider a series of articles. —Ed.

Staining and Polishing Whitewood.—Whitewood.—You ask, "How can I stain and polish whitewood?" but give no clue as to the colour you require it, or what wood you wish to imitate; a whole column of "Shop" might be devoted to staining alone. If you will write us again, saying definitely what you require, we shall be pleased to help you. On the subject of French Polishing, Vol. III. of Work abounds in information, both in articles and "Shop." Amongst the former will be found—"The Rubber in French Polishing," "Filling in," "Bodying in," "Spiriting off," etc. You would do well to procure the whole of the numbers, either weekly or monthly. Scarcely a week passes but something appears in its pages in reference to polishing. The process is essentially the same, whether it is whitewood or the more expensive, such as mahogany, rosewood, or walnut.—Lifeboat.

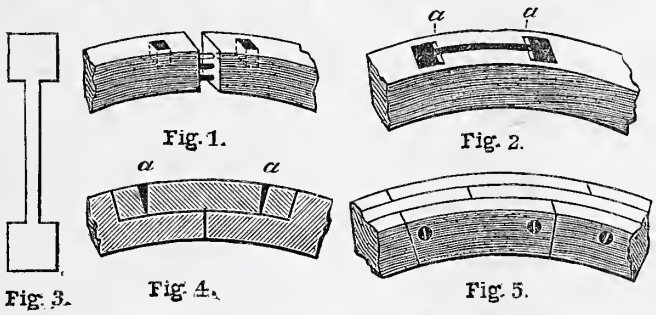
Cellulose Paper.—W. D. (*St. Helen's*). —I think some difficulty will be found in obtaining samples of a paper applicable to the various uses mentioned. It will be admitted by persons who have a practical acquaintance with the wood pulp industry that cellulose is being adapted to a very wide range of uses, but some difficulty will probably be found in placing a sheet of paper on the market capable of being applied, without further treatment, as a temporary covering for roofs, for packing of goods, also as a damp-proof wall-paper, as a production suitable for maps, and a material impervious to water, and absolutely fire-proof. These claims for one particular sheet can hardly be regarded as feasible. It is true, however, that wood cellulose (treated by various processes) is being adapted to all kinds of purposes, and that it is an important factor in many of the industrial arts. I should imagine, if the paper in question had any existence at all, that an imitation parchment made from cellulose was meant. These so-called parchments, which are sold under prices obtained for real parchments, are claimed to be grease-proof, and suitable for wrapping and covering purposes generally. Imitation parchments are made at a large number of mills on the Continent and in this country: notably by the Ekman Pulp and Paper Co., Northfleet; Olive & Partington, Glossop; and the Hythe End Paper-mill Co., Staines, Middlesex. The writer recently had under his notice a process (credited to a German firm) for making a non-inflammable paper for lining walls, floors, ceilings, etc. The ingredients recommended were: 40 parts paper pulp, 10 parts alum or sulphate of iron, 10 parts graphite, 25 parts infusorial earth, 15 parts asbestos, 15 parts water glass. The whole is well mixed and passed through a mill. After drying, both sides are covered with water glass.—F. G.

Double Draught Bellows for Portable Forge. —A. E. W. (*Pershore*).—There are many kinds of double draught bellows, but the one I shall describe is perhaps the simplest to use with the forge described in Work, Vol. III., No. 149, pages 705 and 706. The accompanying drawings will, I hope, make the arrangement quite clear to you. Fig. 1 shows the bellows in section. In this case there are four round boards, A, B, C, and D. The two boards B and D are fixed, and the boards A and C move up and down, the links from the cranks and handle being attached to the board C, in the same way as they are attached to the centre board of the bellows described in connection with the portable forge. The action is as follows: On lowering the handle, the board C will rise, driving the air before it through the valve H^1 into the top compartment, at the same time drawing the air through the valve H^3 into the lower compartment. On raising the handle, the board C will fall, forcing the air down through the wood block E up the pipe F, and through the valve H^4 into the top compartment, at the same time drawing the air through the valve H^2 into the middle compartment. This action is repeated at each either upward or downward movement of the handle. This will force the air through the outlet G in an almost continuous stream. What jerks or irregularities there may be in the flow will be remedied by the rising and falling of the top board A. The bellows are fitted up as described in the article on a Portable Forge, and I think A. E. W. will now have no difficulty in constructing it.—Cyclops.



Double Draught Bellows. Fig. 1.—Section showing Valves, Tubes, etc. Fig. 2.—General View of Bellows.

Semicircular Sash.—Stoke.—There are three or more ways in which a semicircular head or top rail to a sash can be joined. (1) The segments can have a butt joint, with one or two dowels to prevent lateral movement and a handrail screw to draw the parts together. This is good for hard wood sashes. (2) The segments can have a central chase or groove with a tongue of *hard wood* inserted. This tongue can be made "hammer-head" at both ends, like a capital H (see Fig. 3), with an extra long bar to join the uprights. This is good for deal sashes. (3) The top rail can be built up of thin segments, arranged so as to "break-joint," glued and screwed together, and the moulding bent to shape, and fixed after the built-up rail has been properly cleaned off. This would be appropriate if only a small part of the vertical surface is exposed or when the sash is of deal, veneered. There are, doubtless, other ways than these, but these will suffice. As to the scale drawing, of course 1 in. to the foot is not the same as 1 ft. to the inch. In both cases it is left to the reader to supply the missing words. It would be correct to say the drawing is 1 in. to the foot, and it would be understood that the "foot" refers to the object, which object, of course, would be 1 ft. to the inch. As to the marks, ′, ″, they were formerly intended to indicate minutes and seconds of *arc*, but they have often been wrongly used to indicate minutes and seconds of *time*, and they have been now wrested from their true meaning to express feet and inches, which is to be regretted, but it is too late now to resist.—B. A. B.



Semicircular Sash. Fig. 1.—Joint made with Handrail Screw and Dowels. Fig. 2.—Butt Joint, with Hammer-head Tongue; Wedges may be inserted at *a*, *a*, if required. Fig. 3.—Plan of Hammer-head Tongue, to be made of hard wood. Fig. 4.—Section of Fig. 2—*a*, *a*, Spaces for Wedges. Fig. 5.—Top Rail built up in Segments.

Profitable Home Work.—A. M. (*Hastings*).—With no information as to what your capabilities may be, it is impossible to give you any satisfactory answer. *Profitable* employment is only to be had by those who have the special skill required to produce something which is in demand. Unskilled labour—the work which anybody can do—must always, as a rule, be poorly paid. As an evening fireside occupation, some persons within the range of my acquaintance have worked at netting. Anyone of ordinary intelligence can learn to net in an hour; shuttles and meshes are easily made, or may be bought for a few coppers; and there is always a demand for garden nets, fishing nets, tennis nets, etc. For such simple work, however, high pay is out of the question. Still, if you have not the skill to do better, the hint may be of use to you.—A. Y.

Rearer.—T. R. M. (*Wallsend*).—The address of Messrs. Winchcombe is Leonard Stanley, Gloucestershire; and the price of the small rearer is 6s. 6d.—Leghorn.

Oil Gold Size.—Bonâ Fide.—This is another painters' product which, although — like varnish making — easily understood, can seldom be prepared with economy and success by the individual. The quality of good *oil* gold size lies in its being easily workable, drying in about twelve hours, and keeping its "tack"—the scarcely perceptible stickiness of surface, but which is ample for retaining the delicate gold leaf—for some days, and its brilliancy always. It consists of "fat" linseed oil, usually termed "fat oil," which becomes so by age and exposure to atmosphere. Fat oil is also prepared artificially—by heat. This fat oil is the chief factor; it gives us something that will dry, that can be spread to a very thin coating, and yet give much gloss, and at the same time be "tacky" when varnish would be quite dry. To give it a little more body, and to colour it for manipulating purposes, the finest yellow ochre is ground with it. The two form a stiff paste. The value and quality of the product depend much on the fineness of the grinding. It is then thinned for use with either fat oil, boiled oil, or finest copal varnish, or even all three, according to the time it is wanted to dry in and keep its "tack." These points have to be tested before the size is given out for direct use. Many eminent varnish-makers send out an oil gold size thinned to a liquid form, and ready for use. That made and sold by the well-known Mander Bros. is a splendid article, and it would be far wiser to purchase this from them than to buy the paste and dilute it yourself, with the chance of getting on the wrong tack altogether. As to making it—don't; rather thank your stars you do not live in the days of "mullar and stone" colour grinding.—Decorator.

Gold Picture Frames.—C. W. (*Openshaw*).—(1) Mastic varnish is the best, if used in the following manner: Lay your frames flat on a table in a room where no dust can possibly get at them. See that no particle of dust is in the crevices of the ornament, then go carefully over them with a good camel-hair brush, care being taken to spread it evenly, and not to go over the same parts more than once or twice. Let them lay so that it does not run. They will wash, and preserve their brilliancy for years. (2) To repair damage, use white of an egg on parts where gold has come off, or a little gelatine. When nearly dry, lay gold-leaf, and press on with wool until it sticks. When dry, rub off with wool superfluous gold, and varnish with other parts, which will make it smooth with other parts. (3) To clean oil paintings, boil a leek in two gallons of water. When cool, wash paintings well in it, and rub dry with soft silk cloth. When dry, rub a little boiled oil in with the palm of your hand, as you can feel any grit there may be: which remove, in case of scratching paintings. You will find oil restore colour to its former hue, and prevent, in a great measure, cracking.—G. H. R.

Medical Coil Core.—W. T. K. (*Darwen*).—Some makers of medical coils employ a core of rolled soft iron, but the cores in general use for all coils are made of soft iron wires bound up in the form of a round bundle. Steel would be altogether unsuitable, because it would become permanently magnetic, and hard iron is open to the same objection. The best inductive effects are obtained from the core of a coil when it can be readily magnetised, and as readily deprived of the magnetic charge. I know of no book on this subject. You will find something about it in the last chapter of the series on Coils appearing in Work.—G. E. B.

Hot-Air Engine.—W. L. P.—You cannot make a Robinson hot-air engine, as it is patented. If you want to make one, I advise you to make a small one on the Seal pattern first, and experiment with that. I have made a working drawing of one of that kind, with an 8 in. working cylinder; but as this engine

has never been made, I cannot feel certain it would work well, otherwise I would have submitted it to the Editor before this; but I should not like to have anyone go to the expense and trouble of making the engine, and then, finding it needed alterations, be able to say that WORK had misled them. The main dimensions are: cylinder, 8 in. diameter, 8 in. stroke; heater cylinder, 24 in. diameter; stroke of displacer, 3½ in.; depth of displacer, 12 in.; crank-shaft 1¼ in., and 1 in. necks. Flame plays upon the bottom plate of heater, which is renewable.—F. A. M.

Quarter Horse-Power Steam Engine.—LIMITED MEANS.—Articles on the above appeared in WORK, Nos. 106, 110, 121, 125, 131, 136, 141, 145, and 149.

Xylonite.—TIP and other correspondents ask for the address of H. B. (*Leeds*), who sells xylonite in small quantities. H. B. should keep his address in our "Sale and Exchange" column.

Working Model.—C. H. W. (*Erith*).—You had better begin utilising your clockwork wheels and springs yourself, and see how far you can produce the "up and down motion" model yourself. When you come to a real difficulty, then write again. Tax your own powers a little first, and reason things out for yourself. Then some day you may be able to invent; but don't expect to borrow other people's brains in a too wholesale way.

Photo Materials.—A. B. (*Blackburn*) had better purchase a set of good quality rather than the low-priced articles, whose only recommendation is the small cost. With a *good* set, which need *not* be expensive, there is freedom from many troubles engendered by badly-made work. We should advise the purchase of a half-plate set of as good quality as convenient to purchase. Of the lower-priced goods, Lancaster's are as good as any, and procurable from any dealer, or direct from Lancaster, Birmingham. A good single lens and a good rectilinear should be included in the set. We suggest half-plate size in preference to quarter-plate, as the pictures taken on half-plates look so much better for everything except lantern slides, and give more satisfaction generally; also, by getting used to working half-plates it is much more easy to work larger sizes, if required, than if the attention had been given to quarter-plates. The cost of the complete set need not exceed £6 or £7; the principal outlay is in the lenses. By using cheap lenses—which we certainly do not recommend—the cost may be much reduced.—D.

Revolving Photo Album.—T. W. (*Glasgow*).—The revolving album consists of a box with glass top and bottom, divided into four cells, and of a suitable size to contain the photographs, whether cabinets or cartes-de-visite. The division running from side to side between the top and bottom has a space left sufficiently large for the cards to slip through one at a time. Sometimes small frames are provided to each contain a card, or two back to back. This case revolves between uprights fixed on a stand, and the motion accelerated by a little shake, causing the top cards to slip to the bottom cells, to be in turn covered with those next in rotation. The cards must only be placed loosely in the case, and be quite flat.—D.

Castings of ½ to ¾ Horizontal Engine.—READER.—The ½ horse power engine will give out ½ horse-power, but if that is not sufficient, and you wish for a still larger size, you might try Messrs. Lucas & Davis, Charles Street, Hatton Garden, London; or Gladstone & Co., Riddings, Alfreton, Derbyshire; or E. S. Hindley, Bourton, Dorset.—F. A. M.

Greenhouse Construction.—D. T. (*Liverpool*).—These articles appeared in Nos. 12, 14, and 15 of WORK.

Experimental Physics.—C. H. (*Ipswich*) asks for the name of a work on the above subject which also describes the mode of making the apparatus employed. Undoubtedly, the best work which fulfils these conditions is Weinhold's "Experimental Physics," theoretical and practical, containing directions for making physical apparatus and for making experiments. This is a work of some eight hundred pages, and is illustrated with over four hundred cuts. Published by Longmans & Co., Paternoster Row, London; price 31s. 6d.—C. A. P.

Electric Belts.—CRIPPLED.—For an electric belt, consult the advertisers in WORK; or Mr. Atkinson, surgical mechanician, Mill Street, Hanover Square, W.

III.—QUESTIONS SUBMITTED TO READERS.

*** *The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Water-Whee'.—W. S. (*Leeds*) writes:—"I wish to make a small turbine water-wheel. Can any reader help me with patterns, etc.?"

Model Locomotive.—E. W. L. (*Newcastle-on-Tyne*) writes:—"Will any reader kindly give me the names of most suitable books on model locomotive building?"

Knee-hole Desk.—H. L. (*Oxford*) writes:—"Will some reader of WORK please tell me where I can get working drawings of a knee-hole desk, and their probable cost, or instructions as to putting it together? The desk to be made of pine or American white wood. The size of top to be about 1 ft. 10 in. wide by 3 ft. 6 in. long."

Clock Case.—CLOCK writes:—"Would some reader of WORK give me a design in 'Shop' for a small clock case in walnut and ebony for a small lever clock—dial, 4 in. in diameter?"

Fish-Frying Fittings.—C. W. (*London*) asks "How to make and fit up a fish-frying and potato copper, as used in the fried fish trade."

Waggon Brakes.—INCLINE BRAKESMAN writes:—"Would any reader kindly inform me of any appliance to slip between brake-block and wheel of waggon during wet weather (on an incline) to work with more safety?"

Model Screw Steamship.—A. B. (*Leith*) writes:—"Would any reader kindly inform me as to the making of a model screw steamship, say, 30 in. long? I should like to know the depth and width, and if two or three propellers are the best; also what kind of wood to build it with."

Upholstering Cheap Furniture.—J. E. B. (*Epworth*) writes:—"Will some reader kindly inform me how to do the above? I cannot get the buttoning to look like the factory-made furniture. Are the buttons put in before the leather is finally tucked down—the way the leather is creased in couches, etc., gives me that impression? I never can get my buttons deep enough."

Long Boots.—V. L. (*St. Leonards-on-Sea*) writes:—"A pair of riding boots are rather too long in the toes, which are blocked, but without caps. Can they be easily shortened, and how?"

Rand Drill.—J. J. T. (*Liverpool*) will thank any reader for the English address of the American rock drill called the 'Rand.'"

Composition.—F. M. (*London*) writes:—"Would some kind reader inform me how I can make a composition suitable for making small bagatelle balls?"

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Rock Boring Drills.—M. (*Bishop Auckland*) writes to MONT CENIS (see No. 151, page 750):—"There is a very good hand-power machine for rock boring made by R. Wilson & Sons, Bishop Auckland."

Venetian Blinds and Glass Mending.—M. (*Bishop Auckland*) writes to H. R. (*Chacewater*) (see No. 151, page 750):—"A good cement for glass and china is made by a saturated solution of isinglass in pyroligneous acid. Venetian blinds are made by A. Lewis & Co., St. George's Road, Peckham. They would supply you with the laths."

Damp Ceiling.—G. A. H. (*Leeds*) writes to J. W. S. (*Guernsey*) (see No. 158, page 30):—"I can recommend to his notice a paint called 'Vanguard,' which is effectual in resisting the damp from protruding, once it is applied. It dries rapidly, and after it is once dry the ceiling or wall can be whitened or papered. I have seen it applied to a damp wall, and the result is grand. It closes the pores of brick, slate, wood, and stone work, keeping it dry, sweet, clean, and making it last much longer."

Glass Blowing.—E. M. K. & Co. (*Mountjoy Place, Dublin*) write to GLASS BLOWER that they are manufacturers of scientific glass instruments, and carry out inventions of all kinds for scientific glass blowing.

Single Needle Instrument and Battery.—T. B., JR. (*Brooks's Bar*) writes to TELEGRAPHIST (see No. 155, page 814):—"You would find the ordinary Leclanché battery the best for your purpose, as it requires so little attention. It is much cheaper to buy the cells you require, the number depending on the length of your wire."

Oil Light.—M. (*Bishop Auckland*) writes to G. C. (*Pendleton*) (see No. 154, page 798):—"The Wells light is made in various sizes by A. C. Wells & Co., 105, Midland Road, St. Pancras. If you write them, you will get all particulars."

Glass Cement.—EDDIFRA writes to A. S. (*No Address*) (see No. 154, page 798):—"Try indiarubber cement made to the following recipe: 1 part indiarubber, 3 parts mastic, 50 parts chloroform. Let it stand several days at a low temperature to dissolve the cement. It must be applied rapidly."

Lettering Coffin Plates.—H. A. W. (*Holt*) writes to H. E. L. (*Stockton*) (see No. 155, page 814):—"I do a great many in my business, and find the best way is as follows: Write on the plate in pencil what you require; then fill in with sable-writer dipped in gold size, and then sprinkle over it gold bronze powder with camel-hair brush, when you will find it will stick to the size, and form the letters already painted on the plate."

Engraving on Brass and Metal.—W. J. B. (*Londonderry*) writes, in reply to NELSON (see Vol. III., No. 150, p. 733, of WORK):—"A piece of 12 or 14 wire gauge brass—the size required for plate—is first procured; on this the design or inscription is drawn in ink. The plate is then firmly screwed down on a block of wood about 4 in. or 5 in. thick, and the letters chipped out with a steel chisel. After the letters are properly chipped, the plate is unscrewed from the block and planished on an anvil, and afterwards filed perfectly level with a large smooth file. Lines are then drawn at bottom and top of letters, after which the plate is placed on an engraver's sand-bag and finished—*i.e.*, the letters made regular with a large-size square graver. The plate is now heated over a gas-jet, and engravers' wax rubbed into letters. This wax is drawn off with a heated iron—a plane-iron will answer the purpose. When the plate is cool, the superfluous wax is removed with water and pumice-stone, after which emery paper may be used to give the brass a grain. Final buffing materials are rottenstone and sweet oil. Brass coffin plates are riggled—*i.e.*, a lozenge graver, rubbed down on the face to the necessary breadth, is held to the plate at a slight angle, and gently pushed forward, accompanied by a rocking motion of the hand. There are many other branches of engraving on metal, but I apprehend brass engraving is what NELSON wishes to know about. Some particularly interesting and lucid papers appeared in WORK a good while back on Heraldic and Inscription Engraving; I should advise NELSON to procure the back numbers and read them. Many professional engravers have been greatly benefited by them. I am sorry to say good writing is not of much service to an engraver; many crack engravers, like literary celebrities, are but indifferent writers."

Lantern.—CAROLUS REX writes, in reply to E. H. L. (*Leicester*) (see WORK, No. 157):—"What you want is what is known as a 'light box.' Roughly speaking, it is a cheap and ready magic-lantern, but without the objective. It is used to produce the so-called limelight of the stage. It consists of a box, in the front of which is a condenser, and the usual way to throw colours is to employ a disc divided into four sections, each of which is a different coloured glass—red, blue, etc. By revolving this disc slowly before the condenser, the gradations of colour may be made. Purple, for instance, is produced by having half red and half blue before the light. It will be useless to try any other method of illumination than the oxy-calcium or some such powerful light. Get any lantern catalogue; you will find it illustrated."

Brass Polish.—CAROLUS REX writes, in reply to QUILL-DRIVER (see WORK, No. 157):—"Your brass goods were presumably old stock, which your ironmonger had been 'cleaning'; in doing so he had removed all the lacquer—that's all. Your embossed portions you must remove, as they will require to be treated in a weak acid bath. Then dry with sawdust after washing, and apply *cold* lacquer with a flat camel-hair brush. Both lacquer and brush can be had at any drysalter's. Any parts not embossed clean with any good brass polish or Monkey soap, and afterwards lacquer. Never mind if the lacquer looks milky when applied, so long as you don't go over the same part twice; hold the articles near the fire, and the milkiness will disappear. When lacquered, your brasses ought not to require any cleaning—or, at any rate, not for a very long time, when the cleaning and re-lacquering should go together."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—E. P. B. (*Penge*); H. P. (*Langley*); C. G. Y. (*Glasgow*); R. R. T. (*Frome*); A. H. (*Thrapston*); A. B. (*Newry*); F. W. H. (*Weedon*); J. B. (*Crawfordsburn*); W. S. (*Inverness*); A. E. K. (*Aston*); E. D. (*Krugersdorp, S. Africa*); SPOT; MICRO; R. S. H. W. (*High Wycombe*); F. J. G. (*East Molesey*); J. D. (*London*); W. H. (*Plaistow*); TIGER; J. R. (*Glasgow*); T. E. W. & SONS (*Birmingham*); W. F. P. (*Chalk Farm*); G. P. (*Sheffield*); S. M. L. (*Goderick, Canada*); P. C. R. (*Clapham*); A. W. G. (*Jersey*); P. J. (*Mountain Park*); J. M. P. (*Nottingham*); R. P. (*Paris*); J. H. (*Newton Moor*); W. P. (*Dartford*); C. G. M. (*Penistone*); R. D. (*Lewisham*); A. I. J. (*Tipton*); NEW READER; W. A. (*Kentish Town*); OLD MAN; J. A. (*Smallheath*); W. B. (*Queensbury*); J. D. B. (*Ilkeston*); CLAUDON; CARDIFF BOY; S. L. (*Chipping Norton*); SAINT MUNGO; C. S. (*Derby*); PERPLEXED; W. E. L. (*London*); READER OF "WORK"; W. E. C. (*Londonderry*); W. F. C. (*Coventry*); OLD READER.

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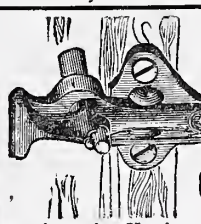

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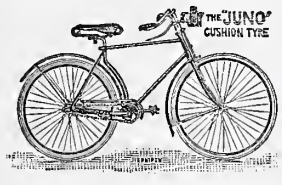

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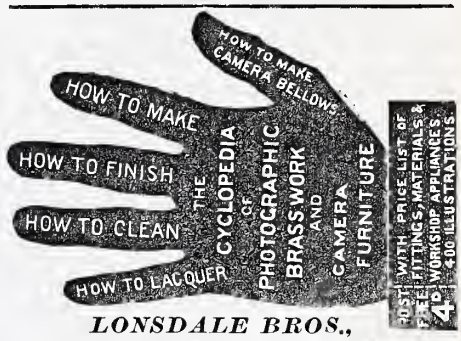

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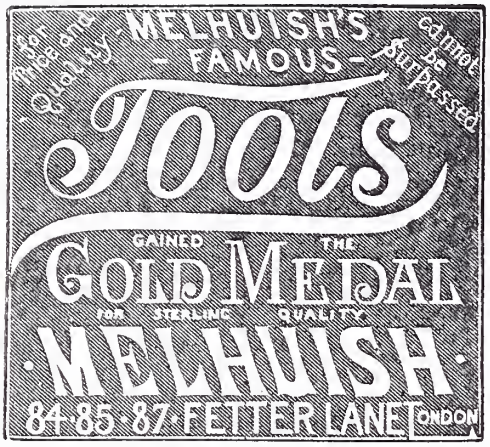

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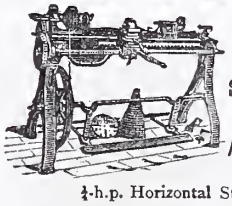

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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Vol. IV.—No. 164.] SATURDAY, MAY 7, 1892. [Price One Penny.

WORK WORLD.

An electric tricycle has been invented that will carry three persons one hundred miles for one shilling. This is the electrical expense—no other!

* *

Pahang mahogany is recommended to amateurs as being easy to work and free from knots. It has little or no figure, but can be used for many purposes. It is cheaper than mahogany, being about 6d. to 7d. per foot super.

* *

A Birmingham bicycle maker has patented a new form of crank which is reported to be a good thing. It is of the detachable variety. The improvement consists in the cutter pin—usually driven tight—being actuated by a screw, no hammering proving necessary for the driving out process.

* *

A new lamp for burning either petroleum or tar oil as required has been introduced. The burner is made of steel, and has no tubes to become filled with deposit from combustion, thus obviating one of the great drawbacks in other lamps. They are made in sizes varying from 500 to 2,000 candle-power.

* *

In high-class French clocks all the ornamental parts are being hand engraved instead of the pressed and chased ornament which has hitherto prevailed. This Paris lead in ornamental work and decoration for clocks should be the advent of a good time for the long-suffering ornamental engravers of London, Birmingham, and Sheffield.

* *

We shall probably soon be in a position to prove the maximum size of gas engine which can be worked economically. A maker has recently completed an engine to develop 60 h.-p., and this has been considered by many to be near the limit of efficiency of this type of engine. Further experiments in this direction will be awaited with interest.

* *

A new invention for the prevention of the bursting of water pipes through freezing seems to be simple. It consists of the insertion into the pipes, at suitable places, of a slender rod of prepared cork encased in thin lead. The cork is compressed by the expansion of the water in freezing, thus saving the strain on the pipes.

* *

Readers of Work should be well represented at the exhibition of swords, bayonets, shields, repoussé, chasing, and all kinds of metal work to be held next week by the Armourers' and Braziers' Company at their hall, Coleman Street, London. There is a rich prize design to be furnished for the certificate in connection with the awards, so that ample scope has been afforded by the Company for rising merit.

* *

A well-known Tyne shipbuilder gave recently some extraordinary figures relating to the bye-products obtained from smoke. The total cost of the fuel exerted was £31, while the value of sulphate of ammonia obtained from the smoke arising from it was £48! Such a result should induce plodding coal consumers not only to husband their own smoke, but turn it at the same time to a similar profitable account.

* *

In the crucible steel trade of St. Petersburg, the wages of the workmen in each shift are as follows:—Head-furnace man, 4s. 9½d. per shift; crucible drawers, 3s. 2½d.; muffle-furnace man, 2s.; head man at gas-producer, 2s. 3½d.; fireman, 2s. As the wages are paid in paper money, their purchasing power is, of course, less than that represented by the nominal equivalent in currency.

* *

American railway managers are now working hard to realise, in time for the opening of the Chicago Exhibition, their dream of running a train from New York to that city in sixteen or seventeen hours. With regard to the increased risk of accident from greater speed, managers are inclined to the belief that the faster a train ran, the more likely would it be to derail any impediment on the track. This our "cousins" will doubtless prove in the Exposition season.

* *

Active measures are now being taken for the establishment of an Engineering Exchange in London, and a provisional committee has been appointed to make arrangements for the erection of the necessary buildings. It is somewhat astonishing that we have gone on so long without such accommodation when the magnitude of the business done in London in this direction is considered, for not only are there upwards of 1,000 constructive firms in and about the metropolis, but nearly all the large provincial firms have their representatives in the City or in Westminster.

* *

It is claimed that an automatic condenser for steam engines has been invented, but so far we have obtained no satisfactory account of its practical outcome. The most striking characteristic of this apparatus is that it is asserted to be self-acting; there is no cold water to be used, the steam in some mysterious way condenses itself on coming into contact with a closed cycle current of *hot* water. Of course, if this is the case, all the condensation water will be saved, and we shall look forward with interest to see so desirable an end attained. In the meantime, it is startling to hear of steam being condensed by interaction with a small quantity of hot water. Still, we are open to conviction.

* *

Since fancy stones—that is, the more uncommon varieties of sapphires, jargoons, etc.—have been in request, there has been a pretty sharp look-out for uncommon gems. Now to those interested in such matters, the place where a new gem can be seen may prove worth noting. It is at the Museum of Practical Geology, in Jermyn Street, W., and the stone is called a beryllonite; it is an American gem like the hiddenite, but does not possess the beautiful colours of that gem. The new gem is white, and is interesting to connoisseurs on account of its composition, which is an anhydrous phosphate of beryllium and sodium. To judge by its appearance at night, it will not supplant any of our old gems. Should any jeweller have one to set, he must exercise care, as it very easily splits. It is, in fact, as quickly damaged as a sphene, and that is saying something. These two stones are good examples of cleavage—in fact, too good for those that have to set them.

An aluminium launch, the motor of which is a naphtha engine, has been constructed by a German firm. Only the hull is of aluminium; yet this makes the boat 35 per cent. lighter than usual. The exterior is polished, and the smoothness gives a considerably greater speed than could be obtained from a steel or wooden launch of the same dimensions and engine power.

* *

It is proposed to substitute an electro-magnetic hammer for the ordinary steam hammer. The piston is of magnetic material, and the cylinder is composed of a series of coils, through each of which an electric current may be passed separately. The passage of an electric current through the coils forming the upper part of the cylinder raises the piston into the magnetic field thus formed, and by cutting off the current, and simultaneously transferring it to the lower coils of the cylinder, the piston is released, its fall being accelerated by the magnetic attraction created below.

* *

Electric welding, invented by Professor Elihu Thomson, in 1886, is now a rapidly developing industry. All kinds of metals and alloys can be joined electrically, and joints can be made between metals and alloys of dissimilar kinds. The process consists essentially in applying the two pieces of metal to be welded together, and passing a strong alternating current through the juncture, when the intense heat, due to the electrical resistance at the break, which is greater than at any other part of the conductor, fuses the surfaces. At the instant of welding, it is found best to exert considerable pressure upon the joint, ranging from 600 lbs. per square inch in the case of copper, to 1,800 lbs. per square inch in that of steel. This process is likely soon to find vent in the direction of a new carriage, cab, and cart wheel, which should work wonders in the wheelwrighting trades. The system was privately exhibited in Birmingham recently, when a number of gentlemen connected with the cycle and kindred trades had an opportunity of witnessing the operation. It cannot fail to be of vast service in cycle building and other trades where small weldings and a large amount of brazing are required.

PRINTING ON BROMIDE PAPER.

BY G. P.

Introductory—Artistic Qualities of Bromide Paper—The Method—Where to Procure the Paper—Exposing the Paper.

Introductory.—It is a common complaint amongst amateur photographers, particularly those who are engaged most of the day and have only a few hours in the evening which they can devote to their hobby, that some of the processes connected with the production of a finished print are too protracted—some say "tedious." This objection may, in all its entirety, be urged against the process of silver printing. Silver printing may be said to date as far back as 1777, when photography was an unknown art. In that year Scheele, the celebrated chemist, discovered that chloride of silver blackened when exposed to light. In 1802 Thomas Wedgwood described a process of making profiles by its agency, and in 1839 Fox Talbot announced to the Royal Society a method of "Photogenic Drawing," in which pictures were produced upon paper prepared with the compound. Since then silver printing paper has advanced but little towards perfection, and, although it is perhaps most used in the present day, it is lacking in many ways. Shortly after the revolution in the photographic world caused by the advent of gelatine plates, a firm of manufacturers introduced a printing paper coated with an emulsion of bromide of silver in gelatine. This paper, known as "bromide paper," has many qualities to commend it, not the least of which is the rapidity with which the whole process may be completed. Some people aver that they can turn out thirty bromide prints in one hour. It is better not to be in quite such a hurry, however. Again, the process may be worked by artificial light, and will therefore commend itself to those who, being engaged most of the day, have generally only a few hours in the evening to spare for attention to photographic pursuits.

Artistic Qualities of Bromide Paper.—Dr. P. H. Emerson condemns bromide paper as "false in tonality, the blacks being too black, and the whole picture lowered in tone"; and there can be no doubt that when worked according to the crude formulæ sent out by the makers, its range is comparatively limited. On the other hand, Mr. Andrew Pringle maintains that "the most expert judge cannot at all times distinguish between a platinum print of good quality and a bromide print, provided he cannot manipulate the surface or scrutinise it in an unusual way—in other words, provided the prints are framed." The facts seem to be that bromide printing has never had fair justice done to it by the makers, who send it out with vague and unscientific instructions for use; for the fine prints of lake scenery by Green, of Keswick, show of what good results the bromide process is capable. Now, bromide prints are certainly very much like prints done by the platinotype process, and I, for one, would not on all occasions undertake to distinguish between them. Platinotype, and therefore good bromide, prints are generally considered to be the most artistic in tone of all photographic prints. They have, to begin with, a dull, or matt, surface, and the tone of the picture is like that of copperplate engraving. The only reason why the bromide and platinotype processes do not make greater headway is because the general public prefer something bright and shiny for their money. The bromide paper has the advantage of platinotype in that it can be worked by artificial light, it is much cheaper, and it is far easier to work.

The Process.—The process is a development one—*i.e.*, the image is latent, and requires subsequent treatment, as in a negative. The paper is coated with an emulsion similar to that used for coating dry plates, and almost as sensitive. It is usually made in four grades: smooth slow, smooth rapid, rough slow, and rough rapid. The slow kind is suitable for both contact printing by artificial light and for enlargement by daylight; the rapid, for enlargement by artificial light. The question of surface is one of taste only, though rough is preferable for large work. The cost for all varieties is about 6d. per dozen sheets, ¼-plate size; ½-plate, 1s. 2d.; whole-plate, 2s. 3d.; 5 in. by 4 in., 9d.; and 8 in. by 5 in., 1s. 9d. The prices of the different makers vary slightly, but the above are about the average.

Where to procure the Paper.—Naturally, we will first of all have to obtain our bromide paper, and this we purchase ready cut for use, as fingering the surface would ruin it. There are many makers, but I have not found one paper specially better than another. The principal brands are: Eastman's; Ilford; Fry's "Argentotype"; and Mawson's; manufactured and sold by the following makers respectively: The Eastman Dry Plate and Film Company, The Britannia Works Company, The Fry Manufacturing Company, and Messrs. Mawson and Swan. Probably the best plan would be for the amateur to procure the paper from the maker whom he is in the habit of buying other goods from. If this paper did not suit him, he might then try each of the other makers in turn, until he gets a paper which suits him; for, because one brand works well with one person, it does not follow that the same brand will work well with another person, or that a different brand will give as good results in the hands of that person. That there is individuality in photography, no one who has studied the art to any extent can possibly deny. How to define it is another matter. It would almost seem as if the essence of one's taste and personality was concentrated in the tips of one's fingers, and was diffused into the developing and toning baths, influencing the plates and prints, and giving them a character of their own.

Exposing the Paper.—Before opening the packet of paper, the negative must be placed in the printing frame, and the film cleared of dust with a camel-hair brush or soft handkerchief. The packet of bromide paper is then opened similarly to an envelope: of course, this must be done in the "dark room." It will be found that the paper is enclosed in three or four envelopes, the flap of each of which is inserted at the bottom of the envelope containing it. This is done to prevent any chance of light having access to the paper; and it is necessary to be particular that no light does get to it; for, as already stated, the emulsion with which the paper is coated is almost as sensitive as that with which dry plates are coated. The packet having been unfastened, we take a piece of the paper and lay it on the negative. If any difficulty is experienced in distinguishing the coated side, it is only necessary to notice which side of the paper *curls inward* when it is taken out of the packet: this side is the coated side. The paper having been placed in the desired position on the negative, the printing frame is closed in the usual manner, not omitting to insert a few folds of blotting-paper or a felt pad between the paper and the back.

The printing frame should then be exposed to the light of a kerosene lamp or gas, a sheet of ground glass or a frosted or opal globe being interposed to diffuse the light evenly. The distance from the lamp is generally two or three feet, but should be altered according to the tones required, always remembering that *doubling the distance quadruples the exposure required: e.g.*, if a negative placed 1 ft. from the source of light requires an exposure of twenty seconds, when placed 2 ft. from the source of light the same negative will require eighty seconds of exposure. A long exposure should be given for light tones,

and a weak developer should be used; while for dark tones give short exposure, and make the developer strong, using at the same time a larger proportion of bromide. It is somewhat difficult to judge the printing qualities of a negative without actual trial, which may be made in the following manner: When taking a trial print from a new negative, expose the whole surface for only half the estimated time; then shield off two-thirds of the plate, and give another half-time; and finally, shield the last third of the plate, and give another half-time. The several portions of the resulting print will then have received half, full, and one-and-a-half times the estimated exposure, and on being developed it will be seen which portion was correctly timed. For ordinary bromide printing, the best plan is to give comparatively long exposure and use a weak developer, with somewhat more bromide solution than is generally prescribed; but as the addition of bromide to the developer markedly increases the contrast in the print, it should be added with caution.

One of the great advantages of bromide paper is its power of admitting of compensation in the case of a bad negative; thus, a negative, too thin to be used for silver printing, will give a good print on bromide paper by exposing 6 or 8 feet from the flame; again, a negative with strong contrasts, which would only give a sooty and chalky silver print, will generally give an excellent bromide print by exposing close to the flame—say about 3 inches from it. A very good average distance to work at for an ordinary good negative is 2 feet. Once you have found the correct exposure for a certain negative, it should be noted, together with the distance from the light, in a notebook kept for the purpose.

Our friendly Editor now reminds me that he prefers short articles, so as to interest more readers in each single number of WORK, and that I must either draw to a close quickly or leave the remainder until another number. The former I cannot do, for quickly must mean imperfectly, so, by his lenity, I take the latter alternative.

HAND-WORKING OF SPECULA FOR THE NEWTONIAN TELESCOPE.

BY EDWARD A. FRANCIS.

HOW THE SPECULUM MAKER WORKS—THE OLD METHOD AND THE NEW—THEIR SIMILARITY AND DIFFERENCE.

As the simplest way to convey a general idea of the process of speculum making, we shall rapidly examine the method followed by the old workers in metal; for the modern method of working is identical in principle with that of the seventeenth century.

In the centre of the workshop stood a small, firm bench, or post, or barrel, of such dimension that the workman could walk quite round it, and reach over to every part of it without effort. In the centre of this bench was placed the first convex tool (Fig. 3), formed of the same metal as the speculum. Moistened emery was spread on this tool, and the concave metal was worked in every direction over it, until the surface became sufficiently true and smooth. The furrows in the tool, and the little central depression, allowed the abrading material to circulate freely and cut evenly. A second tool (Fig. 4), made of small squares of hone arranged on a convex basis, was then substituted for the first, and with this the speculum was fined ready for polishing.

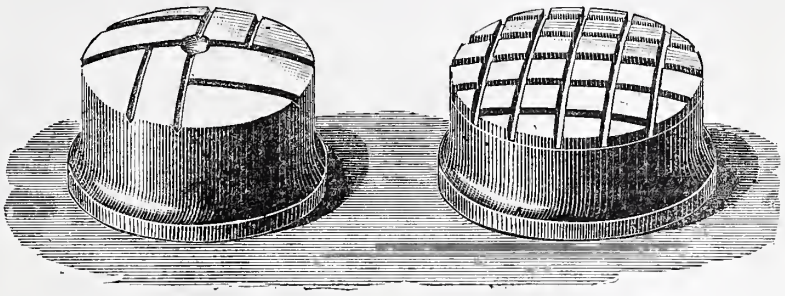


Fig. 3 Fig. 4

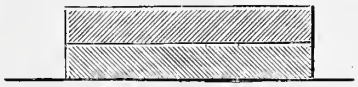


Fig. 5

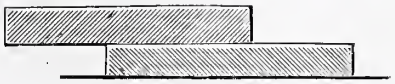


Fig. 6

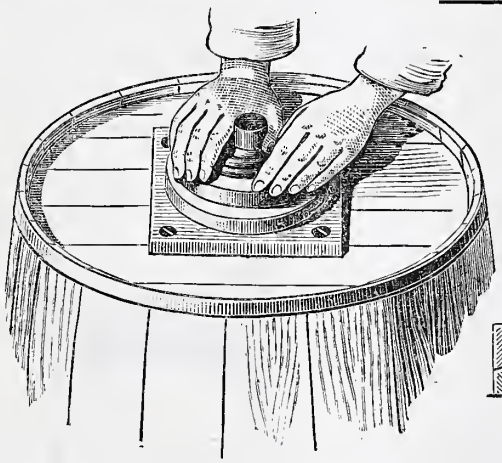


Fig. 8

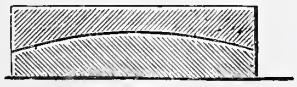


Fig. 7

Fig. 3.—Convex Tool. Fig. 4.—Hone Square Tool. Fig. 5.—Discs. Fig. 6.—Overhanging Disc. Fig. 7.—Curved Section. Fig. 8.—Method of working the Speculum over the Tool.

A polisher was formed by covering the facets of the second tool with a mixture of pitch and resin, and on this the speculum was polished with rouge. During the last process the parabolic curve necessary to obtain good definition in a telescope was communicated to the concave mirror.

During the whole time of working the operator walked ceaselessly round and round the bench, and he changed the line of movement of the inverted speculum at each stroke, and when he desired to alter the curve of the speculum, he altered the length or variety of the stroke with which he moved it to and fro over the tool or polisher. He knew from experience the effect which any such change of stroke must cause, and in this knowledge lay his skill.

The practical optician still works his glass specula on convex metal tools, and still polishes them on pitch. But the tool of hones is dispensed with, and we shall dispense with the metal tools also.

We shall use only two similar discs of polished plate glass. One of these will ultimately form the speculum; the other will be the tool. On the glass tool, covered with pitch, the speculum will be polished with rouge, and we shall be able thus to dispense with the metal tools. For if two flat discs of glass be placed one over the other, with emery between them, and the upper disc be pressed down and worked to and fro in every direction over the lower, the emery will cut away the centre of the upper and the edge of the lower disc.

Thus, in Fig. 5, the two discs are at rest. In Fig. 6, however, at the end of a stroke, the upper disc overhangs the lower, the centre of the one pressing on the edge of the other, and the tendency is to wear away the two surfaces and produce the curved section shown in Fig. 7.

Fig. 8 further explains the working. The tool is cemented to a wooden slab, and then screwed firmly to the rigid bench, and the speculum, with a handle cemented to the back of it, is worked to and fro in such a manner that no two consecutive strokes lie in the same direction. Thus the concavity in the upper disc is regularly cut. As the workman walks round and round, he causes the speculum to rotate slightly under his hands at each stroke. The necessary muscular action is easy and natural, and a very little practice will suffice to form the habit of almost unconscious performance.

When the two discs have been sufficiently shaped, the grinding is continued with a series of emeries of finer and finer grades, until the glass is so far smoothed that emery can do no more. Then the polishing is completed on pitch, with rouge. So that, as has been said, the process of hand-working in the nineteenth century is practically identical with that of the seventeenth century.

ABOUT WORK AND POWER.

BY W. C. CARTER, M.I.MECH.E.

WE have seen that the Modulus of a machine is that fraction of the whole work put into it which appears at the working end of the machine. When, therefore, Dr. Joule addressed himself to the task of determining with exactness how much work corresponded to any given amount of heat, he naturally concluded that the best way to do it was to make a machine which would turn work into heat, because the amount of work done by a falling weight could be exactly ascertained as a starting point. And here it is

interesting to notice that as he wished to turn all the work into heat, the problem was really to make a machine, of which the modulus was o (see No. 158, page 20), a machine which did not possess any efficiency at all, as no useful work was given out. This he accomplished in the following manner. He had a simple arrangement constructed, by which the work done by a falling weight could be transmitted with as little loss as possible to a system of paddles working in a box containing a known quantity of oil. The paddles, by dashing the oil against internal vanes and obstructions, raised its temperature by an amount easily measured by thermometers. Every precaution was taken to prevent any escape of heat in any other way, and the result was determined which has now been accepted as sufficiently accurate for all purposes, and named, in honour of the experimenter, Joule's Equivalent, or, the Mechanical Equivalent of heat. Its value is 772 foot-pounds for every British Thermal Unit. The B T U is that amount of heat which will raise 1 lb. of water 1 deg. in temperature, so that we have here the data required to compare heat and work in any circumstances, and to definitely fix the natural connection between them.

We may now direct our thoughts to the other extreme of Mechanical Efficiency; that is, where the Modulus of the machine is 1. In other words, no work is lost by the internal friction of the machine, and all the work put in at one end is given out at the other. A little reflection will show that, owing to the properties of materials, we could never actually reach this refinement however nearly we might approach to it by fine workmanship. Suppose, for the sake of argument, that we could destroy all internal friction, we should have obtained the often-sought chimera—perpetual motion—and even then we should have no useful result.

Suppose our machine would run round for ever after we had put in a certain amount of work, even then we could put it to no useful purpose, because if we used up the work to do anything useful we should just be able to use what we put in, and our machine would stop again. Viewed in this way, how absurd the idea appears which has occupied many minds—that of forming, by the expenditure of a little work, an inexhaustible fountain of work that could be drawn upon, like the purse of Fortunatus, for ever without diminution. "What shades we are! What shadows we pursue!"

We shall now endeavour to make plain, in several illustrations, the truth of the foregoing remarks, and give such examples as shall show how to apply the Principle of Work to any machine, however complicated. We will begin with the Mechanical powers.

1. *The Wedge.*—Here we have, in Fig. 1, a wedge having a length of L ft. and a height of H ft. This constitutes our machine, and by applying a force F to it, we force it through a distance L, doing, thereby, an amount of work equal in foot-pounds to F lbs. × L ft., whatever they happen to be. But the weight (W) under which the wedge is driven is, during this time, raised a comparatively short distance, H, and the work at this end of the machine is W lbs. × H ft., and by our principle this product must be equal to F × L—neglecting friction—so that the less we make H the more W may be, which everyone knows by experience, that is, the finer taper the wedge has the more power it can exert.

2. *The Lever.*—The usual, and indeed the simplest, treatment of the lever is to consider the relative length of the arms as deciding the relative powers, but by looking a little deeper we see that, after all, the Principle of Work is at the bottom of it. Referring to Fig. 2, we see that the ends of the arms describe arcs of circles, and we know that the whole circumference of any circle is proportional to its diameter (as it is equal to diameter × $3\frac{1}{7}$), and, therefore, to its radius; and also that arcs containing any given number of degrees are proportional also to the radius of the respective circles. We must also remember that the number of degrees in the arcs described by the opposite arms of any lever must be equal whatever their length may be.

The arcs described by the ends of the lever represent the distances moved by each force, and so we can find the work at each arm of the lever, which we know must be equal. For the sake of comparison we will work the case in the figure both ways.

Method I.—Usual treatment.—The forces applied at the ends of the lever will be in inverse proportion to the lengths of the arms—that is, as the arms are as 2 : 1, then the respective forces will be as 1 : 2.

Method II.—By Principle of Work.—The force at A moves along the arc x, and that at B through the arc y. We have seen that x and y are in the same proportion as A F : F B, therefore we can represent them by 2 : 1. But the work done at x is P (force) × x (distance) = 1 × 2 = 2. And the work done at y is Q (force) × y (distance) = 2 × 1 = 2. So it is clear that the result by either method is the same.

Method III. — Spur Wheels.—It will be easily seen by referring to Fig. 3 that a train of spur wheels is simply a system of levers, because at any particular moment the portions of the wheels not in contact are useless. The active part of the wheels is shown by the black lines. We have here, instead of the imaginary arcs dotted at the ends of the levers in Fig. 2, complete circles, and consequently the application of the principle should be very plain.

Our figure shows the usual arrangement for a single-purchase hand winch. The power is applied at a handle which, for simplicity, we will suppose to be of such a length that it describes a circle measuring 3 ft. in circumference. Suppose a constant pressure of 30 lbs. is applied to the handle, then the work put into the machine is 30 lbs. × 3 ft. = 90 foot-pounds in one revolution. Suppose that we want to lift a weight of 500 lbs. by this winch, and we know that we get 90 foot-pounds for each turn of the handle; then the weight must move $\frac{90}{500}$ = ·18 ft. or 2·16 in. for each turn of the handle, and the intermediate wheels and size of chain barrel must be so arranged as to give this speed of lift.

Supposing that we had, instead of the simple winch here shown, a complicated sheer-legs winch driven by an engine, precisely the same principles would apply. We should have to calculate the mean pressure of the steam upon the piston by the usual

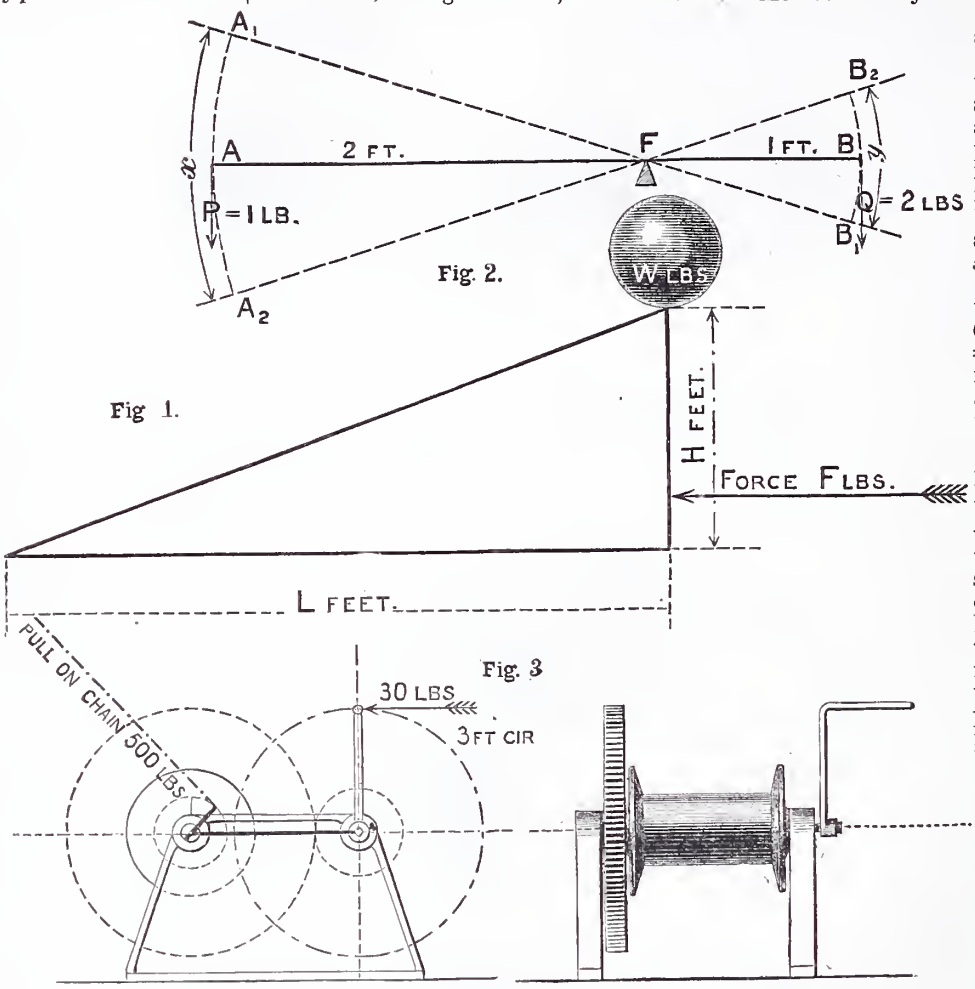


Fig. 1.—Wedge. Fig. 2.—Arms describing Arcs. Fig. 3.—Train of Spur Wheels.

means, and multiply it by the distance moved in a minute by the piston—that is, the piston speed of the engine. This gives us the amount of work passing through the gear of the sheer-legs in one minute, and we know that, whatever complications may exist, the weight on the hook, multiplied by the speed of lift per minute, ought to equal exactly the work developed by the engine in the same time, friction being disregarded. Of course, it must be understood that in the case of large machines the friction becomes a very important factor, but we are here dealing with principles only, and when once these are grasped it will be a comparatively easy matter to make such corrections as experience of the efficiency of similar machines may suggest. If we once know the Modulus of a similar machine, all we have to do is to find the theoretical work to be expected—neglecting friction—and multiply it by the Modulus for any particular case.

INDUCTION COILS: HOW TO MAKE AND WORK THEM.

BY G. E. BONNEY.

SECONDARY INDUCTIVE EFFECTS — INDUCTION IN PARALLEL STRAIGHT WIRES—HOW TO DETECT INDUCTIVE EFFECTS—HOW TO MAKE A DELICATE GALVANOMETER—HOW TO MAKE AN INDUCTION COIL—THE CORE OF AN INDUCTION COIL: HOW CONSTRUCTED — THE PRIMARY WIRE OF AN INDUCTION COIL: HOW SELECTED —THE SECONDARY WIRE: HOW SELECTED AND INSULATED—THE MAGNETIC BREAK, OR INTERRUPTOR.

Secondary Inductive Effects.—A current of electricity passing through the coils of a wire helix not only exercises an inductive effect on the coils of its own conductor, but also influences the condition of another conductor placed parallel to it, yet separate from it by a thin air space. Even when straight wires are run along side by side, the conductor of electricity will exert an inductive influence on its near neighbour, providing the two are not too far apart or separated by a very dense insulator. This may be demonstrated by means of very simple apparatus and a delicate galvanometer.

Induction in Parallel Straight Wires.—Get a piece of plain deal wood, 1 ft. in length by 3 in. in width, and 1 in. in thickness. About $\frac{3}{4}$ in. from the ends, bore two gimlet holes; in these fit wood pegs, with slits in their tops, $\frac{1}{8}$ in. apart; in these slits fix two naked copper wires of from No. 24 to No. 28 gauge (either or any intermediate size will serve our purpose), and stretch these wires from peg to peg, side by side, like two telegraph wires. Connect the two ends of one wire to the terminals of a delicate galvanometer, and the two ends of the other wire to the terminals of the battery. Immediately on connecting the second wire to the battery a movement of the galvanometer needle will be noticed, showing that a current of electricity has passed through its coils. On disconnecting the battery wire, another movement of the needle will be noticed, thus showing that inductive effects are produced both on making and breaking contact with the battery. These effects are only momentary, and are only observed at the instant of making and breaking contact. If now a file be employed on one of the battery terminals, and the battery wire is drawn along the file, so as to cause a succession of interruptions, the needle of the galvanometer will be kept swaying to and fro to right and left of the zero mark, thus showing that a succession of rapid interruptions in the main circuit is necessary to induce a continuous current in the secondary circuit. As these effects cannot be easily detected without a delicate galvanometer with a poised needle, I herewith give instructions for making one.

How to Make a Delicate Galvanometer.—Procure a piece of mahogany, or other hard wood, 4 in. square by $1\frac{1}{2}$ in. in thickness, and turn out of it a disc of wood $3\frac{3}{4}$ in. in diameter, having a central raised boss on one side $2\frac{1}{4}$ in. in diameter by $\frac{5}{8}$ in. in height (as shown at Fig. 2). Next get a piece of boxwood, and turn out a bobbin, $1\frac{1}{4}$ in. in diameter, a depth of $\frac{1}{2}$ in., and flanges $\frac{1}{4}$ in. deep by $\frac{1}{16}$ in. in thickness. Cut this bobbin into two equal parts, and glue the two halves to the centre boss of the galvanometer stand, about $\frac{3}{8}$ in. apart (as shown at Fig. 3). Wind each half with $\frac{1}{4}$ oz. of No. 36 silk-covered copper wire, one half being wound from left to right, and the other in the contrary direction, as in winding the magnets for electric bells. See that the wire is wound on evenly and free from kinks, then bring the two ends down through the base of the instrument, to be connected to the stems of two binding screws when the instrument is finished. Get a disc of thick white cardboard equal in diameter to the centre boss of the stand, divide it into two equal parts by a thin ink line, then subdivide each part into two equal parts, mark out two parallel lines with an inked compass leg near the outside rim of the disc, and divide this by fine lines into numbered degrees (the card may also be divided as shown by Mr. H. A. Miles, in his paper on "A Tangent Galvanometer," p. 57, Vol. III.). In the centre, on the underside, glue a small piece of cork, and through this press the point of a sewing needle until it stands $\frac{3}{16}$ in. above the surface of the card. This will form the pivot for the magnetic needle of the instrument. The card may now be glued down to the bobbins, with its zero line coinciding with the division between them. We must next get a small compass needle $1\frac{1}{4}$ in. in length, or make one out of crinoline steel to the form shown at Fig. 4. Needles are made and sold for this purpose at from 4d. to 6d. each, already capped and magnetised. If we make one ourselves, we must be sure to have very hard steel, and drill the centre hole much larger than required to go on the needle. This will then have to be capped with a brass cap, having a conical hole in the centre (as shown in section at Fig. 4*a*). After the needle has been formed, it must be magnetised by rubbing it on a permanent horseshoe or bar magnet, or placing it in a coil of wire through which a current of electricity is made to pass. When the needle is poised on its pivot, it should act as an ordinary mariner's compass needle, and lie at rest, with its ends pointing due north and south. The whole card and coils should now be covered with a glass-topped box, to keep out dust and to prevent the needle from being swayed by air currents. The ends of the wires should then be connected to two small binding screws on the base, when the instrument, as shown at Fig. 5, may be said to be finished. This instrument will be equal to those advertised for sale at from 2s. 6d. to 3s. 6d. each. It will do very well for delicate experiments in a room free from oscillation, but not for general detector work. The tangent galvanometer described by Mr. H. A. Miles in No. 108, p. 57, Vol. III., will also serve our purpose.

How to Make an Induction Coil.—To demonstrate the principle on which these coils are constructed, it will only be necessary to wind a quantity of fine insulated wire over the primary coil used in the first previously mentioned experiments, connect the ends of this fine wire with the galvanometer, and repeat the experiments over again with this addition to the coil. It will have been seen that to make an induction coil for any useful purpose, it is necessary to have the following parts:—(1) A core of soft iron; (2) a primary coil of stout wire wound on the core; (3) a secondary coil of finer wire wound over the primary coil; (4) a magnetic or other automatic apparatus for interrupting the current in the primary coil. These are the four essential parts. Other parts may be added for special purposes, and special coils have been made to meet special contingencies, some of which will be noticed in their places.

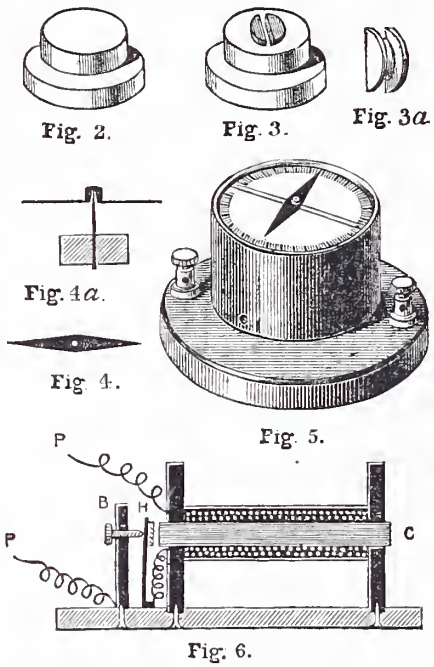
The Core of an Induction Coil.—This must be of soft iron. If made solid, it should be well annealed by heating to redness when finished, and allowed to cool down gradually in hot ashes. Solid cores are, however, slow in action, as they do not readily respond to the inductive influences of the current, nor give up quickly their charge of induced magnetism. The best material for the core of an induction coil is a bundle of soft iron wires, sold as iron binding wire. The sizes most suitable are No. 22 or No. 20. If the wire is already soft, it may be cut into the lengths required for the core, bound into a bundle with twine or tape, and soaked in melted paraffin wax to insulate the wires, keep them from rusting, and give coherence to the bundle. If the wires are not soft, they should be bound with iron wire into a bundle and annealed, as directed for a solid core, before they are soaked in paraffin wax. A spark coil may be built up from the core, having this for a foundation to form the body of the coil bobbin; but a shocking or medical coil should have the core sliding in a tube or a loose tube surrounding it. Metal of all kinds must be rigorously excluded from the body of the coil bobbin, since metal tubes themselves absorb inductive effects instead of transmitting them to other conductors. It is advisable to have the tube, forming the coil bobbin, of as thin and as perfect insulating material as possible, consistent with strength, since inductive effects are absorbed in thick tubes. Ebonite is one of the best materials, since it is strong and a good insulator. Next to this is papier-mâché soaked in melted paraffin. Tough cartridge-paper soaked in melted paraffin will also make good tubes. Paper soaked in beeswax has been used, whilst some persons use shellac varnish, and others employ glue to stick the folds of paper together to form the body of a bobbin. The two last are, however, much too stiff and brittle to yield best effects.

The Primary Wire of an Induction Coil.—This is the first wire wound on the core. It is the wire through which the primary electric current passes. As it is wound over the core of soft iron, the passage of an electric current through it induces magnetism in the core, and the strength of this magnetism will be in proportion to the strength of the electric current sent through the coil. The strength of current permissible through the primary wire of a coil is limited to the safe carrying capacity of the wire itself. The size of wire employed for the primary coil varies with the size of the finished induction coil and its intended use. The sizes

vary from No. 12 to No. 24 in spark coils, the larger size being employed in large coils. In medical coils the size of the primary wire may vary from No. 18 to No. 24, the latter being employed when a coil consists of a long primary wire only, and when several powers are used together with that of the primary current. The wire should always be of high conductivity annealed copper, well covered with silk. Cotton-covered copper wire may be used, but the results will not be nearly as good as those from silk-covered wire. Before winding on the wire, it should be soaked in hot melted paraffin wax, to provide against possible defects in the insulation. This is a necessity in building spark coils. Some persons employ shellac varnish for a similar purpose, painting each layer as it is wound on the core; but this is too hard to give best effects. Other makers cover the core with paper soaked in hot beeswax, and coat each layer of primary wire with a layer of similar prepared paper. There is no insulator equal to paraffin wax for this purpose. The last layer of wire should have two or three layers of the prepared paraffined paper wrapped round it before winding on the secondary wire.

The Secondary Wire of an Induction Coil.—This is the wire wound over the primary coil previously described. It is usually a very long and thin wire, but may be made up of several wires of different gauges wound on over each other, the largest wires being placed nearest the primary coil. This arrangement is only adopted in building medical coils of various powers. Spark coils have only one long thin wire, usually of No. 36, 38, or 40 silk-covered high conductivity annealed copper. The wire must be well covered with silk, free from even the smallest uncovered spots, free from kinks, and continuous throughout the lengths to be employed. Should a break occur, and a knot have to be made, it must be a long splice knot of not less than ½ in. in length, formed of the bared and cleaned ends twisted together, then soldered, employing resin as a flux. The joint thus made must be coated with fine silk soaked in melted paraffin wax. Every layer should be wound on evenly, with the turns running regularly side by side throughout, and in the same direction as those of the primary coil. Inductive effects are lessened by crossing of the coils, as when the wire is run on without any attempt to lay it side by side. Intense or high pressure effects are also lessened by employing large wires, since the large wires absorb into themselves the increased pressure obtained by the inductive influence of a number of coils of fine wire acting on each other. Apart from this, the inductive effects are increased by the number of turns we can get in a small space in close contiguity to the magnetic field of the core, and the number of these turns are lessened by using large wire. Therefore, it is not advisable to use mixed gauges of wire in the construction of a spark induction coil, since our aim in this is to get a high pressure current at the terminal ends of the secondary wire. A long thin spark is obtained from the terminal ends of long fine secondary wires; a thick and short bushy spark is obtained from larger wires. Particular attention must be paid to the insulation of the secondary wire throughout the coil, as the least failure in this will cause several turns of wire to unite in absorbing the extra tension induced by other parts of the coil. What is gained in one part will be lost in another, unless all are alike good. The spark is said to leap across badly insulated parts of a coil and burn away the defective insulation, thus causing it to get from bad to worse. It is, therefore, advisable to examine closely the insulated covering of the wire for a secondary coil, and to run it through melted paraffin wax, to render the insulation of the covering doubly sure.

The Magnetic Break, or Interruptor.—It has been shown that there are no evidences of inductive effects in the secondary circuit of a coil until the current passing through the primary coil has been interrupted. It would be tedious to interrupt the current by drawing one end of the wire over a file placed in the circuit. We must, therefore, resort to some method of interrupting the current by machinery. Fortunately, we can easily arrange a regular and mechanical interruptor, worked by the primary current of the coil itself. As the current passes through



Induction Coils. Fig. 2.—Wood Base of Galvanometer. Fig. 3.—Bobbin Halves glued to Base. Fig. 3 a.—Half of a Bobbin. Fig. 4.—Form of Galvanometer Needle. Fig. 4 a.—Section of Needle, showing it poised on its Pivot. Fig. 5.—Galvanometer complete. Fig. 6.—Sectional Diagram of Induction Coil—B, Break Pillar; H, Break Hammer; C, Core of Coil; P, P, Ends of Primary Wire.

the primary wire, it converts the soft iron core on which it is wound into an electro magnet. This will attract to itself another piece of soft iron, so suspended as to be free to move toward the core. If we make this piece of soft iron a part of the primary circuit, it follows that its attraction by the core will at once break the circuit. If now we fix the piece of iron to a spring, also placed in the circuit, the magnetised core will first draw the soft iron to itself, and in so doing break the continuity of the circuit; a current will at that instant cease to flow in the primary coil, the magnetism of the core will also cease, and it will lose its hold on the iron, which will then be drawn back by the spring to again close the circuit. This to and fro movement will be rapidly executed and automatically maintained whilst current is passing through the primary coil. The action is clearly shown in the annexed diagram (Fig. 6), which gives a sectional view of the arrangement in a coil. In this diagram B represents the break pillar, H the hammer of soft iron, C the core of the coil, and P the primary wire. The details of construction will be given in a following paper.

HOW TO MAKE CORK PICTURE FRAMES.

BY ARTHUR YORKE.

FINISHING THE GROUND — ROUND, OVAL, AND FANCY-SHAPED FRAMES — DESCRIPTION OF THE DESIGNS—CONCLUDING REMARKS.

Finishing the Ground.—In two of the designs given with the former article, as well as in the whole of those which accompany the present paper, the ground is represented as having a roughened surface. A common way of doing this is by rubbing up scraps of cork as fine as sand and sprinkling this on the wood, after first giving it a coat of glue. But in careful cork-work the ground is sometimes completely veneered over with sheet-cork, either bought in that form or sliced up for the purpose; the best work can, undoubtedly, be made with the former. Supposing, however, that the wood of the frame has been so chosen that its colour matches with the cork, the ground will sometimes look well left as it is, quite plain; or a grounding-punch can be used on it, as in wood carving.

Round, Oval, and Fancy-shaped Frames.—As two of the designs attached to the present paper are of this class, it may not be amiss to say a word as to the easiest way of making the wooden foundations for such frames. Say that the shape is that of Fig. 9, or of Fig. 12, and the size not more than a foot in its greatest dimension; my own plan would then be to take two thicknesses of thin board, large enough when put together with the grain of the one crossing that of the other at right angles to include the whole frame; but before joining them I should saw them to shape with the bow-saw, cutting the front one to the pattern as it appears at sight, and working in it a shallow rebate, and cutting the hinder board so much smaller as to allow for the rebate. By using these crossed boards glued together the danger of warping would be obviated.

Description of the Designs.—Fig. 9, though it is here drawn as a round frame, may be equally well carried out as an oval one. Its more prominent decorations have been drawn as half balls of cork. They will look best in that shape; but should the novice find a difficulty in cutting them properly, he can substitute pellets instead—that is, mere sections cut from bottle corks. All the pieces in the two projecting borders end alike in triangular points; of these, the section, Fig. 13, shows by dotted lines the greatest projection, the line G H, through which this section is cut, being at their least projection; the position occupied by the line of balls (neither of which is intersected here) is also indicated by dots. The flat outer border is glued to the face of the frame (as may be seen in the section), leaving the sides uncovered.

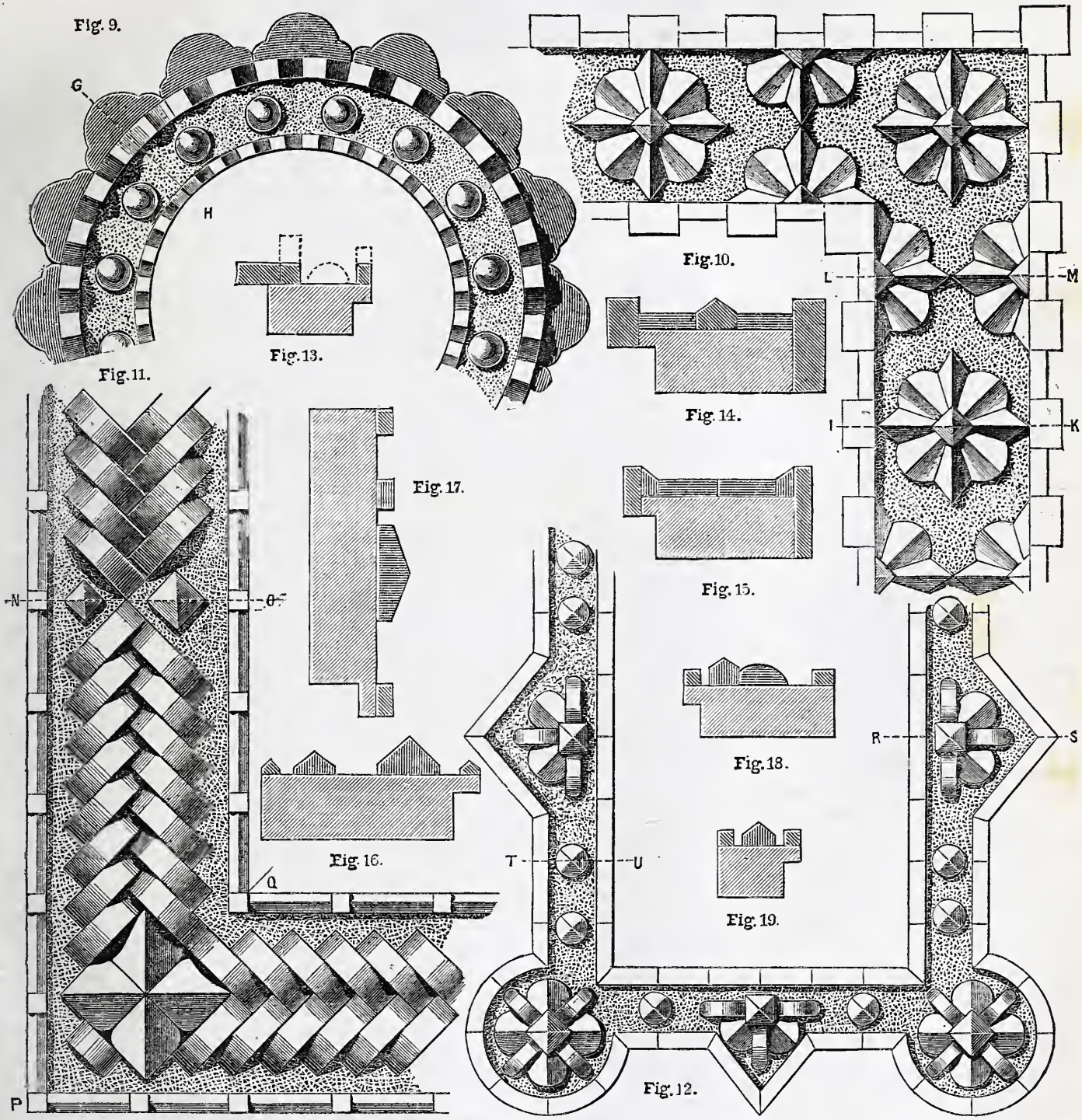
In Fig. 10 it will be observed that a different plan is followed, the sides being covered by rectangular pieces of cork, alternately thicker and thinner, and these project beyond the face of the frame, so as to form a border to the pattern. No difficulty can be found in cutting the different pieces used in the flowers; it will be noticed that they all slope downwards from the central

line. This pattern is one which can well be employed where broader surfaces than picture frames have to be decorated with cork-work.

In Fig. 11 the plait pattern is wholly formed of pieces like those at A, Fig. 4, in the former article. The flower at corner is in four pieces, which should be cut so thick as to be a trifle more prominent than the plait. This is shown in the section, Fig. 17. The border, which lies on the face of the frame, is of small cubes, alternating with longer pieces cut to a ridge on the projecting side.

The design, Fig. 12, is not one intended to be carried out on any large scale. Its success will much depend on the worker's ability to cut out the foundation neatly with the bow-saw. The round ornaments in this frame are not semi-globular as in Fig. 9, but are supposed to be sections of small phial corks, the projecting ends of which have been cut to a pyramidal form, as is shown in the section, Fig. 19. The section, Fig. 18, shows the projection of the parts of the incomplete flower at R S, and sufficiently explains the construction of the complete flowers in the corners.

Concluding Remarks.—In drawing these designs I have confined myself to simple patterns, such as a novice in the art need not be afraid to attempt. Cork-work may, however, be carried out in a much more ambitious spirit, and may be made to emulate high-class wood carving, not only in intricate conventional designs, but also in the imitation of natural objects, such as leaves, flowers, and fruit. Instead of being cut from the solid, the different forms would, of course, be built up, piece by piece, in cork. Whether the material is one which is worthy to absorb any high amount of taste or skill is a point for private judgment to decide. There are many articles beside picture frames in which the cork-worker can, if he desires, exercise his powers.



Cork Picture Frames. Figs. 9, 10, 11, 12.—Designs for Cork Frames. Fig. 13.—Section of Fig. 9 on line G H. Fig. 14.—Section of Fig. 10 on line I K. Fig. 15.—Section of Fig. 10 on line L M. Fig. 16.—Section of Fig. 11 on line N O. Fig. 17.—Section of Fig. 11 on line P Q. Fig. 18.—Section of Fig. 12 on line R S. Fig. 19.—Section of Fig. 12 on line T U.

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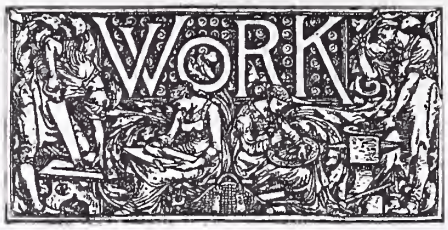

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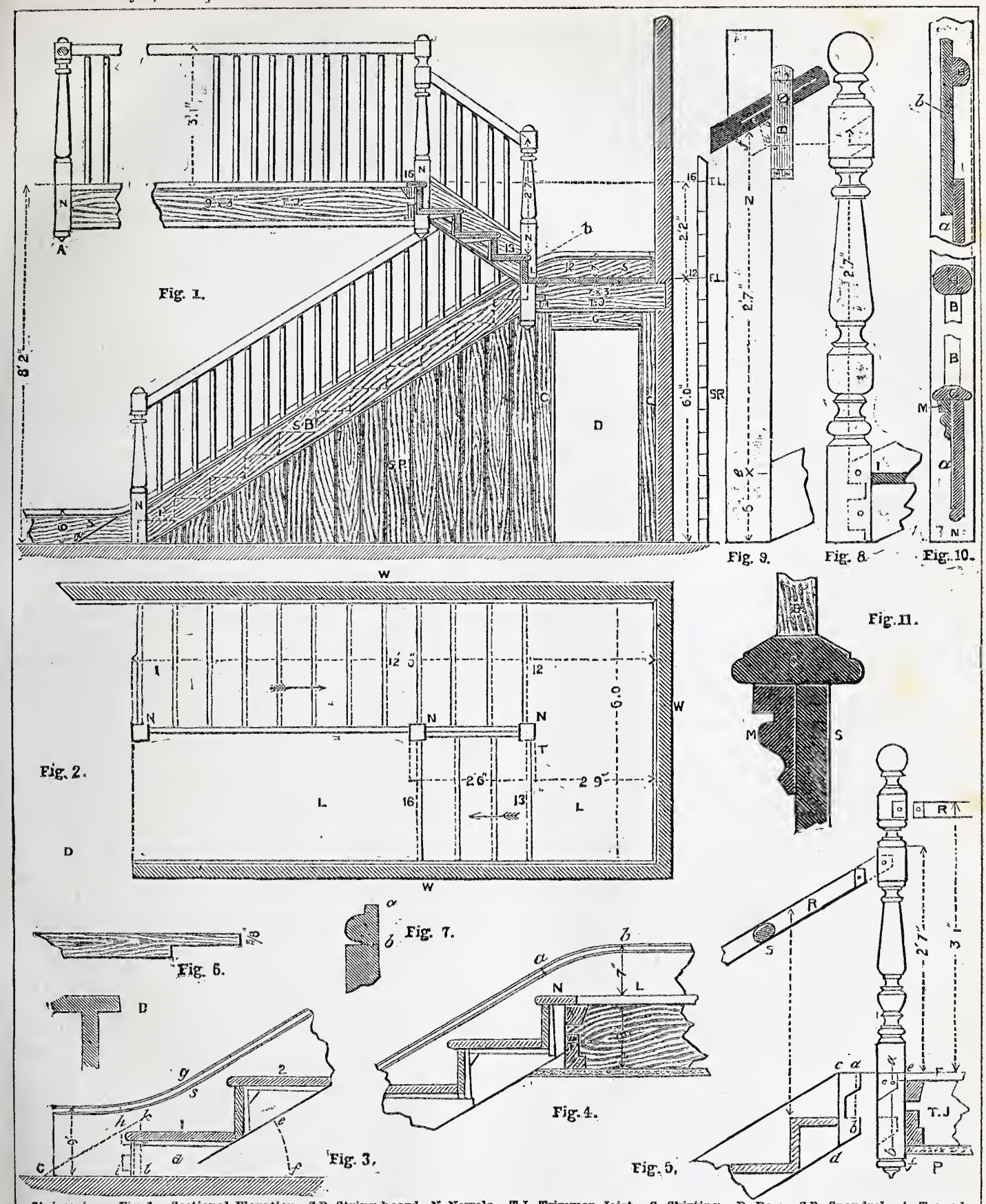
INDIRECT TAXATION.—Dr. W. A. Hunter, M.P., who is perhaps most widely known in connection with his Pensions' scheme for workmen, is occupied just now in a fascinating investigation. He is trying to find out the share paid in Imperial taxation by the working classes, and the share paid by the rich, and some of the conclusions he has arrived at so far are sufficiently startling. The part of his conclusions that most concerns us here is, that if the revenue now obtained from the Customs and Excise in England (Scotland and Ireland being excluded) were obtained by a rate upon property, as the poor rate is obtained, the yearly saving to each working-class family would average £3 8s. 10d. The working classes, and those akin to them, he puts at four-fifths of the population; and the yearly contribution of these four-fifths to the revenue through the consumption of the taxed commodities—coffee, cocoa, dried fruits, tea, tobacco, beer, and spirits—is £4 16s. 10d. per family. Now he finds that the average house rent, outside London, of these four-fifths is £7 10s., and £4 16s. 10d. in taxes is thus equivalent to a rate of 12s. 10d. in the pound. That is the poor man's tribute at present by indirect taxation. If, however, this indirect system of taxation were superseded by a direct rate upon house rent, then the amount now derived from the Excise and Customs, viz., £28,000,000, would be obtained from a rate of 3s. 9d. in the pound. Such a rate on a rental of £7 10s. would be 28s. a year, the average that working-class families would then pay, instead of the £4 16s. 10d. they now pay. We say nothing about the unfairness of the present system, but simply add that Dr. Hunter does not propose to abolish the taxes on tea, tobacco, beer, and so forth, but to retain them for the purpose of pensioning the old, infirm, and disabled. Though the difficulty of adding a rate of 3s. 9d. to the already too heavy burdens of rent-payers may be insuperable, the question of indirect taxation is well worth the attention of our readers. There are few, probably, who would seriously contend that Imperial taxation generally does not hit the poor harder than the rich, even allowing for malt and tobacco—the quantities too often hurled at the heads of working men.

PETROLEUM ENGINES.—These engines, in which the vapour of petroleum oil is utilised as the motive power, though less known as yet than the gas and steam engines, are coming into favour. On the score of economy they compare favourably with engines driven by coal gas and steam; while the advantages claimed for gas engines, such as not requiring a boiler, and the being able to start at short notice, are also possessed by petroleum engines. Professor Unwin states, as the result of trials made by himself on a 5-h.p. Priestman engine, that taking the fuel consumption of 1 lb. of oil is equivalent to that of 1¼ lb. of coal, then the consumption of the oil engine came out less than that of the most economical triple-expansion engine yet tested. Three trials of the 5-h.p. Priestman engine gave respectively an equivalent of 1·02, 1·18, 1·23 lb. of coal per brake-horse-power per hour, while the steam consumption in the most economical triple-expansion engine corresponded with 1·61 lb. of coal per brake-horse-power per hour. These oil engines are suitable for pumping, for driving dynamos in country districts, for working rock drills, for working air compressors, for fog signalling at lighthouses, and for driving launches and barges. As the engines do not reverse, provision is made for going astern by means of a reversing friction clutch. There is one great advantage which the oil engines possess over even the gas engines: that they are self-contained, and can be moved from place to place, no fixed gas pipes being required for connection. The action is very simple: a jet of oil, and a current of air, regulated by a governor, are mixed in a spraying nozzle, which reduces the oil to fine particles. These are received in a vaporising chamber, heated by a jacket of exhaust gas. An additional supply of air is drawn into the vapour chamber with the suction stroke, and the charge is ignited in the cylinder by an electric spark. Oil engines for small and moderate powers should divide the field with gas engines in the future.

LATHE WHEEL BALANCE.—Should there be a balance weight or not? We say, that depends. For instance, if it is a light lathe for wood turning, and especially if it be fitted with a traversing mandrel so that the workman will require to swing the wheel half round and back, then a balance weight will be in the way. But if, on the other hand, there be no traversing mandrel, and a balance weight is arranged as a counterpoise to the treadle, so that when it stops the crank will be in the right position for restarting, the workman will find the following advantages:—First, he can start without taking hold of the band or putting a hand on wheel or pulley—a great advantage in long work. Second, the rate of revolution will be more even. Third, the lathe can be driven very much slower without stopping. Fourth, the lathe may be stopped altogether at the beginning of the up-stroke by the foot alone, and by the foot alone it may be started and driven on again. And, altogether, a lathe is more under control and pleasanter to drive when fitted with a balance weight, if only the weight be not too heavy and yet sufficient to bring the crank up to the proper starting point when the belt is on the usual speed.



Staircasing. Fig. 1.—Sectional Elevation—S B, String-board; N, Newels; T J, Trimmer Joist; S, Skirting; D, Door; S P, Spandrel; A, Turned Drop; S R, Storey Rod; F L, First Landing; T L, Top Landing. Fig. 2.—Plan—L, L, Landings; N, N, N, Newels; W, W, W, 4½ in. Brick Walls; D, Door Opening. Fig. 3.—Details of String at Bottom—1, 2, Steps; *d e f*, Angle of Stairs; *c, s, t*, Piece glued on String; *k l*, Shoulder Line; *h, i*, Tenons. Fig. 4.—Details of String at Top—*a b*, Moulding on Casement; L, Landing; T, Trimmer; N, Nosing. Fig. 5.—Details of Newel on Landing—R, R, Rails; T J, Trimmer Joist; F, Floor; P, Plaster; *c d*, Shoulder; *a, b*, Tenons; *e f*, Depth of Landing; *s*, Section of Rail. Fig. 6.—Details of Tenon. Fig. 7.—Torus Moulding, *a* to *b* Portion nailed on String. Fig. 8.—Turned Newel ready for fixing. Fig. 9.—B, Bevel applied to Newel for Mortise and Square; *a b*, Mortise; N, Newel; *e f*, Height of Rail. Fig. 10.—Details of String as mortised in Newel—*a a*, String on Bottom Flight; *b*, String on Top Flight; H, H, Rails; N, Newel; B, B, Balusters; C, Cap; M, Moulding. Fig. 11.—Details of Cap, etc.—S, String; C, Cap; M, Moulding; B, Baluster.

THE ART OF STAIRCASING.

BY GEORGE F. CHILD.

INTRODUCTION—WINDERS—CLOSE STRING STAIRS WITH NEWELS—WORKING DRAWINGS—SETTING-OUT WALL AND OUTSIDE STRINGS—EASEMENTS FOR SKIRTINGS AT TOP AND BOTTOM—WORKING AND FIXING EASEMENTS—DEPTH OF TRIMMERS—RETURN FLIGHTS—SETTING-OUT NEWELS—CAPS FOR BALUSTERS—NEWELS ON LANDINGS—HEIGHT OF HANDRAILS—NOSINGS—BALUSTERS—SECTIONS OF HANDRAILS—SPANDRELS—REFERENCE TO FORMER FIGURES.

IN the preceding article we dealt with a staircase of the simplest kind, it being placed in such a position that one straight flight enabled us to reach the floor above.

The staircase we now propose dealing with is slightly more complex, as, under the conditions, we find two flights are necessary. On reference to Fig. 1, it will be seen that there are two landings, one being placed at a height of 6 ft. from the ground floor—this height is often varied to suit circumstances—the other being the level of the first floor. Of course, it will be understood that the sizes here taken are only for convenience, to save space. In practice, 8 ft. 2 in. would be much too low, it only giving about 7 ft. to the ceiling line, which the "Bye Laws" would never allow, 8 ft. being the lowest possible. However, this will answer our present purpose.

Winders.—It is always the better plan, where possible, to *avoid* winders—we shall deal with the subject of winders later on—as a landing affords a rest in a long flight of stairs, besides having the advantage of safety, it being obvious that the winders round the newels, gradually tapering, cannot afford the foothold that a landing would. It is also necessary, at times, to introduce a landing, as a door may open directly upon the staircase at this point, when winders, unless specially arranged, would be utterly impossible.

Close String Stairs with Newels.—This class of stairs is so named on account of the outside string-board being *close*, or uncut, as in the case of an open string staircase, where each step is cut out on the string itself, instead of being "housed in."

Working Drawings.—In making our working drawing, we must proceed, as in the last article, by taking the *height*, *width*, and *going* upon the storey rod, as seen in Fig. 1 (elevation), where S R is the rod, F L first landing, and T L top landing. Note that the "going" should properly be taken from the wall at back of landing up to the doorway, it being always better to keep the stairs clear of the entrance to the rooms. The depth of the trimmer joist should also be taken, for reasons that will be seen as we proceed with our work. In preparing the working drawing, first lay down the plan as in Fig. 2, drawing all enclosing walls, doorways, and landings. Next draw the elevation (Fig. 1), marking all landings and joists as shown, allowing $\frac{7}{8}$ in. for floor-boards at the top, and the same at bottom for laths and plaster. Now divide the height to first landing into as many parts as convenient, as given in former article (see No. 160, page 51), which we have taken as twelve; now do the same from the *first* to *top* landings. This, it will be seen, gives four risers.

We now see how this will work for our "going." It will be observed that the first landing projects 2 ft. 9 in. from the wall to the face of the trimmer, T. This distance, then, to the door will be the space available for our treads, or "going."

Now divide the width of staircase (6 ft.) into two equal parts, and on the centre line draw the *newels*, N, N, N. It is very important to bear in mind the fact that in *all* staircases there is *always* one riser *more* than tread, this being on account of the landing counting as one. This being the case, as there are twelve risers in the flight, there must necessarily be only *eleven* treads to deal with; we therefore divide the space from *centre to centre* of the *newels* into eleven equal spaces, as seen.

Now, there being four risers in the top flight, divide the space on plan (representing the "going") into three equal parts.

By projecting lines from the plan to meet corresponding lines in the elevation, we obtain the steps as seen and previously described. At a distance of 2 in. from the nosings draw a line parallel to them, and at a distance of 9 in. from this line draw another, which represents the width of string. Now draw the newels (which are 4 in. square), and at a height of 2 ft. 7 in. from the nose of steps draw a line representing the *top* of handrail; also draw the bottom edge of rail. Draw the rail on the landing at a height of 3 ft. 1 in., as seen. Now, by allowing about 4 in. above the strings and 1 in. each side of the rails, we obtain the necessary squares between which the newels are turned, as seen. It will be observed that there is a small piece of turning at the bottom of several of the newels, known as a *drop*. This is on account of the newels showing below the ceiling line. Now draw the skirtings, S, at their respective widths, and all that is necessary for our working drawing is accomplished.

Setting out Wall and Outside Strings.—Having completed the drawing, first measure the length necessary for the wall strings—that is, from the ground to the first landing—by laying the rule along the top edge of string-board, S B, as seen in Fig. 1 (sectional elevation), from *a* to *b*. This extra length beyond the newels is to allow for the *easements* to skirtings at top and bottom. Now take the length from the first to top landings. The length of outside strings can be taken from the *outside* of the newel at bottom to the one at top, always allowing a few inches to *play* with. The sizes for the newels can also be taken from the drawing. Having set out the pitch-board as before, apply it to the wall string at bottom, so that the edge marked *tread* on pitch-board may coincide with points *c* and *d* (Fig. 3). Then, by cutting the string off at this line, we at once obtain the pitch of stairs, *e f* being the angle between the line of steps and the horizontal plane. Now set out the spaces for treads and risers as before.

To set out the outside strings, commence by applying the pitch-board at the bottom of string as at Fig. 3, only that, instead of allowing the piece to run on, it may be cut off, as seen in *dotted* line, from *h* to *i*, this being for the tenon. The *dotted* line *k* is the *shoulder*, this line being drawn at a distance of 2 in. from, and *behind*, the first riser. The reason for this will be obvious when we remember that the going was taken from *centre* to *centre* of the newels, thus placing the risers starting and landing in the centre of each. The top of string will be set out as seen at Fig. 5, only that the shoulder, *c d*, will be 2 in. in *front* of last riser, *a b*. The tenons should be cut with the *shoulder* on the *inside* of strings, as at Fig. 6, and may be about $\frac{5}{8}$ in. in thickness.

Easements for Skirtings at Top and Bottom.—The easements are for the purpose of forming a nice curve between the strings and skirtings. They are occasionally allowed to form an angle at the point of intersection, but this does not look so well, and is not recommended.

At the bottom, a piece (*c g*, Fig. 3) must be glued on the string wide enough to make out 9 in.—the depth of skirting on ground floor. At the top no such piece is necessary, the string being worked off to meet the 7 in. skirting, as seen in Fig. 4.

Working and Fixing Easements.—To work the bottom easement, a piece of the *torus* moulding should be cut from the skirting (as *a b*, Fig. 7), and laid upon the string, marking its width as *g s* (Fig. 3), then the width of the skirting (9 in.) from *c* to *t*. Now draw a nice easement between the points and cut it out. Now with a *quirk router* (which may be purchased at any of the tool merchants advertising in WORK), work a quirk, or groove, at a distance from the edge equal to the width of torus; finish the moulding with chisels and small planes. The torus moulding at the top is worked independently of the string, and nailed on as at *a b* (Fig. 4), as also is the moulding down the edge of the string itself.

Depth of Trimmers.—As I have said before, it is very important that the depth of the trimmer joist should be known, as from this we obtain the square necessary for the bottom of newels. At Fig. 5 this will readily be seen, as if the square had not been long enough between the points *e* and *f*, the turned *drop* at bottom would have come above the plaster, P.

Return Flights.—Return flights are so called on account of their returning in an opposite direction to the bottom flight, as in Fig. 1.

Setting-out Newels.—To set out the newels successfully requires, in the novice, a deal of careful attention and some little practice, or on receiving his newels back from the turner he may find them utterly ruined, on account of his *squares* being in the wrong place; this is not said to discourage, but only to enforce his attention. To set out the bottom newel, first mortise it to receive the string as at Fig. 8, draw-boring it up to its shoulder. Now, from where the *housing* for the first step joins the newel (6 in. from bottom), measure up the distance equal to the height of handrail—in this case 2 ft. 7 in. (see Fig. 9). From this measure the thickness of rail *downwards* in a line at right angles to the bevel, as *a* to *c*, thus obtaining the position for mortise. It should have been observed that the *bevel* is taken from the pitch-board, as, of course, the rail is the same pitch as the stairs. Now mark 1 in. each side of the mortise, *a b*, thus obtaining the square necessary. As the patterns for newels, of course, are not always alike, the piece at top must be allowed for according to the design. Fig. 8 is a very good form of newel, and not very expensive.

The next newel will require a much longer square at the bottom, as it will take the two strings. The bottom string should be fitted and the step to landing marked (see L, Fig. 1) from this line. The next step on return flight should be measured upwards, and the top string also fitted. Now from this top step measure up the distance to top of rail, and set out square as before.

Newel No. 3 will be treated in the same manner, except that the bottom square will only require to be 12 in. from the floor level, allowing about 4 in. above at top and 3 in. for the drop at bottom.

This newel also must have a square left at the top, to allow for the rail on the landing,

which is 3 ft. 1 in. in height, and a small piece should be turned between, or the square will be long and ugly. Fig. 5 is an enlargement of this newel.

Position of Strings in Newels. — The strings are sometimes placed directly over each other in one vertical plane, but it is a much better plan to place them one each side of the *centre line* on newel. Fig. 10 shows them so placed. The bottom portion of newel shows at *a*, the string, C the cap, B baluster, M moulding, and H handrail. The upper part has the two strings, *a* and *b*, with half the rail at H shown.

The reason for this method being superior to the other lies in the ability to place half the rail on the return string, as shown in the Fig. It may here be remarked that the long rail at bottom only continues as far as the top or return string, and the half-rail then finishes down to the newel.

Caps for Balusters, etc.—As seen in Fig. 10, the strings, coming each side of the centre, throw the balusters on one side. To obviate this, a cap must be prepared to nail on the top edge of string, wide enough at top for balusters and at bottom for thickness of string, and a piece of moulding equal in thickness to the other string. This is shown enlarged in Fig. 11, B being the baluster, C the cap, M moulding, and S the string-board.

Newels on Landings.—These newels are placed at the angle of landing, to take the return rail, and are set out as seen at A, Fig. 1. There being only one square necessary at top causes the turning to be a good deal longer.

Height of Handrails.—The height of rails vary, but they must always be higher on the landings than on the stairs, or people may fall over.

Nosings.—Nosings are placed in the newels at top, half-way on the joist, and form the top step. This will be fully described in a future paper.

Balusters.—Balusters are used of various kinds, both square and turned, and range from 1 in. to 2 in. in thickness.

Sections of Handrails. — Handrails are made in a variety of forms, according to taste and class of stairs; but as this does not enter into our present study, we will leave it for a future paper.

Spandrels.—Spandrels are made in a number of ways, the one shown in Fig. 1 being of a very common order, being simply ¾ in. matchboard nailed in. S is the spandrel; C C C a cupboard front made to receive a door, as by this means a very useful cupboard may be easily constructed.

Reference to Former Figures.—As the description of method for setting out a flight of stairs has now been described, students will be referred to former figures in all future examples—that is, as regards pitch-board, setting-out strings, etc.—or else we shall only repeat ourselves over and over again.

MEANS, MODES, AND METHODS.

Transparent Cement for Microscopical Purposes.—The following recipe for forming a good transparent cement is said to be highly recommended:—Gum dammar, 5 drs.; gum mastic, 3 drs.; dried Canada balsam, 3 drs.; chloroform, 1 fluid oz.; spirit of turpentine, 1 fluid oz. Dissolve by shaking, then filter through filter-paper. To our readers who are following our various articles on microscope and telescope appliances this cement should be useful.

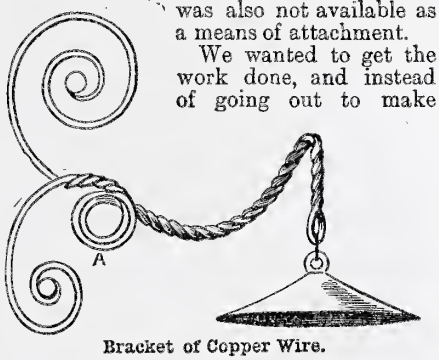
A CHEAP AND EASILY-MADE BRACKET TO SUPPORT A GLASS SMOKE CONSUMER.

BY H. S. GOLDSMITH.

This came into existence from one having a ceiling which threatened to come away if it was touched, and as paraffin lamps do smoke sometimes, we were compelled to find some other way of supporting the smoke consumer in its proper place.

As shown by the sketch, it was for a bracket lamp we had to arrange: one over a mantelshelf close to an overmantel, which was also not available as a means of attachment.

We wanted to get the work done, and instead of going out to make inquiries here, there, and everywhere for something that would do, we set to work with pencil and paper and devised this article, which cost us nothing more than an hour's work.

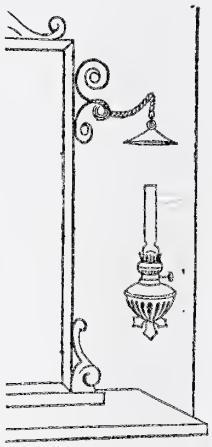


Bracket of Copper Wire.

The material, which we had by us, is 4 ft. of copper wire, rather less than ⅛ in. thick. It was first got quite straight, then doubled on itself, one end being 5 in. or 6 in. longer than the other. We next made the round loop (A) by turning both ends round a strong peg—an inch screw well driven into the wood-chopping-block answered very well. The loop was 10 in. to 12 in. from the end.

We next put an iron rod into the closed end, and twisted the wire up into a rope by merely rotating the rod; the two loose ends we twisted up our fingers.

We now took the screw out, and very carefully got the whole thing into form; the single loose ends were turned up into spirals, the double part into a graceful snake-like curve, this shape being necessary to get the consumer in its proper place right over the lamp chimney.


Sketch showing Position of Lamp.

A hook on the glass consumer passed through the loop on the end of the wire, which was formed by doubling it over at the commencement. We finished our work by blackleading it—just a rub or two with the stove-cleaning brush did it.

It is held in its place by a good strong brass-headed nail through the large loop, and by two small ones through the centre of each spiral.

We spent some time over the scrolls, and now that it is up in its place there is nothing of the makeshift about it. In small households it would prove very useful.

SCIENCE TO DATE.

Aluminium.—Some experiments made at Berlin with a view to test the applicability of aluminium for the construction of cooking utensils, etc., have proved unfavourable to the employment of this metal for this purpose. It dissolves rapidly, and in relatively considerable proportions. It is worthy of notice, however, that the metal is becoming cheaper every day.

Electrical Transmission of Power.—One of the features of the Frankfurt Electrical Exhibition was the transmission of power by electricity from Lauffen, on the Neckar, to Frankfurt, a distance of 110 miles. It is now reported that 113 horse-power taken from the river at Lauffen represented 81 horse-power at Frankfurt; so that, taking into account all possible sources of loss, the efficiency was 72⅛ per cent.

A Colourless Varnish.—We have tried, and can answer for, the following directions for a colourless varnish: Dissolve 2 oz. of bleached shellac in 1 pint of rectified alcohol; to this add 5 oz. of animal bone-black, which should first be heated, and then boil the mixture for about five minutes. Filter a small quantity of this through filtering paper, and if not colourless, add more bone-black and boil again. Run the mixture through silk and through filtering paper. When cool, it is ready for use.

An "Alpine Club" in South Russia.—An "Alpine Club" has been formed at Odessa with a view to exploring the mountains of the Crimea and affording facilities to tourists visiting this country.

Optical Measurement of High Temperatures.—M. Chatelier has made experiments to devise a method for measuring high temperatures by determining the intensity of the luminous radiations emitted by a pyrometer of platinum or clay. The results are satisfactory. The method is especially available for metallurgical operations.

Disappearance of a River.—The Vorskla, which fifteen years ago watered one of the most fertile districts in the province of Poltava, Russia, is now entirely choked up with sand. All that remains of the river are a few large pools.

NOTES FOR WORKERS.

On a cold day about 40,000 tons of coal are consumed in the 700,000 houses in London; and this coal emits, from about 1,500,000 chimneys, 480 tons of sulphur. An effort is being made to get anthracite—a variety of coal which contains no sulphur and emits no smoke—generally used in London, and so abate the "fog nuisance." It is already largely used in Paris, Berlin, etc.

The Chicago Exhibition buildings will be dedicated with suitable ceremonies on next October 12th, the 400th anniversary of the discovery of America by Columbus.

Dr. Nansen expects to leave Europe about January, 1893, for his expedition to the North Pole. A specially constructed vessel is nearly completed; its nett tonnage will be about 250, and it will accommodate 12 men. Provisions will be taken for six years, although the expedition may not be away for more than three or four.

In repairing lamps, many find it difficult to get the old plaster out of the brass socket or collar. To do this, heat the collar and then plunge it into cold water, when the plaster will wash out quite easily.

An Arlington gardener has introduced electric lights into his hothouses, with the result that he can raise a larger crop of lettuce or cucumbers in a shorter time than he could before.

Magenta is not a good stain for microscopic objects, as it stains diffusely, and the colour is not permanent. Hæmatoxylin and picro-carmine are far more useful.

In October, 1885, Hell Gate or Flood Island, at the entrance of New York Harbour, was removed by a single blasting operation. It was nine acres in extent, and 282,000 lbs. of explosives were used, being fired by electricity.

Friction produces heat, and this heat produced is an exact measure of the work expended in overcoming the friction.

A foot-pound is the unit of work; thus, if 10 lbs. be raised to a height of 3 ft., then 30 foot-pounds of work is done.

TRADE: PRESENT AND FUTURE.

*** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

SILVER AND ELECTRO TRADES.—The Sheffield silver and electro trades are dull. The trade in ivory and pearl is marked by increased prices, although the demand is not increasing.

HARDWARE TRADES.—In Rochdale district, trade is in a very bad state, and there is no sign of it improving, orders not coming in sufficiently fast to keep the men going; consequently, short time is the rule. In Sheffield, the makers of agricultural implements are well employed. Sheffield file-makers, as well as makers of crucible steel, are complaining of the severe competition at home and abroad, and their expectations of a busy spring trade have been unfulfilled.

TIMBER TRADE.—The Baltic Sale Rooms, where for many years the timber sales have been held, will in a few weeks know them no more, the rooms being required for other purposes. Messrs. Foy, Morgan & Co. have held their sales for some time past at the Cannon Street Hotel, and we understand that Messrs. Churchill & Sims will in future hold theirs at Winchester House, Old Broad Street. Quietude has been prevailing in the wood trade, and business will not revive until after the great May demonstration. The threatened strike for June 1st by the bricklayers and plasterers will tend to keep things back until arrangements have been made.

PLUMBING TRADE.—Plumbers have been pretty busy in the Liverpool district all winter, but trade is slackening, and there does not seem any prospect of its becoming brisk at present. Wages are 8½d. to 10d. per hour, according to ability. Joiners are earning 8d., but there are a good many seeking work.

FLANNEL TRADE.—This keeps in a satisfactory condition, most of the mills in the Rochdale district being busy. Manufacturers find the market in a better state than it has been for some time.

CUTLERY TRADE.—There is little alteration in the Sheffield cutlery trades. If anything, a falling-off is perceptible. Makers of bone, pearl, and ivory handles report that business is not improving. Matters have been altered for the better in Chili, Peru, and Uruguay; but the improvement in these directions is counterbalanced by the stagnation in the United States markets.

BUILDING TRADE.—In Rochdale and district this keeps in a prosperous state, scarcely a man belonging to any of the building trades being out of work, unless by his own fault. Our Birmingham correspondent writes:—The strike of bricklayers and labourers in the building trades seems no nearer a settlement; the masters still offer arbitration, which the men stubbornly refuse. As yet, no ill-effects are felt by the allied trades—carpenters, plumbers, painters, and glaziers.

ENGINEERING TRADE.—The condition of the Lancashire engineering trade remains much the same as it has continued of late, and a steady depression appears to be setting in all round. Locomotive builders report a fair amount of new work in hand, but no very encouraging prospects for the future; while machine tool makers, although here and there fairly busy, are, as a rule, getting very short of orders. Stationary engine builders are steadily quieting down, and, with few exceptions, the leading firms of machinists have few orders of any weight coming forward. The Barrow district continues to be the only locality in the county in which anything like activity exists. The iron trade continues very quiet; but as there is an almost complete cessation of production in the North of England, prices in some branches exhibit an upward tendency.

JEWELLERY TRADE.—In London there are signs of life, for a few orders are about, now that Easter is past. The termination of Lent, almost coinciding, as it does, with the end of a quarter, has put just a little liveliness into trade. About this time we expect to find a gradually increasing amount of work about, and so far the quantity of orders seems to be but little less than the average. We cannot expect anything like the season we were looking forward to, but still, it will be a fairly busy one in all probability.

CHEMICAL TRADE.—The chemical trade is rather dull. There is a falling-off in the export of most articles, though an increase for bleaching powder. Present prices are: Oxalic acid, 3⅝d. per lb.; soda ash, 48 to 58 per cent., £5 6s. 3d. to £6 7s. 6d. per ton; caustic soda, £10 10s. to £10 15s. for 70 per cent., £9 12s. 6d. for 60 per cent.; soda crystals, £3 10s. to £3 12s. 6d. per ton, f.o.b.; borax, 28s. 6d. to 29s. 6d. per cwt.; yellow prussiate of potash, 10½d. per lb.; bichromate of potash, 3¾d. per lb.; chlorate of potash, 7d. per lb.; chloride of ammonia, £33 to £35 per ton; bleaching powder, £7 5s. to £7 10s. per ton; sulphur, roll, £8, flour, £9 5s. per ton; copperas, 45s. per ton; blue vitriol, £14 15s. per ton; white lead, English, £29 per ton.

MASONRY TRADE.—At the quarterly meeting of the Aberdeen Operative Masons' and Stonecutters' Society the chairman explained that in a number of cases in which it was reported that journeymen were underpaid and too many apprentices were employed, complaints were lodged with the firms involved, with the result that the ground of complaint was at once removed. It was proposed and seconded, and, after considerable discussion, agreed to by a large majority, "That, in view of the number of our members who are annually out of employment, this society is of opinion that the number of journeymen is in excess of the requirements of the trade, and, in order to remedy to some extent such a state of affairs, the Standing Committee be instructed to use every endeavour to organise the masons of the different centres throughout the North with a view to limit the number of apprentices employed, and co-operate with this society in establishing an eight hours day in the granite trade."

DYERS' AND FINISHERS' TRADES.—A memorial from the Dressers', Dyers', and Finishers' Benevolent Society has been adopted for presentation to the employers of Manchester and district. The main proposals are: (1) That the maximum working hours be reduced to 56½ per week; (2) that hours so reduced be taken off the latter portion of the day; (3) that the said reduction come in operation on Monday, the 16th.

COAL TRADE.—The strike of Durham miners is far-reaching in its effects. The brass casters and smelters of Birmingham and district are nearly at a standstill for want of Durham coke, which, it is asserted, is pre-eminent for their purpose. Coke made of Midland coal is no good. Some are trying Welsh coke, but the supply is so indifferent and uncertain as to cause a vast amount of inconvenience. In Manchester and district, coal for trade purposes has lowered somewhat in price. Local colliery owners have to reduce their prices on account of the plentiful supply of Welsh coal at cheap rates. The price of house coal is firm.

COTTON TRADE.—A meeting of delegates from the Master Cotton Spinners' Federation and the Amalgamated Association of Operative Spinners has been held in Manchester with reference to the Stalybridge dispute. The matters considered were the assessment of compensation for alleged bad work and damages, and the question of discharging the present hands at the mill where the dispute has arisen. With regard to the first, it was agreed that it should be dealt with by arbitration; but the employers' section would not agree to the settlement of the second matter in the same way. The Burnley manufacturers have passed a resolution to work short time to the extent of three days per week in the weaving trade. Our Rochdale correspondent writes:—The much-talked-of lock-out is on the point of collapsing in this district, several of the largest mills having started work again, and all the others will be at it in a few days; so that what threatened to be a serious matter has passed away.

CYCLE TRADE.—From all home quarters we hear of the continued big trade of the manufacturers. In Boston, America, the dealers find the pneumatic tire to be the only tire saleable, and think the season is going to be a prodigious one for the trade. Large cycle firms intend to offer prizes to cyclists for performances done on their machines this season. This is apart from what is known as "makers' amateurism"—*i.e.*, amateur riders of repute employed by makers to attend race meetings and use their machines in competing for prizes.

SHEET METAL TRADES.—Trade has slightly looked up in various branches. This improvement is most apparent in season goods of galvanised iron, such as waterpots, baths, garden barrows, etc. Makers of japanned goods are likewise becoming busy in such lines as trunks, bonnet boxes, toilet ware, etc. Prices of sheet metals all round are very low, especially black sheets. Galvanised sheets are also remarkably cheap. Buyers at present have it all their own way.

POTTERY TRADE.—A great lock-out in the Staffordshire pottery trade is threatened, owing chiefly to difficulties which have arisen between two important firms of manufacturers and their workpeople. At a meeting of the Manufacturers' Association it was resolved that sixty-five manufacturers, employing 25,000 hands, should give their workpeople a month's notice to leave work until the disputed matters have been settled.

SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

*** *In consequence of the great pressure upon the "Shop" columns of* WORK, *contributors are requested to be brief and concise in all future questions and replies.*

I.—LETTER FROM A CORRESPONDENT.

Hobbyists' Emporiums.—J. W. R. (*East Liss*) writes:—"I have read with much pleasure your suggestions in WORK, No. 160, as to forming some means by which amateurs might dispose of their work, and should be glad if others would take the matter up. It seems to me that it would be a great boon to many readers of WORK and others. Could not some dépôt in town be formed, to which work might be sent for sale, a proper deduction being made as commission? An entrance fee also might be charged, the sender paying all expenses; and if not sold in a certain time, articles might still be given, with the sender's consent, to some sale of work. I think there are hundreds of people who would be glad to take the risk. Of course, the work might not bear comparison with professional, but there are many amateurs nowadays who turn out good work; and there are many ladies of limited incomes who would be glad of some such unobtrusive means of disposing of their handiwork. Such things as wood-carving, fretwork, macrame work and brackets for the same, Oxford frames, inlaying, etc.—indeed, it would be almost impossible to enumerate all the things which might be sent. I have been a subscriber to WORK from the first, and have often been struck with the ingenious suggestions of different correspondents. In many cases the proceeds would relieve absolute necessity; in others—to those who have not much spare cash, for instance—they might supply the means of purchasing tools and materials for further work. At any rate, it might create an interest in amateur workers of both sexes, even if the profits were not taken into consideration, and at the same time might, as you sensibly suggest, 'put him in touch with a market to which he might send his labour with some fair prospect of its finding a buying public at the makers' price.' I hope the matter will be taken up by other readers of WORK."

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Incubator.—J. B. N. (*Lancashire*).—I presume you have not seen the "Incubator" article in No. 143. If not, order that, and also No. 149, from your bookseller, and I think you will find what you want. For a machine to take one hundred eggs, make your case about 18 in. by 12 in. (inside measurement). I do not think it will be necessary to alter the size of internal fittings, but you will need to allow for a larger heat supply, using for this purpose a lamp with a ten-line Kosmos burner. If you wish for any further details, write again.—LEGHORN.

Incubator.—W. W. (*Balham*).—(1) If you will again refer to the sketches on p. 610, No. 143, Vol. III., you will see by Fig. 11 (and also by description, if you read it carefully) that the disc, R D, is supported *over* the lamp flue by a tripod. (2) You will already have seen, in my reply to another correspondent, how regulator is to be fixed. (3) For the plunger cut a sound cork to slide easily in the tube, but mind it does not get wet. Turned ivory would be preferable, but more expensive. (4) For fittings, write to Mr. Stevens, whose advertisement appears in No. 149, "Sale and Exchange" column.—LEGHORN.

WORK MSS.—E. A. P. (*Cork*).—Contributions to the "Means, Modes, and Methods" column of WORK are not paid for, this column being open to, and for the benefit of, all readers of WORK. It is a pity you do not get your weekly copy of your local bookseller; and if you or others experience any difficulty in obtaining the publication, you have only to make this known to the publishers—Cassell & Co., London, E.C.

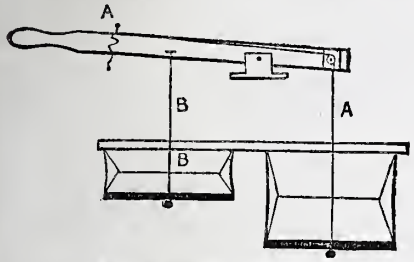
Guide to Letter Writing.—H. H. (*Burton-on-Trent*).—Messrs. Warne & Co., Bedford Street, Strand, London, W.C., publish one which is popular, and seems calculated to answer its desired end. Particulars with regard to it you will get from your bookseller.—S. W.

Accumulators.—H. McM. (*Bootle*).—Grids of lead, such as you propose, have been tried with only partial success, as a grid of perforated lead over the paste increases the internal resistance of the cell, and shields a portion of the active material from the direct chemical and electrical action necessary to ensure a full volume of current. If the plates are properly perforated, and the paste of red lead, or of litharge with sulphuric acid, is well forced into the perforations so as to form a firmly adherent coat, and this coat is allowed to become quite firm before placing the plates in the cell, there need be no fear of the paste dropping off, providing, of course, that the plates are subjected to fair usage. Knowing that the coating of lead paste is, at its best, friable, some care must be taken in handling the coated plates, so as to prevent the coat from being cracked by buckling or jolting. Plates are liable to injury in the cell from a too rapid charge and a rapid discharge or short-circuiting. I saw a set of plates a little while since that had been in daily use for fifteen months, and had not lost any paste, if we except a very thin film on the bottoms of the cells. The sample of powder enclosed in your letter was a good sample of litharge.—G. E. B.

Model Electric Lights.—P. A. B. (*Manchester*).—Articles on the above appeared in Nos. 76, 82, 89, 92, 94, 97, 99, 101, and 104 of WORK.—ED.

Electro-Motor.—G. H. B. (*Horsham*).—If you will address your four questions to Mr. Atkinson, he will reply to them in detail. The little motor described in that article is not suitable for a useful dynamo, and was not designed to be used for this purpose. If the vendor of the castings does not advertise in WORK, you must write him respecting their price and cost of carriage.—G. E. B.

Blower for Harmonium.—F. W. (*Dunstable*).—We do not see how it is possible to use both foot blowers and side lever on the same bellows without foot blowers "affecting the shaft," or, as an alternative, requiring the bellows feeders being detached from the lever. F. W. can, however, alter shaft so that the detaching may be easily managed. The



Blower for Harmonium.

accompanying sketch will give a way by which it may be done. Put a pulley in the lever, and lead a piece of catgut from feeder over pulley and along lever to any accessible part of handle, making fast to a hook or cleat provided for the purpose. Feeder (B) may be attached to the lever with a piece of catgut.—B. A. B.

Electric Belts.—J. C. E. (*Salop*).—I do not know of any maker of electric belts who manufactures them as described by me in No. 141, p. 589, but I agree with you that such belts are different to those generally supplied to purchasers.—G. E. B.

Cutting Gas Retort Carbon.—J. M. (*Kirkham*).—Use an old saw or piece of iron made in the form of a saw, and an abundance of wet silver sand or other sharp fine sand. Fix the carbon, and saw away at it, using plenty of elbow-grease, until sawn into the required rods or plates.—G. E. B.

Quarter Horse-Power Engine, etc.—OLDHAM ENGINEER.—Articles on the "Quarter Horse-power Steam Engine" appeared in WORK, Nos. 106, 110, 121, 125, 131, 136, 141, 145, and 149; on "Knotting, Splicing, and Working Cordage," Nos. 105, 109, 113, 117, 120, 124, 127, 134, 139, 143, 147, and 150.

Lacquering.—F. S. (*Dover*).—Yes; you are quite right as to the address of the firm. See also reply to H. J. (*Oxford*) in this number. Sample bottle, 1s.—R. A.

Art Designs.—SOUTH KENSINGTON.—Design both for interior and exterior application will in future find much more space in WORK—as you will have seen from Vol. IV., No. 157. Arrangements have been made with several trained art workers to give us priority of designs, suitable for domestic and general application.

Labour and Trade News and Items.—FOREMAN.—Yes, information of this nature we have always regarded as useful to readers of WORK, and shall be glad to give insertion, in some suitable column of the paper, to any properly authenticated news of this kind which you or any responsible correspondent may send. Address the Editor of WORK, c/o Cassell & Co., London, E.C.

Duchesse Table.—G. C. (*Woolwich*).—As you seem to need many constructive details in reference to the above, I considered it preferable to omit a design, etc., in "Shop," and to draw the attention of my brother contributors to the following plan of the article you need, in the hope that one of them

Duchesse Table Plan.

may treat the subject fully in the body of WORK. I prefer to restrict myself to novelties; otherwise, I should have given more attention to this query; but my time is so fully occupied in devising new articles that I should not have felt "at home" in treating the article mentioned above.—J. S.

Optical Lantern.—W. H. (*Failsworth*).—All parts for lanterns you will obtain of Caplatzi, Chenies Street, W.C., who advertises in WORK.

Boys' Carpentry.—JACK PLANE.—Some pages of carpentry for boys will appear in Volume IV. of WORK, beginning with No. 157. The first paper was on Rabbit Huches, and how to make them.

Bookcase.—A. H. A. (*No Address*).—I advise you to look through the indexes to WORK for Vols. II. and III. (1d. each), wherein you will find noted so many particulars and designs relating to bookcases as preclude the possibility of detailing the several numbers containing them here. Of course, if you cannot then suit yourself, write again, and I will help you.—J. S.

Ivory Scale.—CONSTANT READER.—There are a thousand and one ways of rendering your scale legible by means of some black substance—black wax, soot from a piece of smoked tin, pencil dust, etc. The only point which need trouble you is in clearing off of all superfluous stuff, leaving only the lines black. A black enamel is preferable, as when dry it would not be liable to brush out. My own scale has become black in the lines from no other cause than that of constant use for the past few years.—J. S.

Tinmen's Tools.—W. J. H. (*Penzance*).—I have much pleasure in replying to your queries. (1) For tin plates, try Godwin, Warren, Fry & Co., Bristol; Peate, Chattock & Co., Thames Street, London, E.C.; or A. & H. Farwig, Thames Street, London, E.C. (2) Cheap tin goods: Ponder & Baker, Featherstone Street, London; Harding & Son, Long Lane, Borough, London. (3) I would not buy a grooving machine until I found the work sufficient for one; then it is a great time-saver. (4) Order small, medium, and large bick-irons; cast-iron will do for the largest size. (5) By all means have a dripping-pan swage: it is indispensable for cheap dishes. (6) Get a medium-size horse and a full set of heads; you will find a use for all. (7) Follies are very useful indeed for punching the holes for riveting tea-kettles and tea-bottle handles, and similar work. (8) The oval handle former will turn ¼ in., *but not thicker*, very well. I should advise you to try and cultivate a good class of trade. Make your goods well and of good stuff, and they will soon get a name. There is so much "jerry" work about in tinware now, especially in country towns, that it is really difficult to get a strong, well-made article without having to bespeak it, and then it costs nearly double what it ought to. If you have a prospect of being fairly well employed, I should try and get a steady lad as apprentice. You will find him very useful making small work, and assisting you in any out-of-doors work that you may have. I do not know that I can add anything more, except to say that I shall at any time be willing to help you through the columns of WORK. You should read WORK regularly.—R. A.

Lacquering.—H. J. (*Oxford*).—It is somewhat difficult to say why you have failed in lacquering your brass furniture, as there may be several reasons for it. You should not dip the articles, but, after they are finished ready for lacquering, place them in the oven, or on a hot plate, till they are just hot enough to be bearable by the back of the hand. They must not go much beyond this, or the lacquer will burn. Try the under part first, and if the lacquer frizzles and turns dark red, it is too hot, and you must wait a minute till it cools a bit. You should use a soft camel-hair brush, and not have too much on it at a time. Give decided strokes with the brush, and do not go over any part twice till you have coated it once all over. You can lacquer cold and put in oven, but it is not quite so good. If you have any difficulty, I strongly advise you to try the substitute for lacquer sold by the Fredk. Crane Chemical Company. It can be used cold, and I consider it superior to the ordinary kind. It can be had in a variety of shades; and the firm will, I believe, send a sample bottle for 1s.—R. A.

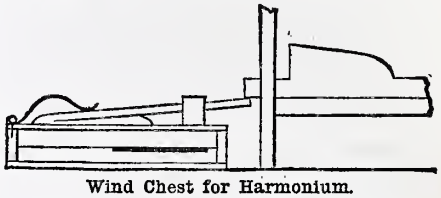
Lacquering Bedstead.—J. L. (*Harleston*).—See reply to H. J. (*Oxford*) in this number.—R. A.

Cycle Matters.—HOLBORN.—(1) The numbers of WORK in which cycle making appeared are in Vol. III. I am unable to give the numbers, as part of my WORKS are lent out. The Editor gave a list of the numbers to a correspondent. You should write to the Editor. (2) Weldless steel tube may be had of most cycle houses. For long lengths, write Herbert & Hubbard, Coventry, or Credenda Steel Tube Works, Birmingham. For short lengths cut for a cycle frame, write St. George's Cycle Company, Upper Street, Islington; Brown Bros., 7, Great Eastern Street, London; Thos. Smith & Son, Saltley, Birmingham. The price for lengths cut are about per foot: 1⅛ in., 1s. 8d.; 1 in., 1s. 4d.; ⅞ in., 1s. 2d.; ¾ in., 1s.; ⅝ in., 10½d.; ½ in., 9d. (3) The long wheel base, as applied to a safety bicycle, means a greater distance between the wheels, say, from 12 in. to about 15 in. or 16 in. 1st, it has this advantage, namely, the steering wheel is sufficiently in advance of the pedal shaft to make it safe from touching the toes when pedalling round a corner. 2nd, It is said to make the machine steer steadier. 3rd, It throws less weight on the steering wheel, and, consequently, more on the rear wheel. 4th, It has this disadvantage: that as the steering post is a greater distance from the centre of seat, if the handles are not extended further back to make up the difference, then the rider has to stoop further forward to reach them, and looks like a monkey on all fours. This is a fault that already exists in a good many otherwise good machines.—A. S. P.

Model Hot-Air Engine.—APPRENTICE.—The pressure and vacuum in the model hot-air engine on p. 717 is so small, and the power developed so little, that packing would create too much friction. I should trust to a good fit made by grinding out the bits of tube for the cylinder and plunger; then add a little grease, which melts with the heat. It is more important to avoid friction than to stop all leakage. Very likely there is *a little*, but you cannot see it as with steam; also, it is not of much consequence.—F. A. M.

Mercurial Column.—J. H. (*Mile End*).—You will obtain full information on this subject by writing to Messrs. Negretti & Co., Holborn Circus. If the gauges you wish to test are for high pressures, you will find some difficulty in using the mercurial column, as, putting it in round numbers, fifteen pounds per square in. is balanced by 30 in. of mercury.—F. C.

Pedal Chest to Harmonium.—S. G. V. (*Battersea*).—Make a small wind chest, in length equal to full width of the pedals you have. The top of the wind chest will carry levers and pallets, at the same time forming the pan for reeds; ordinary springs will do, and reeds of broad description can be had. If S. G. V. is a wood-worker, let him try wood reeds, mortising an opening in a piece of ½ in. beech, and fitting reeds of ⅛ in. rosewood or box. The trouble may be considerable, but the tone is beauti-



Wind Chest for Harmonium.

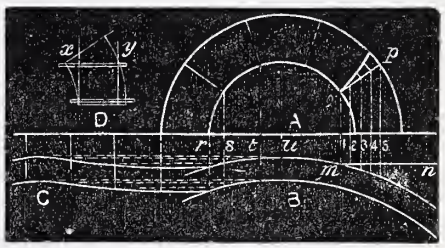
ful: like a euphonium in quality. The accompanying section will afford an idea of how the pedal action may be made. Without seeing the harmonium, it is impossible to tell the best way to connect the wind trunk to bellows and chest, or the best place to put it. If more than one set of reeds are required, some trouble will arise in stop-action, but if only one set of reeds, a valve to control wind supply is all that is needed.—B. A. B.

Tinning Iron Ears, etc.—TINNER.—To tin small articles of wrought iron such as you mention, you need a "bath"—that is, an iron receptacle for some quantity (according to the size of your work) of molten tin. The goods to be tinned are pickled in hot acids—a mixture of hydrochloric and sulphuric acids and water of equal parts will do very well. The hotter it is the quicker the articles will be ready for tinning. After pickling, dip the articles in a tub of killed spirits of salts without water added, and place them very slowly in the bath of tin, holding large things with tongs, and stringing small things together on wires. Use sal-ammoniac for a flux; and when tinned, take out and shake, and throw into sawdust. With regard to japanning, I may say that it is optional whether you "stove" the work or not, but it is much harder and more durable when so done. Very good air-drying japans can be obtained from Mander Bros., Wolverhampton, or Wilkinson, Heywood & Clark, West Drayton, Middlesex. I do not know of any work on the subject.—R. A.

Phonograph for G.P.C.—CLAPTON.—There is an article on "How to Make a Phonograph" in the hands of the Editor, which may be published when space permits.—W. D.

Tissue Paper.—BRASS.—Write to D. F. Taylor & Co., New Hall Works, George Street, Birmingham. They may be able to supply you with what you want.—W. D.

Stone Arch.—YOUNG EBOR.—Draw a section of the arch, and divide it into the number of stones in the arch, as at A. Below this draw the plan as at B, setting off the thickness of the soffit. The first stone is worked as at D, the face mould of the lower bed being the same curve as the plan. Work two drafts, *x*, *y*, square from the under bed, and apply two curved rules on these drafts, in the position



Stone Arch Plan.

shown, the curve of these rules being the same as the plan, and work the face to this curve. To find the face mould of the second joint, o *p*, divide it into four or more equal parts, and draw the lines 1, 2, 3, 4, 5, at right angles to the springing line to the curve of the plan; then draw the line in a parallel to the springing line. Draw perpendiculars at right angles to the joint line from the ends of the lines 1, 2, 3, 4, 5, and mark these to the lengths of the lines from *m n* to the curve of the plan. A curved line drawn through these points will give the curve of the face of the first joint. The remaining joints are found in the same manner. To find

the soffit mould, draw lines *r, s, t, u*, from the joints of the arch at right angles to the springing line and through the plan; then draw perpendiculars at right angles from the springing lines, as shown at C, the distance between these being equal to the length of the soffit of each arch stone. Then draw lines parallel to the springing line from the points where the lines *r, s, t, u* cut the plan, and draw curved lines through the points in the perpendiculars where these parallel lines cut them, which will give the soffit moulds of each stone. The moulds for half the arch only need be got out. There is another method described in P. Nicholson's "Practical Masonry and Stone Cutting," published by Batsford, High Holborn.—M.

Designs for Cottages.—T. R. H. (*Birmingham*), P. S. (*London*), O. W. O. (*East Dulwich*).—I cannot tell you what scale the designs for cottages in No. 150 are reproduced to. Size of rooms: Ground floor—kitchen, D, 14 ft. × 10 ft.; scullery, E, 8 ft. × 10 ft.; parlour, C, 12 ft. × 10 ft. Chamber floor—Bedroom, O over D, 14 ft. × 10 ft.; bedroom, O over E, 8 ft. × 10 ft.; bedroom, O over C, 12 ft. × 10 ft.—W. B.

Timber Buildings.—O. W. O. (*East Dulwich*).—The only books I can recommend you on timber buildings are Nicholson's "Carpenter and Joiner," Rivington's "Building Constructions" (Vols. I. and II., price 8s. 6d. each nett), or Seddon's "Builders and Building Work," price 12s. 6d. nett. All these books are thoroughly practical ones.—W. B.

Distance between Railway Carriages.—RINBY.—Your question calls for several answers, each applying to the special composition of the train. On suburban and local lines trains are run with carriages having buffers at one end only, the contiguous end of the next carriage being fitted with a spherically recessed block. The vehicles in this case are connected by links and pins. The distance between the carriages can thus be restricted to 18 in. The distance between the carriages coupled by the ordinary links will, in some cases, reach 4 ft., and the play of the buffers is in proportion. The actual length of the buffer rods varies with the type of buffer used; if they are controlled by leaf springs in the under frame of the carriage, the rods will usually extend into the framing for about one-quarter of its length. If spiral springs are used abutting against the inside transom of the frame, the rods will be shorter. If the buffers are self-contained, as in the "Brown" or "Turton" makes, the length of each beyond the buffer-board of the vehicle will be about 2 ft. These buffers are controlled by volute springs, which are coiled about the tubular trunk of the buffer. If you wish to get some idea of the number of buffers, central, side, and combined with couplings, you should run over to the Leeds Public Library, and look through the Patent Specifications.—F. C.

III.—QUESTIONS SUBMITTED TO READERS.

**** The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Type Ribbons.—J. B. (*Jubbulpore, C.P., East India*) writes:—"I shall feel much obliged if any reader could inform me how to make inking ribbons for a typewriter in indelible black and coloured inks."

Aniline Colours.—AMATEUR CHEMIST writes:—"I want to know the chemical names and synonyms of the black, blue, magenta, violet, etc., aniline dyes sold in packets. Also, if there is more than one compound giving same colour, the means of distinguishing same."

Kites.—H. N. (*Ipswich*) writes:—"I should like to know how to make parachutes that may be sent into the air like kites. Also, how can I make ornamental kites resembling birds and animals; or where can such information be obtained?"

Paste.—H. C. (*Old Charlton*) writes:—"Can you or any of your very numerous readers inform me how to make a paste which will *not* dry (say, within a fortnight), and which contains no grease? Such a paste is made, I know, but I have been, up to now, unable to obtain the recipe, or even the compound itself."

Enamel on Slate.—H. A. H. (*Tunbridge*) writes:—"Can any reader tell me where to purchase enamelled slate in small pieces suitable for switch or fuse bases, or give particulars for enamelling slate for the same purpose?"

Pinhole Photography.—H. A. H. (*Tunbridge*) writes:—"Will any camera do to take views by above method?"

Match Brimstone.—T. R. (*No Address*) writes:—"Will any reader tell me how to mix the liquid for dipping, and what are the ingredients? Is the brimstone used hot or cold?"

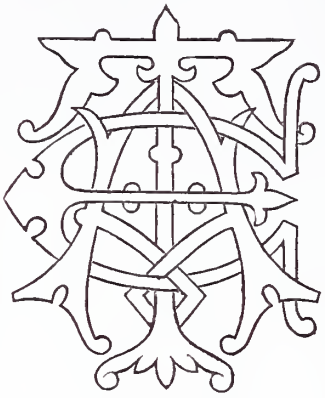
Surveying.—C. J. T. (*Devonport*) would feel obliged for the name of some cheap but reliable book on Surveying.

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Copies of Photographs.—R. A. R. B. (*Oxford*) writes to RECTILINEAR (see No. 156, page 830):—"You must erect the photograph at such an angle to the light that no light is reflected from its surface into the lens. Then take the photograph, giving rather a long exposure. When developing, use a good deal of bromide and not very much ammonia, and bring the picture out very slowly, so that the result may be a dense negative, with as much contrast as you can get from the print. An isochromatic plate would be the best, but they require more careful treatment than the ordinary brands."

Musical Glasses.—TEACHER OF THE ZITHER writes, in reply to J. R. S. (*Liverpool*) (see WORK, No. 159):—"No solution is required; all that is necessary is to wash the hands clean from *grease*. A good rub with pumice-stone, and afterwards a wipe with a cut lemon, will ensure a clear and brilliant tone—always supposing that your *glasses* are also free from greasiness. Instead of the finger-tips, some performers prefer a pad, which may readily be made by straining a small piece of wash-leather over a small cork bung, the leather to be freed from grease and acidulated in precisely the same way as mentioned above for the fingers. A much more lively *tempo* may be achieved by the use of the pad than is possible with the fingers, as the surface is so much greater."

A. E. T. Monogram.—R. D. T. (*Marylebone*) writes:—"I notice our respected correspondent, SHAMROCK (an Emerald lad) asks for 'A. E. T.' monogram (see No. 156, page 830). I have sent herewith a design which may suit our Emerald lad's purpose. The design is a little larger than would be required for the shield, but SHAMROCK can reduce it to size required."



Shield Monogram.

Lucifer Match Making.—A. B. C. (*Darlington*) writes to ANXIOUS INQUIRER (see No. 150, page 733):—"The ingredients are nitre, charcoal, and sulphur, the proportions of which vary in different factories. The sulphur is commonly in the smallest quantity, and the nitre in the largest. Some take but one part of sulphur to seven of nitre; others, three or four of nitre to one of sulphur and one of charcoal; others, two parts of charcoal to one of sulphur. There are differences also in the choice of charcoal and the sulphur, and the purity of the nitre. It is not the sulphur in the compound that first takes fire, but the charcoal. You can mix sulphur and nitre in as many different proportions as you like, but none of the mixtures will take fire from a spark without the addition of some animal or vegetable inflammable matter."

Coffin Plates.—GUGLIELMUS writes to H. E. L. (*Stockton*) (see No. 155, page 814):—"Get some quick-drying japanners' gold size, and with a camel-hair or sable writer (crow size) write the name, etc., after the following styles:

Patterns for Coffin Plates.

When sufficiently tacky—which it should be almost as soon as written, if you do not put the size on too thick—rub on a little *best* gold bronze with a hare's foot, carefully dusting off the surplus bronze with a flat camel-hair brush. This makes a very effective plate, and has, besides, the merit of drying very quickly, which is of much importance. Care must be taken, while writing, to keep a piece of paper between the hand and the plate, as the slightest moisture causes the bronze to adhere. Of course, it is easily rubbed off, but the part so rubbed gets polished, thus destroying the dead surface of the plate. The above method is suitable either for black or white plates. The appearance of the writing on a black plate may be considerably enhanced by shading the letters with the gold size."

Catgut.—H. M. H. (*Cambridge*) writes:—"In reply to CANOE's inquiry *re* 'Catgut for Angling Purposes' (see No. 157, page 14), I should advise him to get 'Keene's Guide to the Manufacture of Fishing Tackle.' I quote the following from the above-mentioned work, as it may interest other readers as well as CANOE: 'Silkworm gut is manufactured chiefly at Murcia, in the south of Spain. . . . About the beginning of May, the silkworm is taken and plunged into hot vinegar, and, after remaining there for a few hours, the workmen slough off the body from the intestine. The latter is then stretched out, and each end is wound round a pin, and so left to dry. These threads are then gathered together (all sizes are mixed), and in a few days are ready for sale. The gut is sold in this state by the pound weight, and is purchased by the gut *manufacturers*. The first process to which it is subjected is that of being put in a bath of soap and soda, when the outer skin or scale comes off. It is then laid on rods, and hung up in a room to dry, and thereafter placed in an oven for the purpose of bleaching. After this, it is given out to girls, each of whom, taking each single fibre, puts one end between the teeth, holds the other end with the hand, and rubs it (the gut) with a wash-leather. She is paid so much per thousand strands. Next day she sorts out the various lengths and thicknesses of gut. She then again rubs each strand with the wash-leather, and then the gut is passed on to men, who tie it up in bundles of one hundred of each length and thickness, and it is ready for sale." Mr. Keene says he got this information from Mr. Ramsbottom, Great Market Street, Manchester, who annually publishes a 'Gut Report.' He also quotes from this 'Gut Report' the prices of gut (in 1884-5), which vary from 2d. per hundred lengths to 50s. per hundred, according to quality, length, etc. etc."

Picture-Frame Making.—E. B. (*No Address*) writes to SENTINEL (see No. 159, page 46):—"I have had over twenty years' experience in frame-cutting, and I can safely and truly say that the best way is to cut them with the aid of a mitre block, and then to shoot them with a keen-edged plane. It beats all the machines that ever were invented; and as for cramps, while they are screwing one on I can get the whole frame together, and every corner glued and sprigged. I should not be able to get through one quarter of the amount of work if I had to bother with cramps."

Fretwork.—J. Y. (*Woolwich*) writes, in answer to W. M. (*Brixton Hill*) (see No. 146, page 154):—"If he will publish his address in WORK, I will send him one of Skinner's catalogues, as I have one to spare."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—C. W. S. (*Washington, D.C.*); J. W. R. (*Liss*); F. T. (*Porthill*); J. R. (*Dorchester*); W. L. (*Leith*); J. H. C. (*Halifax*); J. H. K. (*Hollinwood*); R. N. (*Grays*); W. B. (*Bradford*); J. T. (*Bingleswade*); J. R. R. (*Stourbridge*); S. P. (*Bromsgrove*); LEARNER; AMATEUR FRETWORKER; T. W. E. (*Bournemouth*); A. P. B. (*Walthamstow*); S. K. (*Leytonstone*); T. A. T. (*Dublin*); AMATEUR CHEMIST; J. W. (*Dublin*); A. W. (*Manchester*); APPRENTICE LAD; A. R. (*Falkirk*); W. W. (*Sheffield*); INCUBATOR; H. G. (*Leith*); J. H. G. (*Birmingham*); BUTCHER; T. M. (*Torquay*); W. B. (*Honiton*); J. W. (*Chorley*); CLAUDIUS; TINKER; NOVELTY MAD; BONA FIDE; J. McC. (*Lochwinnoch*).

NOTICE TO READERS.

Next week's issue of WORK—*i.e.*, No. 165—will contain the Second Article of the Series on "Design and Decoration of all Ages." The subject of the article and illustrations will be EGYPTIAN ORNAMENT AND DESIGN.—ED.

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Victor Cycle Co., Grimsby, sell Mail-cart Wheels and Parts. [4 R

Cycle Fittings, mail-cart wheels and shafts, mitre-cutting machines and cramps.—WALKER BROS., Wellington Road, Leeds. [3 R

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Caplatzi's Matchless Technical Collections embrace most things electrical, optical, mechanical, chemical, photographic, models, materials. Catalogues, 2d. Chenies Street, Bedford Square. [9 R

The Climax Screw-chasing Lathe Attachment for 3 to 6 in. foot lathes. Enables a novice to cut perfectly true threads of any pitch from 8 to 30 per inch; seen working. Price 57s. 6d.—DRESSER, Swan Cycle Works, Lewis Grove, Lewisham, S.E. [11 R

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Picture Moulds.—15 to 25 per cent. saved. Send for wholesale list, one stamp.—DENT'S, Importers, Tamworth. [12 R

The Model Typewriter, 5s. 6d. Specimen of writing, one stamp.—WALTON, 9, Queen Anne Street, Stoke, Staffs. [16 R

Wanted.—WORK, Numbers 3, 6, 22, 42, 107, 108; "Amateur Mechanics," Vol. I., bound or numbers; Northcott's "Lathe Turning."—Address, R. TANNER, Portway House, Frome. [2 S

Carpenter's Bench for sale, cheap; also Goodall lathe, with fretsaw attachment and tools. Seen by appointment.—ROBINSON, 12, Sutton St., Commercial Rd. [3 S

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(*See* "WORK" *of the 9th January,* 1892.)

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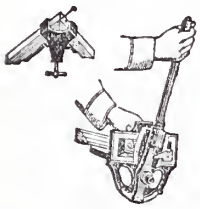

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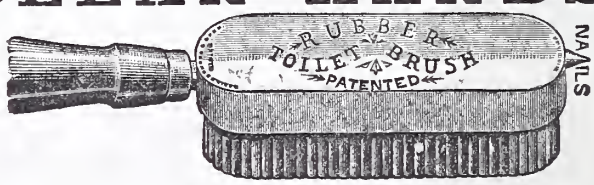

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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VOL. IV.—No. 165.] SATURDAY, MAY 14, 1892. [PRICE ONE PENNY.

WORK WORLD.

ORMOLU workers, silversmiths, jewellers, and all others who may have to mount up beautiful Algerian onyx, will do well not to be deceived by its appearance into thinking it is as hard and as tough as onyx is generally. It is not. It can be filed and drilled quite easily, but will not stand any more rough usage than will alabaster—of which it is a variety.

* *

We may, perhaps, dare to confess our admiration for the beauty of colour and effect to be found in the humble ribbon jaspers and agates. These pebbles, as they are mostly termed, will often well repay examination, and they would receive greater attention if their smaller but more attractive relations, the diamond, ruby, and sapphire, did not monopolise all the fashionable taste.

* *

Architects—and there are many—who have no practical knowledge, frequently specify scantlings of timber which are so far different from the usual imported sorts of sawn timbers as to necessitate a large amount of extra cutting, waste, and worry. Surely it is not too much to ask that professional men should master such practical details as these; and that the Royal Institution of British Architects should include this subject in their examinations is not an unreasonable suggestion.

* *

Wire glass is the name of a new article on the Dresden market. It is indifferent to the most abrupt changes of temperature, and will even withstand open fire. The glass is especially adapted for skylights, since the powerful resisting qualities of the material enables the usual wire protectors to be dispensed with. It cannot be cut by the diamond save with great force, nor can it be broken without causing considerable noise. For these reasons wire glass is claimed to be, in a measure, burglar-proof.

* *

The Irish Industries Association is doing really good work. It is making all arrangements for an exhibition of laces, linens, embroidery, woollen, and other industries, at the World's Fair, Chicago. Loans have been granted by the Association with the object of promoting the lace and crochet industries as follows:—To the Lace School, Carmelite Convent, New Ross, £50; to the Torchon lace centre, Laccafid, £40; to the Bath and Shirley Lace School, £50. Other sums have been devoted as prizes to individual workers and to teachers for the furtherance of technical education in design.

* *

Masonry executed in very cold weather is not well thought of, but it appears that in Norway building operations are successfully carried on at temperatures as low as 2° Fahr., and that work compares favourably with summer work. The Christiania builders maintain that it is superior. The secret of successful work under these conditions is the use of unslaked lime. The mortar is mixed in small quantities at a time, being made up immediately before use; and it must be put in place before it loses the heat due to the slaking of the lime. The lower the temperature, the larger the quantity of lime required.

* *

The work of constructing the Lancashire, Derbyshire, and East Coast Railway has been commenced without any undue delay. The contract for the central section of the railway has already been let. Huts for the accommodation of the navvies have been erected at Bolsover, and some of the plant used in constructing the Manchester Ship Canal has been obtained. At Monsal Dale, a secluded valley in Derbyshire, the line will be carried on a viaduct 272 ft. in height—the loftiest in the Kingdom. The noted viaduct near Louisville, United States, is 6 ft. lower than this. It was erected in ninety-six days, and has safely borne the wear and tear of traffic since 1877.

* *

The present method of producing sheet steel for the manufacture of tin-plates is one involving melting in the converter, casting into ingots, reheating, and compression or slabbing by means of hydraulic compressors and passing through the rolling mill. Sir H. Bessemer proposes to dispense with these intermediate processes, and to pass the fluid metal between water-chilled rollers, securing homogeneity and toughness equal or superior to that produced by the present roundabout method. The process was introduced some years ago, but in a less perfected form, and the tin-plate makers did not care to take it up, but it is probable that in the face of increasing American and other competition they will now be more inclined to give it attention.

* *

The Birmingham Canal Navigation Company will apply to the Board of Trade for power to alter their rates and tolls, by which freightage will in many cases be more than doubled. Here the great railway and canal companies are practically one, as for the greater part of their distances both run side by side. Traders who were looking forward to water carriage as a relief from excessive railway rates had apparently overlooked this fact. Not so the railway company. Such arbitrary action not only increases the cost of coal to the householder and traders, but seriously cripples trade. It ought surely to lead to concerted action on the part of all interested classes, and hasten the day when English railways shall be more directly under State control—*i.e.*, for the good of the country, and not for the benefit of a few private investors and capitalists.

* *

The usual form of drawing-board for stretching the paper consists of a panel let into a frame, but if a larger size than one easily made with a panel be required, it can be prepared in the following manner. The ordinary drawing-board, with the slabs secured to battens at the back, has made in it a groove of square section—say of ¼ to ½ in. side, according to size—running round its face, just inside the edge. Into this groove four slips of wood, like the square rules so common in French schools and offices, fit easily. The paper is wetted in the usual manner, and, when fully expanded, is attached to the board by means of the slips being forced into the grooves, carrying with them the edges of the paper. When it is required to release the drawing, all that is necessary is to push out the slips from the back by a pencil thrust into holes, several of which are bored from the bottom of the grooves right through to the back. To accommodate different thicknesses of paper, the slips may be made to fit very easily in the grooves, and be retained in place by slight plate springs.

Oldham is to have the electric light instead of gas. As a rule the northern towns are backward in electric progress compared with some of the southern towns, several of which have long had the new light.

HOW TO MAKE A PORTABLE HOT-AIR OR VAPOUR BATH.

BY R. A.

Introductory Remarks. — This article is written mainly in response to a correspondent who wished for instructions to make the above-mentioned article; therefore, though I shall give all necessary particulars, yet it will be in a more terse form than is usually adopted: a slavish following of ideas is not required. I will give a general description, with details where necessary, and the intelligent reader will be at liberty to alter dimensions and modify or add to arrangements as may suit his individual requirements. With these remarks, I will commence to describe

The Case.—This can be of any wood the maker chooses; good deal will do as well as anything, and is easy to work. It is in shape a rectangular box, higher at the back than the front. Fig. 1 is a general view of it, with dimensions as follows: Size at bottom, 3 ft. 6 in. by 2 ft. 6 in.; height at back, 3 ft. 10 in.; height in front, 2 ft. 9 in. In the front are two doors, A, A; on the top are another pair of doors or lids, B, B, hinged to the sides of the box. These lids have a semicircular piece cut out of each side, and nicely smoothed and rounded off; this is where the head of the sitter comes through. I might mention in passing that a friend of mine suggested a sloping reading-desk to be fixed at the lower part of one of the doors, so that the bather could place his WORK upon it, and peruse it whilst enjoying the pleasures of the bath. I refrain, however, from adding any such refinement to my plan, fearing that it might, if adopted, cause the user of it to stay longer in the bath than would be good for him. After this warning, anyone can add the desk who wishes to do so.

It is not my intention to give detailed instructions of the making of the case, and will leave it to the judgment and taste of the reader whether the sides and doors shall be plain or panelled, and other little details of making. I would advise that no fastenings of any kind be used to the doors, in case the occupant wishes to step from the bath very quickly. A stop can be placed to keep the front doors from going inwards, or they can be hung low enough for the door to close against the bottom, which will answer the same purpose. The two top doors should project or overlap the front doors an inch or two, and a strip of wood nailed on so that when they are shut they will keep the front doors closed. The occupant of the bath, by simply pushing the top covers and pressing forward the front doors, has at once free passage from it in an instant. The hinges for the top covers should be those known as stop hinges, so that the cover will only open to the extent of a right angle to the position they are in when closed; or, instead of this, cords or leather straps may be used to attain the same object—viz., to prevent them falling right back when thrown up by the occupant. I think this description will suffice for the case, so we will now proceed to the

Internal Arrangements.—First, the stool or seat. This should be 20 in. or 22 in. high; an ordinary chair is hardly high enough to admit of the apparatus we shall require to fit up beneath it. I should make it square, with four plain legs without bars of any kind across, and the seat about 12 in. square. It could have a back or not, at the option of the maker, and a few holes might be bored in the seat. The next thing to consider is the heating and vaporising arrangements. For the lamp, I should advise a Hinks' duplex burner, fitted to a tin tank about 9 in. square by 2 in. deep. Get one of the kind that has an extinguishing lever, which will be useful. We now come to the most important part of all—viz., the vaporising arrangement. I have thought of, and rejected, several plans, but at last I have decided to recommend a method and apparatus that will act as a reservoir for the water, and at the same time conduct away the heat from the lamp. Reference to Fig. 2 will assist in the explanation which I will now give. A is an elbow and flange of 2 in. pipe, to be fixed to the back of the case; B is the reservoir. It consists of an inverted funnel with a deep band round the outside; this you will have to get made—any tinsmith will understand what you mean. The shaded part shows the water, which, of

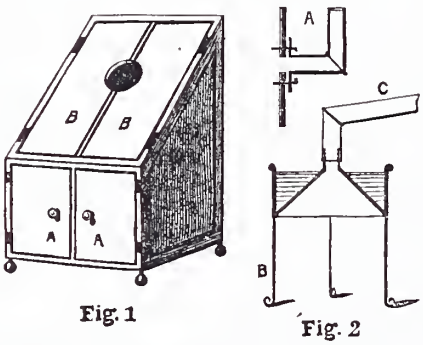


Fig. 1 Fig. 2

Portable Vapour Bath. Fig. 1.—General View of Case. Fig. 2.—Water Holder—A, Heat Pipe; B, Reservoir; C, Elbow.

course, would be all round. It must be made—or, rather, it had better be made—of copper. Three legs should be riveted on, of sufficient height to allow the lamp to be placed beneath it. C is an elbow to slip on the funnel top and into the pipe in the back of the case. To work the arrangements, you have simply to place the lighted lamp upon the floor, place the funnel and pipe in position, fill the funnel nearly full of water (hot, of course), place the stool over the apparatus, and by the time you are ready for the bath it will be ready for you. I need not take up further space by detailing means whereby the heat may be increased or lessened: they will suggest themselves to the ingenious operator. I will just mention that a cord can be attached to the extinguishing lever, so as to enable the sitter to put it out at once should he wish to do so. This cord would have to be run through an eye *below* the lever, as the levers are made to pull down. A talc spreader on the top of the chimney would be an advantage, as it would diffuse the heat to the sides of the funnel better. It would also be better if the chimney of the lamp were made of copper, with a talc front, as it could be a little shorter, which would be an advantage, and the expense of breakage would be saved. These copper chimneys can be obtained to order from any ironmonger. This concludes my instructions and suggestions. I trust they will be of service, not only to the original querist, but to all WORK readers.

BOOT AND SHOE MAKING.

BY WILLIAM GREENFIELD.

BUYING THE LASTS, AND FITTING THEM UP TO THE MEASURE OF THE FOOT.

Buying the Lasts.—It has been said, "The first thing in a boot is the last," and in writing the following articles upon the above subject it will be seen I have thought it best to deal with the last first.

In making a pair of boots or shoes, the lasts are the one thing that cannot be done without. German made lasts can be got now at nearly all leather and grindery shops.* Prices range from 9d. to 2s. per pair, according to whether they are wanted for the purpose of ladies', gent's, or children's boots. Many of these lasts are not of good shape, but if you buy a pair of four or five fitting,† there is nearly always enough stuff of which to make a good pair of lasts.

The dotted lines in Fig. 1 indicate the faulty parts of these lasts; but these faults, with a little skill and trouble, and a good rasp, can soon be set right. In doing this the plan of the bottom of the lasts should be shaped as in Fig. 2. This will save the trouble and expense of going to the last maker and having a pair made, and you will really get a good shape, for they can be got to the shape of your foot as well by yourself as anyone, and then you not only take the credit of making the boot, but also of fitting it. This will give you courage to try a pair for anyone else.

Fig. 1, minus the dotted lines, shows the proper shape of a last—being not too round at the bottom (A), nor projecting too much at B or C, for a round bottom will not only make the toe turn up, but will, while the boot is being worn, cause undue strain on certain parts of the front (or vamp). If there is too much stuff at B it will tend to throw the heel of the boot too far back, and also make it higher at the breast (D) than at the back, as shown by the two lines B and D, whereas, if taken off, the heel can be built in proportion all round, as shown by D and E. The disadvantage of a last being too prominent at the place C is that it makes the toe of the top an exceedingly difficult thing to last in.

In Fig. 2 it will be seen that there are three shapes of toes, but this should make no difference in the construction of the inside of the last; for, no matter what the shape of the last is to be, room must be given for the great toe, or a bunion will be the result.

The plan of the bottom of the last (Fig. 2) is (it will be seen by comparison) designed to suit the requirements of the foot, as it is drawn on the sheet of paper (Fig. 3).

To take the measure of the foot, place a sheet of paper on the floor, or any smooth surface. Then let the person stand full weight upon it, and draw an outline of the foot on the paper, being careful to hold the pencil quite perpendicularly at the toe and heel (C and D, Fig. 3). Then draw a second and third line as A and B, to give the curvature of the waist. It is customary then to take the length of the foot with a size-stick‡, but as this, and the measuring

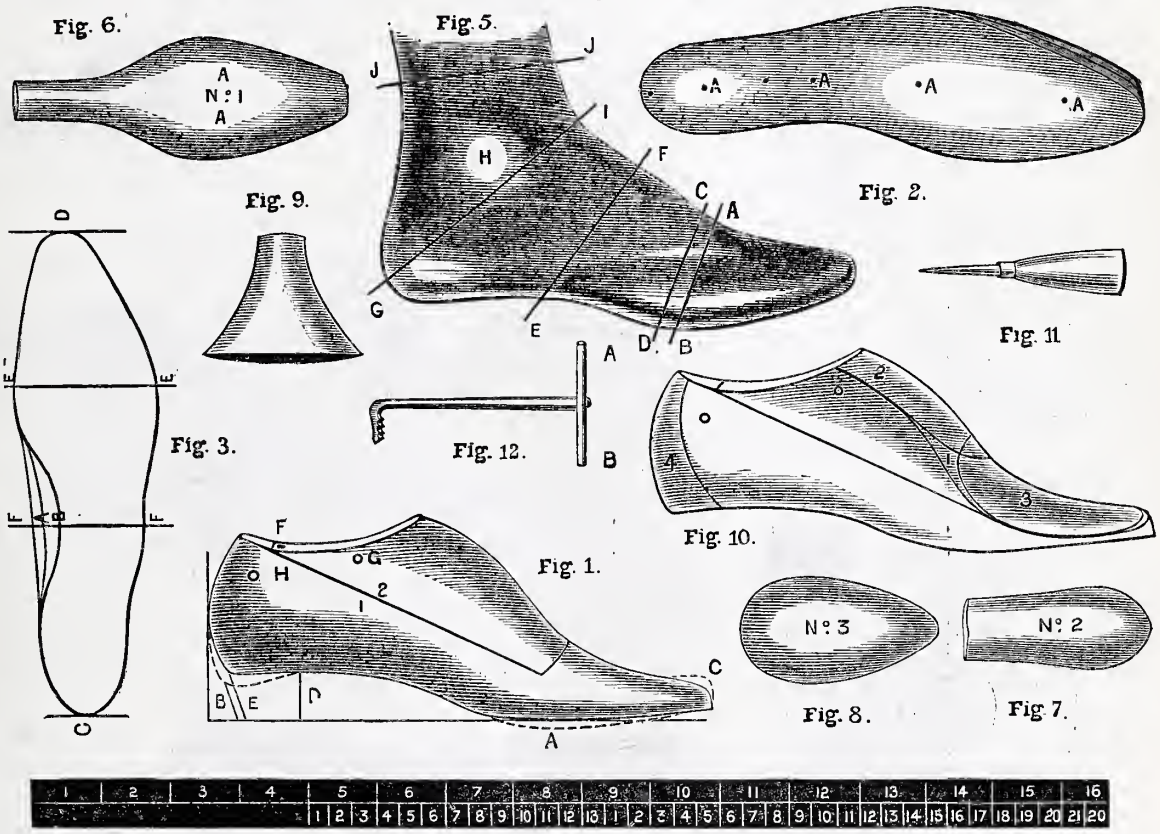
* "Grindery" is the term used for such things as hemp, flax, wax, bristles (hog's hairs), rivets, pegs, heelball, etc.

† "Fitting" is the girth measurement of the joint and instep.

‡ A size-stick is a tool in the form of a rule. It has an upright at right angles, which is a fixture at one end, and another to slide up and down, which (as the stick is pressed against the sole of the foot and the fixed upright at the back of the heel) can be set *ad libitum* to the top of the toe, to indicate the length on the stick.

of the last, is the only use for the tool, I do not think it necessary to do more than give a description of it, as in the footnote.

Fig. 4 represents a penny tape measure (shoemaker's); it has inches on one side, and sizes (three to an inch) on the other. A 5's last measures just 10 in. Before buying the lasts, take the length of the draft from C to D (Fig. 3) with this tape, and, supposing it to measure size 5, you will need a last size 7. Had the length been taken with a size-stick off the ground, it would only have drawn size 4, but you would have needed a 7's just the same. This proves that the joints in the toes elongate in walking, and shows the urgent necessity of having the boot or shoe longer than the foot. When the size of the foot has been taken, as shown by Fig. 5, it should be put upon the drawing. The next measure to be taken is the joint. This should be done with the inch side of the tape. It must encircle the whole of the joint, and be only drawn just tight. For this measurement we must pass under the foot at E E (Fig. 3), and over the great toe joint and knuckle of the little toe, as A B (Fig. 5), this measuring 8 in., which we then place on the draft, and so on with each measure until all is taken. Now take the second joint, passing the larger parts of the ball of the foot as C D (Fig. 5), and next the instep, letting the tape pass under the hollow of the inside waist E (Fig. 5), across the bone F (Fig. 3), and instep bone F (Fig. 5). Then the heel measure is taken, passing round the extremity of heel (G), under the ankle (H), and across the throat of the foot (I). The leg measure is taken about $1\frac{1}{2}$ in. above the ankle bone (H) round the leg from J to J.



Boot and Shoe Making. Fig. 1.—The Last (1) and Block (2). Fig. 2.—Bottom View of Last with Three Shapes of Toes. Fig. 3.—The Shape of the Foot on a Sheet of Paper. Fig. 4.—Shoemakers' Tape Measure, with inches on one side and sizes on the other. Fig. 5.—The Stockinged Foot, showing how to take the Measure. Figs. 6, 7, 8, and 9.—Tools as Noted. Fig. 10.—Last with Fittings and Heel-pin, showing their Position. Fig. 11.—Peg-awl in Handle. Fig. 12.—Last-hook with Handle.

In fitting up the last to the measure taken, if it be for a gentleman's ordinary foot, one not too bony or very fat, and the boots are wanted to fit well and not too easy, then let the last be exactly the same measure as that of the foot. If it be for a lady's, it will need to be about half a size* smaller than the measure at the joints and instep, unless the boots are wanted very easy. If wanted easy for gentleman's boots, make them about half a size over the measure. For all children's work about a quarter over the measure must be taken.

If you can get an old shoe that is of no more use for wear it will be found to be one of the safest guides to a fit. You can fit the last up to it—that is, if the shape of the toe you want to make is not wider than the old shoe; if it is, you must cut the toe of the shoe right round, to admit of its spreading out to the shape of the last you are about to put in. By fitting a new last into an old shoe, you can soon see if it is of the size and the shape to suit your tread. If it wants a piece on anywhere, for a corn or bunion, this can soon be added by means of pegging on a piece of leather. Should you want such a piece the exact spot is very readily found while the last is in the shoe, for, if it is deficient at any particular part, the leather of the old shoe will be baggy. Then an awl hole, pierced through it into the last, will show exactly the place where you want the room and where you will need to make the last larger.

Should the last be a little too small in the fitting (girth), or you should want to make another pair of boots a little larger to allow for a thicker pair of stockings, or even a pair for anyone with a little larger foot than your own, you will find it very handy to have a set of ordinary fittings. These are best made from the softest part of crop belly, which is just the flank ends of the leather, and of not much use for anything else, therefore cheap. It must be well wetted, and stretched with a pair of pincers. Then cut out roughly to the shape of Figs. 3, 6, 7, 8, and 9.* The shaded drawings show how they should be skived† thin to the edge; then while wet tack them on the last in their proper position as indicated by the figures 1, 2, 3, and 4 in Fig. 10. Each piece, however, must be put on separate and allowed to dry in order to block it to the last before it is taken off; then the edges can be cut evenly all round, taking care not to take the block (or shape) out. Each piece must be served the same way. For the benefit of booking* them, they can be marked 1, 2, 3, and 4, as shown above. Bunion pieces should be pegged on with fine $\frac{1}{2}$ in. pegs. The piece of leather must be put on wet, and pegged so that it can be skived down all round smooth to the last, leaving an even projection to the shape desired. To put in pegs, a hole must always be made with a peg-awl (Fig. 11) quite as deep as the peg is long, the peg being always driven home with one blow from the hammer. To get the last out of the shoe a tool called a last-hook (Fig. 12) is used. The screw (F, Fig. 1) having been taken out, the hook is inserted in the hole, G, to draw the block, and in H to draw the last, taking the toe of the shoe in one hand and the heel in the other. Then put the handle of the hook on the ground, and by standing on A and B (Fig. 12), you will get plenty of power to pull the last out.

* A sixth of an inch.

* Fig. 6 is called a long leather (abbreviated L. L.); Fig. 7, an instep leather (abbreviated In.); Fig. 8, joint leather (abbreviated J.); Fig. 9, heel-pin (abbreviated H.-p.); when a piece is put on the toe it is called a toe-pin (abbreviated T.-p.); a piece on either side, a side-pin (abbreviated S.-p.).

† To skive, is to take the knife from A A (Fig. 6) just in a slanting position to the outer edge, and skive away the shaded parts gradually till there is *nil* at the extreme edge.

* Supposing a last is used with no fittings on, and you have numbered it 1, book it as 7's, No. 1 bare; or if you used it with heel-pin, toe-pin, and one L.L., book it 7's, No. 1, H.-p., T.-p., and No. 1, L.L., and so on for any fittings.

A GEARED WHEEL-CUTTER AND DRILLER.

BY F. A. M.

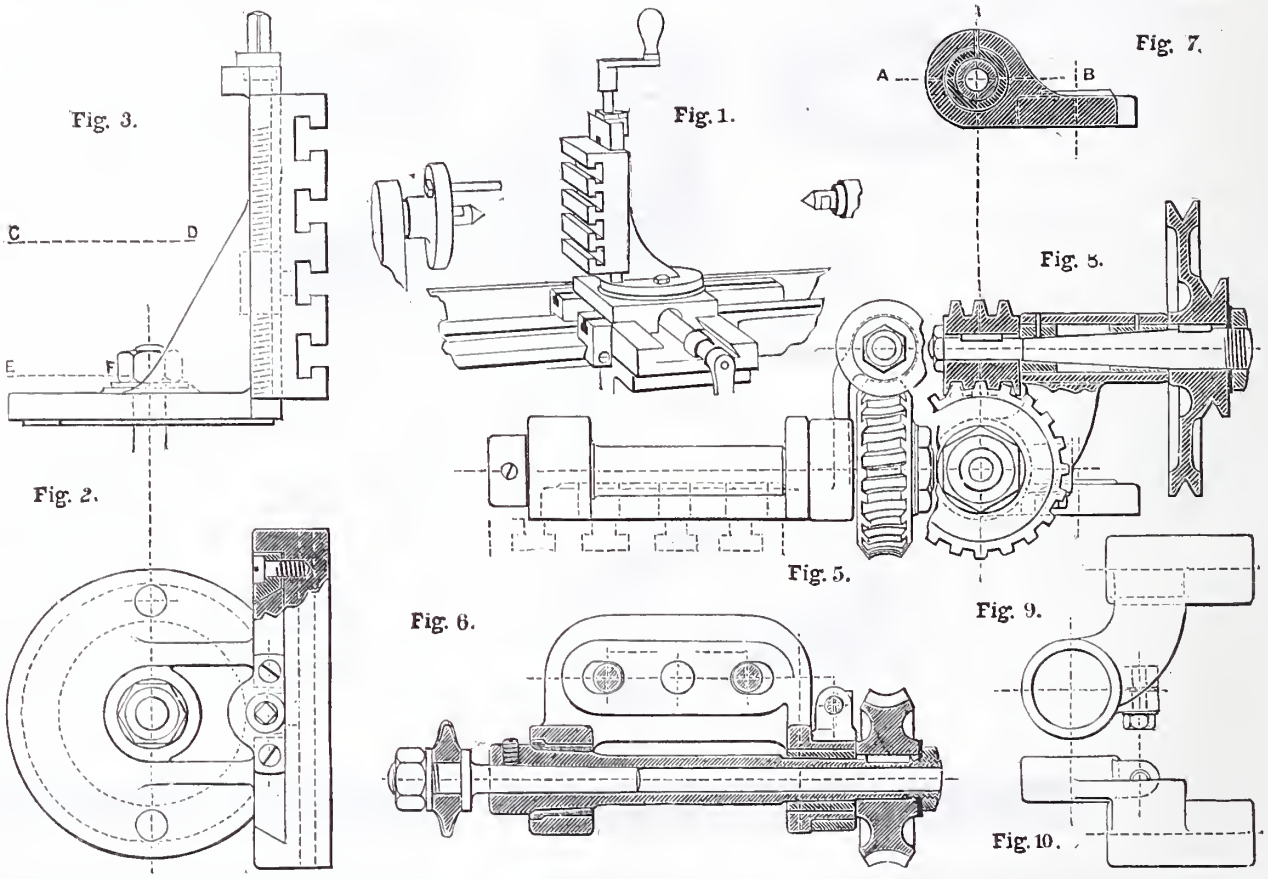
An ordinary drill will only produce a hole, but if the drill be fixed, while revolving, upon the top slide of a slide-rest, then the

workman has the power, not only to advance it into cut, as when drilling holes in a division-plate, but he can also cause it to *travel sideways* while cutting, and thus produce a groove or slot. This process was partly illustrated on p. 92 of Vol. I., but there the driller was only intended for working upon wood, and to run at a quick speed (see Figs. 1, 2, 3). Where, however, we desire to drill slots in metal, the driller must be of a stronger form, and it must be geared, so that the speed of the driving-belt shall be translated into power at a slower speed. This gearing is for a similar purpose to the "back-gear" of lathes, and it may be managed in the usual way by cogged wheels, or, as in the example before us, by a worm and wheel. As an example of slot-drilling, notice the hole in a spirit-level through which the glass is seen; it may be 1½ in. long, and has rounded ends. The power to produce slots or grooves of any section, flat-bottomed or round, is most useful to the workman, and the drills are very easily made.

The grooves in shafts for keys to secure wheels, and the spaces between the teeth of cogged wheels, may also be formed by slot-drilling; but this work can be done much more advantageously by milling cutters, little hardened steel discs or wheels about 2 in. in diameter, having their edges serrated, so as to act as saws or revolving files (see p. 252 of Vol. II.). Now, for this purpose there is generally provided a frame, carrying a spindle, geared to produce the speed and give power to the cutter, and so arranged that it can be held in the slide-rest. Here, however, the idea suggests itself, Why have two sets of gearing and two spindles; cannot the two instruments be combined? The answer to that question is the design now laid before our readers.

Thirdly, both the geared driller and the geared wheel-cutter need to be adjusted for height, and for this we require a vertical slide. Some idea of one may be obtained by looking at p. 730 of Vol. II., where will be seen a wheel-cutter designed by Mr. Milnes having a vertical slide for height adjustment. This is a very good appliance for wheel-cutting—it drives very smoothly and with great power; the present design is an attempt to improve upon it by making it do drilling and other things as well. Looking again at the Fig. on p. 730, it may be noticed that the angle-bracket is intended to bolt down upon the tool-plate of the slide-rest, so that the cutter can, by the vertical slide, be adjusted to the height of the lathe centres. If now the spindle and its bearings were made detachable from the face of the vertical slide, then this face would be available for bolting work to, which work might then be held firmly in front of the mandrel, and, a cutter being fixed therein, the work could be milled. This makes a third use to which the apparatus could be put. Turning now to Fig. 1, we see the vertical slide alone; fixed, not on the tool-plate, but on the cross slide, in the place of the slide-rest; this brings it lower down and more opposite the centre of the mandrel; it is fixed by the bolts which usually secure the slide-rest. Figs. 2 and 3 show this part in detail, and in Fig. 3 there is a line (C D) showing the position of the line of centres when the bracket is fixed, as in Fig. 1, whilst the line E F shows the height of centres when it is secured to the tool-plate by putting the central hole of the flange over the holding-down bolt of the tool-holder. Thus mounted, the appliance holds work to be milled by cutters running in the mandrel.

Fig. 4 shows how the geared driller can be attached to the face of the vertical slide. This part is shown in detail in Figs. 5 to 10. The driller may be driven by the worm and wheel, or the pulley may be exchanged for the worm-wheel, when it appears as in Fig. 4, and is driven by the band direct. The small bracket (Figs. 9 and 10) fits upon the end of the driller; it carries a hard steel spindle running in hard collars; at one end of this spindle is a two-speed groove pulley, and at the other a worm; this little bracket can be swung round to suit the band, and fixed, or it may be taken off altogether. Passing on to the main drilling spindle (seen in section at Fig. 6), it is bored throughout with a ⅜ in. hole; it may be bolted upon the top of the tool-plate by the centre one of the three holes, and when in that position its centre line should correspond with the lathe centres; it is bored at the large end to fit the smallest Morse-taper size, and the hole in the mandrel being the same, any drills, chucks, milling-cutters, slot-drills, etc., can be used in either, and should interchange. Thus the driller is equivalent to a perfect little lathe-head, and can be used, driven by a band from the overhead, for making small screws from stock passed in through the thoroughfare hole. A little set-screw is shown for securing the chucks, but probably many will prefer to dispense with it, and trust simply to driving them in. A cutter or slot-drill might, for instance, be turned up in the mandrel, and, when finished, transferred to the hole in the driller, where it should fit equally well and run perfectly true.



Geared Wheel-Cutter and Driller. Fig. 1.—Vertical Slide for Milling. Fig. 2.—Plan View. Fig. 3.—Side View of Angle-Bracket. Fig. 5.—Side View of Wheel-Cutter and Driller. Fig. 6.—Sectional Plan. Fig. 7.—Section through A B. Fig. 8.—End View of Section of Worm Shaft. Fig. 9.—End View of Removable Worm Shaft Bracket. Fig. 10.—Plan of Worm Shaft Bracket.

Fig. 11 shows the apparatus arranged as for wheel-cutting, except that it should be bolted on to the tool-plate, so as to raise it higher up; also the swivelling bracket is secured by a set-screw instead of by the proper method shown at Figs. 9 and 10.

Now as to the speeds at which the cutters can be driven. We may have a fly-wheel of 28 in. diameter; on the pulley of the driller there are two speeds of 4 in. and 2 in. Supposing an average rate of treading of 80 revolutions per minute, and that the band coming down from the overhead runs at the same speed as that leading up to it; then, since the worm-wheel has twenty teeth, and the worm one thread, we have the speed ratios of—

$$\frac{28}{4 \times 20} = \frac{7}{20} \text{ or about } \tfrac{1}{3}, \text{ and } \frac{28}{2 \times 20} = \frac{7}{10}$$

This gives for the cutter at 80 treads per minute $80 \times \frac{1}{3} = 27$ revolutions, and $80 \times \frac{7}{10} = 56$ revolutions.

If we take 80 revolutions as the proper speed for a 1 in. cutter working on cast-iron, then the 2 in. cutters for wheel-cutting might run at 40 revolutions, which gives 20 ft. per minute, about, for the rate of cutting; so that by treading a little slower, the faster speed would be right for cast-iron and the slower speed would do for cutting steel or when a larger cutter must be used.

Mr. Milnes has adopted the design, and by means of this comparatively simple apparatus, which can be made at a low cost, a vast variety of work can be done.

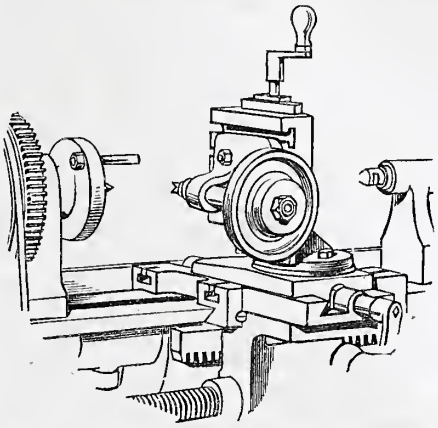


Fig. 4.—Gear-Cutter arranged for Slot-Drilling.

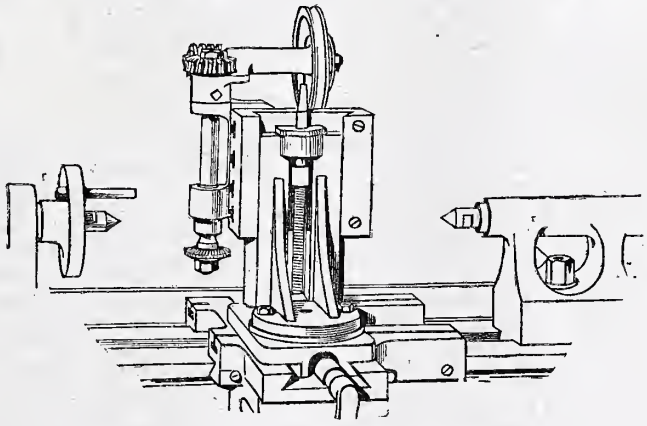


Fig. 11.—Appliance arranged for Wheel-Cutting.

HOW TO TEST GOLD.

BY H. S. GOLDSMITH.

Several correspondents wanting to know how to test gold, it has been thought best to make the subject one for a short article. I suppose it is testing by the "touch" that they want to know about, and not by "assay." If it is by assay, then the best course will be to join a class in metallurgy under the Science and Art Department, where it would be taught under proper supervision; for to carry out properly this most delicate process it is necessary to have seen it done and to practice the methods, as there are two, a "wet" and a "dry" assay.

With the "touch," which is more of a rough-and-ready test, I can perhaps deal successfully here.

The chief requisite will evidently be something which will discriminate between qualities, and nitric acid does that for us; and it *is by comparison of the way nitric acid acts on certain known qualities of gold, with the way it acts on the article to be tested, that the "carat," or quality, is ascertained.*

The necessary appliances are:—

(1) A touch-stone (usually a piece of Lydian stone, which is, I believe, a black variety of jasper): this has its surface smooth and partly polished, but is not bright; or a piece of Wedgwood ware (black for choice) does very well; and, at a pinch, one might even use a piece of ground glass.

(2) A series of "needles," or pieces of gold, of such qualities as we think are necessary. These are to be our standards of comparison; and for general use small pieces of wire of 9, 12, 15, and 18 ct. should be sufficient.

(3) Nitric acid in some convenient bottle. There are bottles specially made, with a long-pointed stopper, so that a small drop of the acid can be got out without dropping any or without coming in contact with the fingers; for it would destroy the skin where it touched.

The ordinary commercial nitric, as sold by oil-shops, will do. Aquafortis is another name for the same stuff.

Now, to test any article we first have to get a rubbing on to the touch-stone from some one or two places that shall fairly represent the whole. For example, let us say we get a clean streak of gold, $\frac{1}{2}$ in. long and $\frac{1}{8}$ in. wide. Now, by the side of this we take rubbings from our known qualities, then put a narrow streak of nitric acid across the whole lot.

What are we to look for now? Why, simply to see which of our standards is acted on in the same way as the rubbing from the article. The effects may vary from no change at all with good qualities to complete destruction of the rubbing in low qualities. On removing the acid by means of tissue-paper or a rag, the effect can be better judged.

Let me repeat that it is by comparison we arrive at a result; but, of course, it is easily possible to arrive at a false conclusion if an unfair sample (or rubbing) is taken. A piece of work may be very thickly plated, or even gilt, and the rubbing taken may not go through the gold into the metal; and, on the other side, the soldering seam may alone be tested, where the gold will naturally be poorer. Therefore judgment is wanted to select a place or places to apply your test; and even then it is better to file away a portion of the surface as well, and apply the stone or acid direct to it.

After some practice, when one knows the effect that acid has on the different qualities, it is customary to do without the touch-stone in most cases; but it is well to use it, at any rate, until one is quite used to the process roughly indicated here.

Coloured gold articles do not always need the application of acid; for if, by scraping the surface, there is a granular brown layer, then one can judge very nearly indeed the quality of the article by the extent of the change that has taken place below and on the surface while the article was undergoing the process of colouring. If the article is coloured, it must be more than 12 cts., fine anyhow, and is generally 15 ct.

I said that nitric acid was used—and I use it myself, as it is always to hand in the workshop—but a writer on the subject (Gee, in his "Goldsmiths' Handbook") advises for the purpose a solution made up as follows:—Nitric acid, 2 oz.; water, 4 dr.; muriatic acid, 1 scr. These to be well mixed together and kept ready for use in a stoppered glass bottle. It does not act on any quality of gold above 9 ct.; so to me it appears rather useless, being useful in qualities below 9 ct., a quality which is not much used in any decent class of jewellers' work.

Following up the way nitric acid is used on gold alloys to find the quality, so should comparison be made with its effects on silver and brass, copper, etc.; for although brass will boil green, so also will some very common qualities of silver and gold. It is a matter of experience, chiefly, this capability of judging qualities.

And besides, to people that are used to handling gold-work, the very appearance of the article is often sufficient to denote its quality.

Then its specific gravity is also another way of finding out the quality. But I must stop. Some day I hope to write an article dealing fully with this matter, and illustrating it with drawings from actual pieces of gold tested by the "touch" and by other methods. But enough is said here to clear up the present doubts of our correspondents. If more information is wanted it can be given in "Shop," on receipt of a letter of inquiry.

HOW TO PURIFY THE CISTERN.

BY E. DICKER.

I do not think it can have failed to strike anyone, in walking about the residential parts of large cities, how very much the water cisterns are exposed to all the dirt and filth that run down the walls and copings of front and back areas when it rains, and in the dry weather to all the dust and dirt which blow about—to say nothing of cats. As I write in London I see two cats seated on the cistern next door; and whenever I go out in the morning (which is early, by the way), I see broken lids, large gaping joints in the tops, and cats asleep on these, and I often think to myself what an amount of nastiness must get into the cistern from time to time.

What would the generality of people say if their meat-safes were exposed as the cisterns are? Then they would exclaim, "That is where we keep our food"; and one would never think of putting the safe in such a position. But the cistern is where

you store the water that you drink, inasmuch as the safe is where you store what you eat; and, according to the best authorities, pure water is of quite as much importance as wholesome food, and I think I may say—if there is any difference—more so. Therefore, the first step towards making the water cisterns healthy is to have a top which will render it impossible for the above-mentioned impurities to get into them. They should be made water-tight, either by lids properly made of wood, or the defective ones should be covered with zinc or lead.

They should also be periodically cleaned out. To do this, hang up the ball-valve by a piece of string to prevent the water running in, and then empty the cistern, after which thoroughly scour it out with a scrubbing-brush, and clear up any deposits left in the bottom.

In some cisterns there is what is called a trumpet waste, which is a short piece of lead pipe with a "ground in" union at the bottom. This pipe forms the overflow, and by taking it out of the "ground in" joint you can easily empty the cistern. Sometimes it is necessary to bale out the last three or four inches of water, as the "draw-offs" are generally kept some distance above the bottom, to keep clear of any deposits.

When the cistern is emptied and *thoroughly dried*, it would be a great advantage to give it two coats of one of the best of the enamel paints. By paying attention to these simple matters, one can rest assured, as far as they themselves are concerned, that the water they drink is clean and pure, also that the cistern itself is healthy. The enamel can be bought for a few pence at any oil stores, but be sure that before using it the cistern is perfectly dry. In view of the diseases and epidemics which set in with the hot weather, this cistern matter is an all-important one, which it would be a blessing to arouse everybody's sympathy with.

PHOTOGRAPHIC EXPERIMENTS.

CURIOUS, AMUSING, AND INSTRUCTIVE.

BY WALTER E. WOODBURY.

Photographs without a Lens—A Cheap Camera—Photographing Clouds—To make a Pen-and-Ink Sketch from a Photograph—To make Red Pictures; Green Pictures; Violet Pictures; Blue Pictures—Recovering Fogged Plates—Making Direct Positives in the Camera.

Photographs without a Lens.—Although a lens is the most important part of the photographer's apparatus, it is not absolutely necessary for the production of photographs. Very good pictures can be made by means of a pinhole. Remove the lens from the camera, and insert in its place a sheet of thin, hard cardboard. In the centre make a tiny hole with a fine-pointed needle made red-hot. Another method is to make a large hole in the cardboard, and paste over it a piece of tinfoil and make the pinhole in this. The essential point is that the hole be perfectly round without any burring at the edges. The most perfect arrangement can be obtained by getting a watchmaker to drill a fine hole through a piece of sheet metal. The diameter of the hole should not be greater than the one-fiftieth of an inch. Whatever is used, cardboard or metal, it should be blackened all over to prevent the reflection of light in the camera. The focussing glass should be brought within about 6 in. of the hole. Owing to the small amount of light admitted, focussing is very difficult. It can be done by pointing the camera towards the sun and focussing its image. For the same reason the exposure is very long, ranging from ten minutes to half an hour; it is, in fact, difficult to over-expose.

A Cheap Camera.—In the foregoing we have shown how a photographic negative may be made in a camera without the use of a lens. Those, however, who do not possess a camera can easily try the experiment by constructing an apparatus for themselves, costing but a few pence and a little time and trouble. Take an ordinary cigar box and cut a hole in one end, inserting a piece of metal having a fine hole bored in it. At the other end a groove is made inside so that the sensitive plate can be inserted. Blacken the whole of the inside with a dead-black varnish, and arrange the lid so that it will be perfectly light-tight. When the box is closed not the slightest trace of light must be admitted except through the pinhole aperture.

Photographing Clouds.—Nothing improves the appearance of a landscape more than beautiful cloud effects, but these are, as a rule, very difficult to obtain, for the reason that the exposure required is so much less than what it is necessary to give to the surrounding landscape. Further, the blue sky is almost as active as the clouds themselves, so that the contrast is lost to a very great degree. The most effective plan is to arrange in front of the lens at a suitable angle a sheet of black glass, one surface of which is a true plane, and to photograph its reflection of the clouds. The effect of this black mirror is to extinguish the polarised portion of the blue light of the sky and to reduce the brilliancy of the general illumination. All the finest and most beautiful structure of the clouds, which otherwise is so dazzling as to be obscured from sight, is now plainly visible, and for the making of cloud negatives for printing in landscapes this method excels all others.

To Make a Pen-and-Ink Sketch from a Photograph.—The following is a plan so simple that anyone without any knowledge of drawing can produce from a photograph a perfect pen-and-ink sketch suitable for reproduction as an illustration. Make an ordinary silver print from a negative, fix it, and thoroughly wash without toning. When dry, trace all the outlines out carefully with a pen and ink. This done, all that is necessary is to immerse the print in a saturated solution of bichloride of mercury, when the photograph will disappear, leaving the outline sketch intact. Thoroughly well wash and dry.

To Make Red Pictures.—Float a piece of plain paper for about twenty seconds on the following solution—uranium nitrate 1 part, water 5 parts—and dry it before a fire in the dark. Expose it behind a negative in an ordinary printing frame. Length of exposure varies from eight to ten minutes in the sun to an hour or two hours in the shade. Wash the print for a few seconds in water heated to about 120° Fahr., and immerse it in the following: potassium ferrocyanide 1 part, water 50 parts. In this solution the picture will in a few minutes become of a beautiful red colour. It should then be well washed until the water is colourless, and then dried.

To Make a Green Print.—Take a red print made in the manner described above, and place it in nitrate of cobalt 2 parts, water 100 parts. Remove it, and without washing dry it before a fire, when it will become of a green colour. To fix, place it for a few seconds in the following solution: sulphate of iron 2 parts, sulphuric acid 1 part, water 50 parts. Well wash, and again dry before the fire.

To Make a Violet Print.—Prepare plain paper with uranium nitrate as recommended for making red prints, and after printing underneath a negative, wash in hot water and develop with chloride of gold 8 grains, water 2 oz. When a fine violet colour is obtained, wash the part in several changes of water, and dry.

To Make Blue Prints.—Float plain paper on a solution of potassium ferrocyanide 20 parts, water 100 parts. Dry in a dark room. Print under a negative while the shadows are of a light bluish colour. Place the print in a saturated solution of bichloride of mercury, then wash it in water, and place it in a saturated solution of oxalic acid heated to a temperature of 100° Fahr. It is then washed in several changes of water and dried.

Recovering Fogged Plates.—It often happens through accident or otherwise that sensitive dry plates get exposed to the light and are considered spoilt and of no further use. This is not the case, however; all that is necessary is to immerse the plate for about five minutes in a solution composed of chromic acid 30 grs., potassium bromide 60 grs., water 10 oz. The operation must take place in the dark. They are then thoroughly washed and dried, after which they can be again used in the camera as before, only that they are somewhat less sensitive, and consequently require a little more exposure.

Making Direct Positives in the Camera.—Prepare a saturated solution in water of the crystals of thiosinamine, and add from two to eight minims of it to an ordinary pyro or eikonogen developer. Expose rather less than usual. The effect of this addition to the developing agent is an entire reversal of the image, a positive instead of a negative being obtained. Ammonia will assist the reversal. Colonel Waterhouse, the discoverer of this process, recommends in some cases the plates being subjected to a bath of 5 per cent. nitric acid and 3 per cent. potassium bichromate before exposure, followed by a thorough washing.

PLASTERERS' WORK.

BY A WORKING PLASTERER.

Introductory—Tools—Mortars and Cements—Hair—Laths—Three-Coat Plastering—Render, Float, and Set—Screeds—Lath, Lay, Float, and Set—Fine Stucco—Rough Stucco—Two-Coat and One-Coat Work—Pugging—Rough-Casting—Concrete Floors.

Introductory.—Plasterers' work is the art of covering walls and ceilings with mortar or cement; it also includes the running of beads and mouldings, and the casting and fixing of trusses, ceiling flowers, and enrichments. We are indebted to the labour of the plasterer for much of the comfort of our houses.

Tools.—The tools used by the plasterer are: the plastering trowel (Fig. 1), with which the mortar is spread on the walls or ceilings; the mortar is laid on a hawk or hand-board, which is a board about 12 in. square, with a handle on the underside, and is held in the left hand. The gauging trowel, which is an ordinary trowel with a blade about 7 in. long, and is used for mixing gauged stuff. The screeding or floating rule is about 6 ft. long, narrowed down at the ends, which is used for straightening the work. The hand float is made of wood, about 10 in. long and 4 in. broad, with a

wooden handle on the back, and is used for floating and levelling the work. The darby, or two-handed float, is about 2 ft. 6 in. long, with two handles on the back, and is used for levelling large surfaces.

The lath hammer (Fig. 2) is used for nailing the laths to ceilings and stoothings. Mitring tools (Fig 3) are used for mitring mouldings, and are of various sizes; they are made of steel. The mitring rule (Fig. 4) is also used for mitring mouldings. Flat and round brushes are also used by plasterers, and moulds of various kinds. The mortar is laid on a large mortar board, supported on legs about 2 ft. 6 in. high. For preparing the mortar, riddles and sieves of various degrees of fineness are used. A scoop with a long handle is used for ladling the liquid lime into the riddle; and a drag, which is a rake with two or three iron prongs, is used for mixing the hair with the mortar. A wooden beater 4 in. square, with a cross handle at the top, is also used for beating the mortar.

Mortars and Cements.—The mortar used by the plasterer is made from the best stone lime; chalk lime is not suitable, although it is sometimes used for putty. The lime should be freshly burnt, and should be laid under cover if possible. A pit of a suitable size, about 18 in. deep, and lined with boards or bricks, is prepared, also a tub about 3 ft. in diameter and 2 ft. deep. A quantity of the lime is thrown into the tub and covered with water; it will begin to boil in a short time, and is stirred with the drag till it has all fallen, when it is ladled into a riddle or sieve fixed above the pit; it should be of a thick, creamy consistency, but not too thick. When the riddle is full of "craps," as they are called, it is emptied, and again refilled, till the pit is full; if hair is to be added, it is mixed in the pit with the drag, and the whole is allowed to stand till stiff. If water rises to the top of the mortar in the pit, it should be run off. Sometimes the lime is slaked, and used in powder instead of being boiled, but it works better when boiled. If the lime is wanted for putty, no hair is added. Parian, Keene's, and Martin's cements are used for running skirtings, mouldings, etc. They are mixed with fine sand, and set very quickly; they finish with a beautiful smooth surface. Plaster-of-Paris, made from calcined and ground gypsum, is used for running mouldings and casting trusses, etc. It sets very quickly, and is generally mixed with about two-thirds fine white putty.

Robinson's cement is used for easting and mouldings; it sets very hard. It is also used for plastering where work requires finishing very quickly. The makers state that it can be papered or painted in a few days after finishing; the cost is rather more than ordinary plastering. The first coat is laid on with No. 2 quality, No. 1 being employed for finishing (it is mixed with about three parts of fine, sharp sand); No. 3 quality is used for floors, concreting, etc.

Portland cement is used for wall plastering, for skirtings, for concrete floors, and tile-fixing, and for coring or floating under the more expensive cements; it is generally mixed with three parts of fine, sharp sand.

Scagliola is a species of plaster invented in Italy; it is composed of various earthy colours mixed with plaster-of-Paris, and when laid on can be polished to a very fine surface.

Hair.—The hair used by plasterers is generally bullock's hair; it should be long, and free from hard lumps; its use is to strengthen the mortar. In mixing, it is beaten on a wood floor, then soaked in water, and mixed in the liquid lime by means of the drag.

Laths.—The laths are made of fir, and are from 2 ft. to 5 ft. long, 1 in. wide, and from $\frac{3}{16}$ in. thick; from 110 to 120 are in each bundle. They are split or riven with a special knife, and are nailed on with cast-iron or steel nails; they should be about $\frac{3}{16}$ in. apart, so that the mortar can be squeezed through between them, forming a key on the inside; the bond should be broken every 2 ft. 6 in. when nailing them; if nailed too close, the work will crack or fall off. Sawn laths are also made, but they are not so strong as split laths. Laths are known as single, lath and half, and double, relating to the thickness. Woven wire is sometimes used instead of laths.

Three-Coat Plastering.—In executing three-coat plastering, the walls are first coated, then scored over with three or four pointed laths nailed together, to form a key for the second coat; this is allowed to get white dry, when the second coat is laid on with the float, and when this is about half dry, the third coat is laid on and smoothed with the trowel and brush. The first coat on walls is called rendering, the second floating, and third setting. In order to make the floating straight, "screeds" are laid on the walls at intervals of about 6 ft. These are bands or widths of plastering about 6 in. wide, which are straightened with the floating rule. Screeds are fixed in the angles; these should be made plumb, and the intervening screeds are lined to them; after the screeds have been laid on, the spaces between them are filled up and straightened with the rule and made level with the darby and hand float. The joints in the walls should be raked out, and the walls brushed and wetted before commencing to plaster.

Three-coat work on ceilings and partitions is executed in a similar manner; it is called lath, lay, float, and set. The laths are first nailed on, then coated over and scored to form a key to the floating; this must be white dry before being floated. It is then floated and set in the same manner as described for walls. The first coat on ceilings is sometimes called "pricking up." The mortar for laying and floating ceilings is mixed in the proportion of about one of lime to three of sand; that for walls contains a greater proportion of sand. The setting or third coat on walls and ceilings is made with putty and fine sifted sand; the putty is washed lime which does not contain hair. The sand for plastering should be clean and sharp; good work cannot be made with soft or loamy sand. Sea sand should not be used, as it strikes out damp. Sometimes the third coat is mixed with a proportion of fine, light-coloured hair, and trowelled smooth; this is called fine or trowelled stucco. Rough stucco is that which is finished with the float. A piece of felt is often nailed over the float for finishing this work.

Sometimes plaster-of-Paris is mixed with the putty for the finishing coat, which makes it finish with a hard, smooth surface. This is called gauged work, and when plastering is required to be finished very expeditiously the whole is executed with gauged stuff.

Two-coat plastering is rendered, and levelled at once with the float, then set when dry; it is not scored or screeded.

One-coat plastering is rendered, then smoothed with trowel and brush. The two latter methods of plastering are only used on inferior work.

In using the hand float, a nail is sometimes driven through it with the point projecting; this scores the floating, forming a key for the setting or putty coat.

Pugging.—This is coarse mortar mixed with hair, and spread to a thickness of $1\frac{1}{2}$ in. to 2 in. on boards nailed between the upper floor joists in houses to deaden sound.

Rough-cast.—This is used in some districts for covering the outer walls of houses. The wall is rendered with hair-and-lime mortar, and, while soft, the rough-cast, which is formed of gravel about the size of peas mixed with liquid lime, is thrown against it by a flat board with a handle at one end. The sand is sifted out, and the rough-cast must be made as level as possible, and must completely cover the rendering.

Concrete Floors.—These are formed of Portland cement, and crushed bricks, slag, or limestone to pass through a $\frac{1}{2}$ in. mesh. The foundation must be levelled and well beaten; wood pegs are then driven in, the tops of which are level with the finished surface of the floor. Then lay a covering of broken stones to pass through a 2 in. mesh over the whole surface, and from $1\frac{1}{2}$ in. to 3 in. below the tops of the pegs according to the required thickness of the floor. The broken stones should be not less than 3 in. thick, and for heavy work should be more. The stones are beaten down level, then mix the concrete on a wooden platform, in the proportion of one of cement to five of crushed bricks (the ingredients should be measured in a box, open at the top and bottom); the whole is then turned over and thoroughly mixed with the shovel and drag; then form it into a pie and mix with water. It must not be saturated, but every portion must be wetted, turning it over and mixing with the drag. Then commence to lay the floor, starting from the side opposite the door; the concrete is levelled to the top of the pegs by a rule, and beaten solid by a beater similar to a hand float, but made larger. When the whole is laid and beaten level, it must be left from eight to twelve hours to harden; it is then smoothed over with the plastering trowel.

Fig. 1.

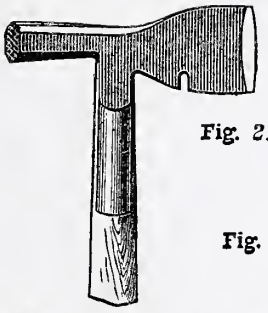


Fig. 2.

Fig. 3

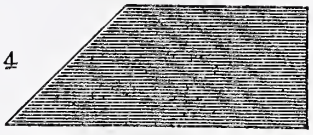


Fig. 4

Plasterers' Work. Fig. 1.—Plastering Trowel. Fig. 2.—Lath Hammer. Fig. 3.—Mitring Tools. Fig. 4.—Mitring Rule.

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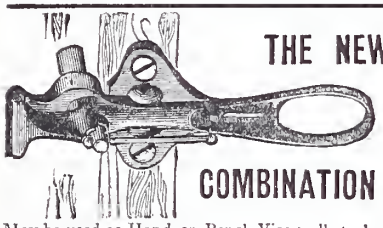

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CRAFT TRAINING.—The Company of Armourers and Braziers have just been holding their third exhibition of works in brass. We welcome exhibitions of this class. The example of the Armourers might be followed with advantage by many of the other City companies. It is not one of the wealthiest of the City companies, yet it is especially active in the interests of technical education. If the City companies wish to justify their continued existence, they must do good work that will be appreciated by the people. It is impossible to over-estimate the ultimate effect of technical education among the people. The craft companies of the City of London could soon make the old-fashioned rule-of-thumb workman as extinct as the dodo. Then would evolve a new race of artist workmen whose works might rival those of their mediæval brethren, "the evangelists of art," "laureates of their gentle craft," who left their noble deeds in stone and metal. The Armourers will award their certificate of merit to prize-winners, and grant the Freedom of their company to any especially gifted craftsman, apprentice, or student. There is one point, however, to which we should like to invite the attention of the Company of Armourers. People living in the large provincial towns which have long since outgrown numerically those of London in the matter of craftsmanship are unable to derive advantage from these exhibitions. Could not some of the wealthy London companies join with poorly-endowed technical schools in the provincial towns to promote exhibitions of this character, changing the location from year to year? London is now a commercial not a manufacturing centre; but Manchester, Glasgow, Leeds, and a score of other cities, are the centres of teeming industries. If the provincial workmen cannot come to London, cannot London go to the provinces? Despite what is done through the City and Guilds of London Institute channels, the City companies as yet only reach a very meagre few of the technical student element of the country.

ALUMINIUM.—The cost of aluminium, and alloys of aluminium, has been reduced so immensely by the invention of electrical processes, that it will shortly come into very extensive use outside of engineering. Aluminium bronze, in various grades, is already extensively used in engineering. The latest field which appears to be opening up for its employment is that of domestic utensils. It possesses the advantages of extreme lightness, and of being practically unaffected by acid liquids, not excepting vinegar, so that possibly our kitchen utensils may be made of aluminium in the near future. There would be an æsthetic pleasure in the use of a metal, or an alloy, having the lustre and colour of silver, without its expense. The report some weeks since that the German army had found the spirit flasks, made of aluminium, vehicles of poison for the troops, requires better authority than the testimony of the ordinary paragraphist.

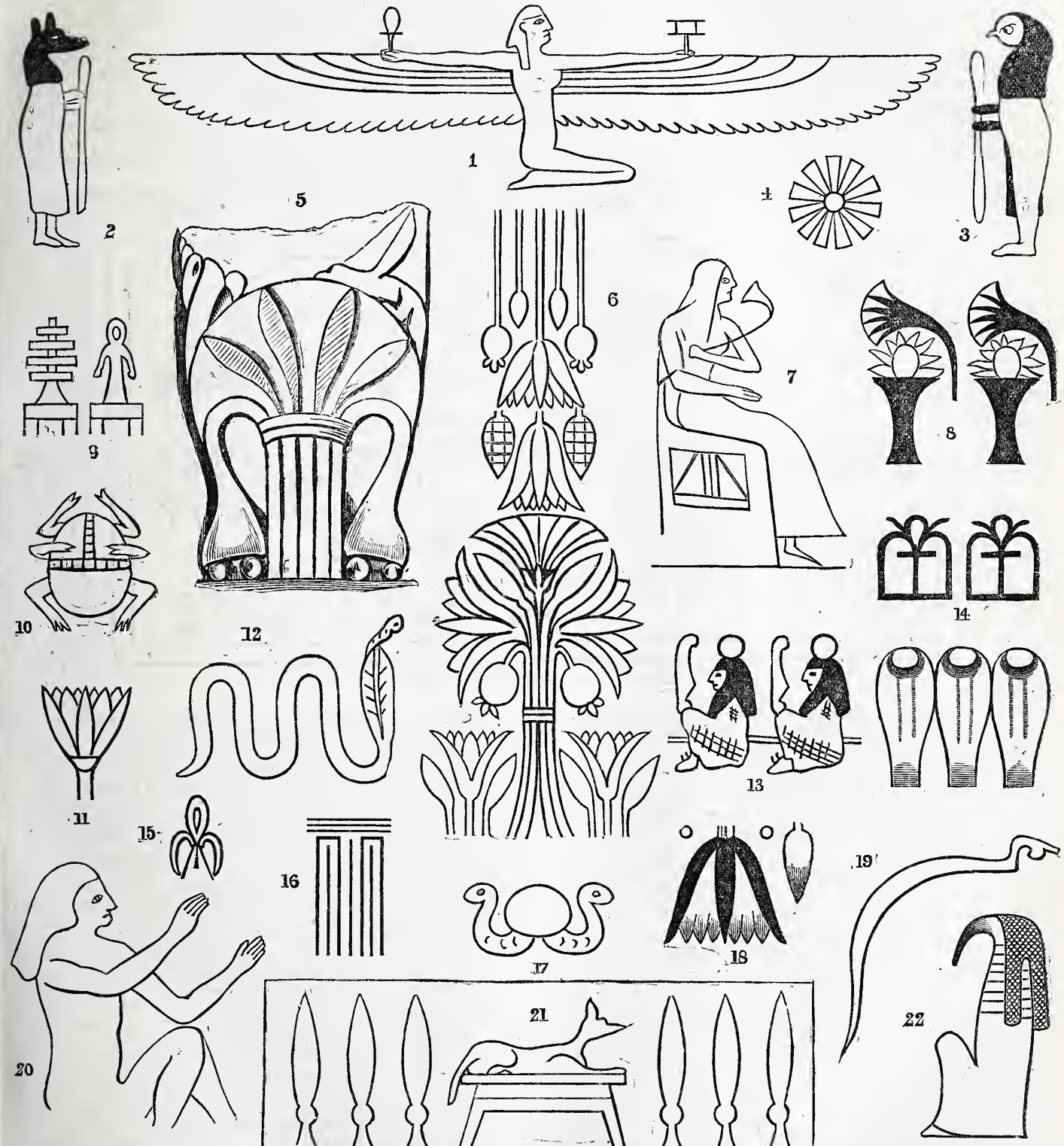
AMERICAN V. ENGLISH LOCOMOTIVES.—An engrossing topic for some months has been English and American locomotives, and endeavours have been made to show that the American locomotives are superior to the English, carrying greater loads on the same consumption of fuel. Our contemporary, the *Engineer*, takes the matter up, and proceeds to analyse the statements published in an American journal, and finds that the American locomotives burn more coal than those of this country, which the writer "is at a loss to explain." Does he know that the orifice of the blast pipe generally used there is much smaller than that used in this country—from a third to half smaller—and in consequence the "pull" on the fire when the engine is under way is tremendous, and causes the fire to be pulled out of the box at a rate nearly sufficient to account for the greater consumption of fuel? It would almost seem that in America it is a sure sign of a good engine if you can hear her at a great distance—the further the better. Some time since an American engineer visited one of our great terminal stations to see the express go out. He eyed the start with great interest, but exclaimed, "Where's the blast? I don't *hear* it!" Notwithstanding an explanation to the effect that it was more satisfactory to take the power out of the steam in pulling the train instead of letting it make a row up the funnel, he would not be convinced. The Midland Nottingham express was a further poser. Though greatly struck with the design and workmanship of these splendid specimens of mechanical skill, the visitor could hardly believe that the engine, with a goodly number of carriages, runs from Nottingham to London and back, or *vice versâ*, with from 42 to 45 cwt. of coal for the double journey—250 miles—and does the journey, without a stop either way, in about two hours and ten or fifteen minutes, on a consumption of 21 to 22 lb. per mile. Here, as the engine started, he could not hear the blast, and seeing what could be done without the tremendous crash of the American blast, he concluded they must be wrong in their practice, and on his return intended to wake them up a bit on this point. As a rule the American locomotive carries steam a greater distance in the cylinder before cutting off than the English; consequently a greater bulk of steam has to escape; and this also causes more steam to be used, and therefore more fuel is used to keep her going. There is no doubt that American locomotive practice is far from perfect, and there is great room for improvement.

DESIGN AND DECORATION OF ALL AGES.

BY M. H. C. L.

EGYPTIAN.

THERE is, perhaps, no country in the world so interesting, so absolutely fascinating to the student of old times, as Egypt, emerging as it does from the misty blackness of thousands of years before the Christian Era, and leaving evidences of a learning and civilisation which some modern writers maintain held all the knowledge to which we in our own day have but just arrived. When we study their art, we are astonished to find the skill and perception which guided their construction of design, and their command over the material in which they worked. The Egyptians were admirable carvers in stone and wood, though the lack of suitable timber restricted their use of the latter. They wove the most delicate textures, and embroidered them with consummate art. Their repoussé work, enamelled work, and inlaying were all exquisite. They made tapestry in simple geometrical designs, they worked in leather, their pottery was beautifully decorated, their paintings retain, under the time-stained surface, the brilliancy of the day they were produced. In very early ages the Egyptians became masters of the art of colour, each workman having his own



Decorative Art. Fig. 1.—Winged Sphinx from Sarcophagus. Fig. 2.—Anubis. Fig. 3.—Horis. Fig. 4.—Rosette. Fig. 5.—Fragment of Carved Spoon. Fig. 6.—Bas-relief of Sarcophagus of 30th Dynasty. Fig. 7.—One of row of Six Figures on Table of Unnifer. Fig. 8.—Border on Funeral Box. Fig. 9.—Frequently occurring Border. Fig. 10.—Scarabæus, or Sacred Beetle. Fig. 11.—Lotus Blossom. Fig. 12.—Serpent incised on Ivory. Fig. 13.—Repeating Border from Græco-Egyptian Mummy Case. Fig. 14.—Border Patterns. Fig. 15.—Ta Girdle Buckle, an Amulet placing the Wearer under the protection of Isis. Fig. 16.—Border Pattern. Fig. 17.—Egg and Serpent from Mummy Case. Fig. 18.—Painted Border on Coffin. Fig. 19.—Serpent. Fig. 20.—Repeating Pattern on Stone Altar to Amen-ra. Fig. 21.—Border on Tomb, repeating Pattern. Fig. 22.—Thoth.

little bags of paints, and mixing them for himself. The colours were laid on in flat washes, and in the best period of decoration were so used as to form a "scheme of colour," giving to each tableau a general prevailing tone of red, blue, or gold. The Egyptians loved colour; all their carvings and bas-reliefs were painted.

There was in Egyptian decoration, as in that of other countries, a classical age up to which art was continually improving; a subsequent decline, a short renaissance, and a final decadence characterised by a corruption of the native style with that of other countries, notably of Greece, ending in extinction.

It is of the purely Egyptian designs, as they were handed down from generation to generation, each retaining its individuality through century after century, that this paper treats. The designs of Egypt may be classed under two heads: the sacred and the secular. Only a small proportion of the decorations which have come down to us are distinctly secular, but there still exist some humorous paintings in the form of caricatures of animals. There are also records of wars and victories, and more peaceable scenes forming the subjects of wall paintings — herds of oxen with their drivers, flights of wild birds and flocks of geese, fishes swimming, men engaged in different kinds of handiwork, and amusing themselves in the chase. The Egyptians evidently loved animals, some of which, as we know, were considered sacred. The lotus is the only flower we find, except in the rarest instances, upon their decoration, if we except the stalkless blossom varying in semblance between a marigold and a potentilla, which is technically called a rosette. The lotus was no doubt peculiarly prized by the Egyptians as being the produce of the sacred Nile lotuses. These lotuses were grown in the tanks, which were the favourite adjuncts to an Egyptian garden. A representation of one of these tanks from a wall decoration is given in Fig. 23. The Egyptians had no knowledge of perspective, though they were admirable draughtsmen, and their animals in profile were drawn not only accurately, but with much spirit and in different varieties of pose. When they wished to represent figures of men in line, they made the head of each appear above that of the one in front, or by some similar device showed all the figures separately. In drawing the human figure it was their custom to give the head in profile, with a full face, eye, and bust, the trunk in three-quarter view, and the legs in profile. In the specimen given, the pond is seen in bird's-eye view, the four edges being the banks, while the animals and lotuses are seen sideways.

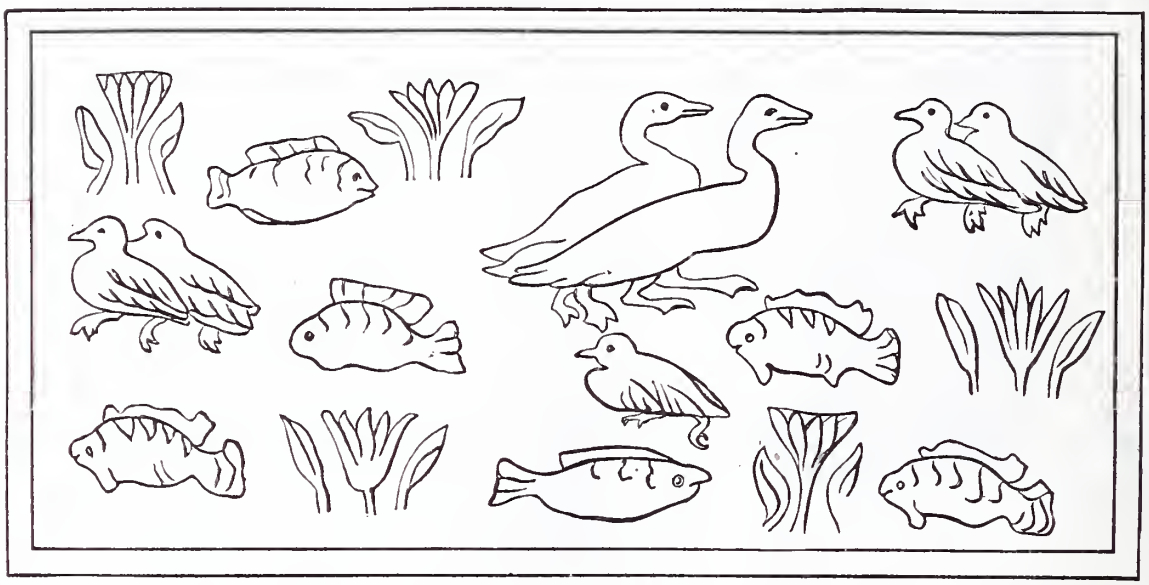


Fig. 23.—Wall-Painting of a Fish Pond.

Among the wall decorations are pictures of offerings being made to the gods. The mystic ceremonial religion of old Egypt entered intimately into the life of the people, and, in fact, their secular art merges in the sacred. The most numerous and important remains of Egyptian decoration are from the tombs. While the houses and palaces were open to destruction from invaders and pillagers, the tombs were so carefully concealed that many of them have remained intact till discovered by modern explorers. Man, according to the Egyptian faith, was composed of four parts: the body; the *ka*, or double of the body; the soul; and the divine spark. This *ka* precisely corresponded with the astral body with which the theosophy now in vogue has made us familiar. Its life continued as long as the body was in existence, but died with its destruction, hence the care taken by the relatives of the dead to guard against the violation of a tomb. When the mummy was deposited, the passage leading to its resting-place was filled, and the entrance carefully concealed. The *ka* had his chapel in earliest times in another portion of the tomb, which was built in the rocks, but later it was often at some distance from it. Here offerings were made on stated days, and should ideally have continued to be offered to the end of time. But filial piety could not be expected to survive the third or fourth generation, and for fear the *ka* should be left to starve, a plan was hit upon which would satisfy the appetite of so ethereal a creature, while relieving his relations from further cares after the burial day.

Offerings of portions of oxen and gazelles, of clothes, of furniture, of birds and of flowers, were made at the funeral, and these were depicted on the walls. On the sight of these painted objects the *ka* was supposed to feed, but for his diversion, or instruction, not only the actual portions of flesh and loaves of bread were represented, but all the processes of their production and preparation were added. In later centuries, when the idea of future reward and punishment had gained prominence in the religion of Egypt, a record of the career of the deceased, with scenes from his life, were painted on the walls. Later again, the progress of the soul as it followed the sun through the infernal regions of the night and out into the glory of day formed the subject of the pictures. All these representations, by their formal repetition from age to age, tended to crystallise into mere conventional decoration; but every form thus employed had its significance, and, till the complete decadence of Egyptian art and religion, conveyed to the spectator some mystic import, corresponding to the Christian symbols of the cross and the Sacred Monogram. Indeed, the painting of such symbols on a sarcophagus, or in the chamber of the dead, was believed to act as a charm. The lotus flower (Fig. 11) is constantly met with in every species of decoration. It signified eternal youth, and was an offering much affected by the gods. It had one conventional form both for bud and blossom, but was adapted in a variety of ways.

Fig. 18 is part of a painted bordering on a coffin. Fig. 6 is carving on the stone Parsep sarcophagus of the 30th dynasty. Fig. 8 is from a painted sepulchral box, one of those chests in which the *ka* kept such possessions as were made his on the day of his funeral. Another favourite symbol in decoration was that given in Fig. 15; it was used in solid form as a girdle buckle, and represented the blood of Isis, which washed away the sins of the wearer. The scarabæus, or sacred beetle (Fig. 10), symbolised duration of life on earth and in the after world. It preserved from death, while a frog was the emblem of renewed life. A winged scarabæus is painted on the coffin of Soter, Archon of Thebes. Serpents were numerous, generally bent up in decorative though improbable attitudes, and rearing an angry head (Figs. 12 and 19). Very frequently in the mummy cases we find a procession of men or animals carrying a serpent. In what is considered one of the oldest forms of symbolic art, the serpent is represented with an egg (Fig. 17), the egg symbolising life and the serpent eternity. In its passage through the nether world the soul had many serpents with which to combat: there was one to guard each hour. Down there were also the fearful assessors of the dead, corresponding with the human beings above, who sat in judgment on the corpse, and determined whether he were worthy of burial in its gorgeous tomb. The gods are constantly represented — quaint creatures with the heads of animals on human forms (Figs. 2, 3, and 22). On nearly every mummy case a winged figure is painted, the wings being drawn in a highly conventional and decorative

manner, doubtless representing the wings attained by the departed soul when it had safely passed through the terrors of judgment. As a rule, there is a human head and upper part of the body between the wings, sometimes a completed body as in Fig. 1, though occasionally a scarabæus or a bird's head, and dogs were very common in funeral decoration: Cerberus was the guardian of the Hall of Judgment (Fig. 21).

The human figure was very largely employed, generally with the hands stretched out, one higher than the other, in a graceful attitude, symbolic of devotion (Fig. 20), standing, seated (Fig. 7), or in what appears to have been a favourite pastime among the Egyptians, squatting on the ground (Fig. 13). The painting on the walls of the tombs and sarcophagi were to a great extent reproductions, more or less exact, from the illustrations in the "Book of the Dead."

This wonderful work, the oldest book in existence, gave an account of the soul's progress through the unseen world. It was considered in the highest degree sacred, and passages from it were written on the sarcophagi and on slips put in the hands of the dead to act as a charm. The tombs and sarcophagi so elaborately decorated were of course those of kings and great men; the poor were buried in pits and in clefts of the rocks, simply bandaged or wrapped in palm branches, with an amulet or two to protect them in the realms of the departed. In life, however, the common people were not shut out from the world of art. As with us in the middle ages, every craftsman was an artist, and gave a touch of beauty in the form of some simple and appropriate decoration to whatever he made. There is nothing lovelier of the kind than the wooden perfume spoons and kohl boxes carved in the form of lotus plants, figures in various attitudes and the like, of which one specimen is sketched in Fig. 5.

Here variety of invention came in, whereas in the paintings and bas-reliefs—which were nearly always consecutive tableaux of fixed and definite meaning, or symbols of traditionary form and usage—there was little scope for originality. Certain sketches of design made by Egyptian artists yet remain drawn on a surface marked out in squares, like the architects' paper of our own day, to facilitate their enlargement by the copyists. Early efforts at drawing have also been found, with the master's corrections in red ink. Till a late and degenerate period of Egyptian art, when the Greek influence began to be felt, all drawing was done with a brush formed of a reed, and not with a hard, fine-pointed instrument.

There is not much in Egyptian design that can be taken as it stands and applied to modern European decoration; so large a proportion of their ornament was exclusively concerned with their own religious rites. The lotus adaptations and animal forms which have been rendered decorative without any departure from fidelity to nature might indeed be copied direct. But the great gain in studying the decoration of the Egyptians lies in the insight thus acquired into their especial artistic genius—*i.e.*, the combining severity of outline and a frank conventionalism with artistic grace and truth to nature. This they attained by seizing and emphasising the main features of their subject, while suppressing all unnecessary details which would interfere with the effect of the decoration as a whole.

Those who have not the opportunity of travelling to the East, may make explorations almost as valuable for practical purposes within the walls of the British Museum. Egyptian remains are also preserved in the Soane and the South Kensington Museums.

For the letterpress of this paper the writer is much indebted to Maspero's work on "Egyptian Archæology," translated by Miss Edwards.

ABOUT THE ARLBERG AND OTHER ALPINE TUNNELS.

BY HENRY FRITH.

The success of the St. Gothard line aroused the emulation of Austria, and her eagle eyes were turned to a separate line to Paris from Vienna, *viâ* Constance, Landeck, and Innsbrück. The Brenner Railway runs at right angles to the Arlberg line.

The necessary tunnel for the new line was begun in 1880. It was estimated to occupy five years in construction. The other portions of the railway between Bregenz and Innsbrück are also very interesting—the engineering is excellent; the views are magnificent. Seated in the hindmost carriage, with its immense sheets of glass all round, the prospects and gradients and cuttings can be studied by the passenger at leisure.

But our business is chiefly with the Arlberg Tunnel, which pierces the water-shed of the Arlberg, lying between the Rhine and the Danube.

The great tunnel was begun in 1880, and the engineers having the Cenis and Gothard experiences before their eyes, were enabled to work very cheaply and expeditiously. They progressed so rapidly that the line was actually open in 1884! On the 15th of May, 1880, the order to begin arrived; on the 13th of November the boring began; on the 13th of November, 1883, the borings met, the working having been, as usual, from both sides simultaneously.

The contractor had performed his work in four hundred and twenty days less than the stipulated time; and this was the most satisfactory part of the business, for the Government had agreed to give him £80 a day for each day he lessened the contract time. Thus he earned the welcome sum of £33,600—his private share of the undertaking—as a premium.

The motive power for the works and some machines was water, which exists in quantities on the Arlberg. The streams were dammed, and the water conveyed, under tremendous pressure, in pipes to work the necessary machinery. The borings in the tunnel were also done by compressed air, and two kinds of machines were used. There was quite a rivalry between the men employed on these when one was worked by air and the other by water.

The drills were the Ferroux and the Brandt. The former was worked by air, the latter by water. The former is a percussion drill, something like the instrument employed in the Mont Cenis Tunnel on the Sommeillier system. The Brandt machine drills holes by revolving-boring, and has been pronounced the superior tool, inasmuch as a certain number of Brandt machines will do as much work as twice the number of Ferroux drills under equal conditions.

Twelve miners and seven navvies were employed on the Ferroux drills each shift. Seven miners and seven navigators only were employed on each of the Brandt machines, with one mechanic to repair them; the Ferroux were taken away and repaired. The explosive used was dynamite. The manner in which the work was done is as follows: The "heading," or upper cutting of the tunnel, was "levelled" with the intended railway below. From the heading the men drove vertical shafts downwards at certain distances. When they reached a proper level, each party cut sideways, and thus formed the lower gallery (to meet each other), into which the rock and *débris* was thrown down by the shafts and carried off.

The tunnel was carefully lined with bricks, the progress made being about 18 ft. a day. As the actual tunnel was completed the rails were laid, the *débris* carried out, and materials carried in. Regular trains of trucks were constantly in movement, and "marshalling" them was quite a business. The men laboured in semi-darkness daily; and the contract provided for a supply of air to the extent of 5,300 cubic feet per minute for the workmen.

This, the main tunnel on the line, is just 6·375 miles in length. It extends between two stations—St. Anton and Langen; it cost £1,209,400; and three years were occupied in its construction—the actual boring of it. In less than a year after the railway was actually opened—viz., in September, 1884. There are nine other tunnels on this line from Innsbrück to Bregenz, which will well repay a visit.

Several other schemes for driving great tunnels through the mountains have been projected. Of these, the Simplon Tunnel seems to be the most likely to be begun. It will be about ten miles long. The railway is already at Visp, in the Valais, and at Domo d'Ossola, in Italy. The gradient is estimated at 1 in 90 on the Swiss side, but much heavier on the southern slope. The borings will be exceptionally heavy. The expenditure is estimated at £2,118,000. The big tunnel will cost, perhaps, £1,877,000, and a considerable sum, in addition, for ventilation plant must be added.

Other tunnels, which have not advanced much towards estimates, are those suggested to penetrate the St. Bernard and Mont Blanc. The writer has seen no late suggestions concerning these projects. They were proposed to reach Aösta by different routes, and the plans vary greatly. The St. Bernard is to have steep gradients and a short summit tunnel; the Mont Blanc route is to have easy approaches and a long tunnel. The cost of these undertakings cannot be less than £40,000 a mile.

SCIENCE TO DATE.

New Fossil Mammal.—Mr. C. Dawson has discovered the tooth of a mammal in the Weald, near Hastings. It seems to be related to the well-known Plagiaulax from the Purbeck beds. It is the first trace of a mammal of the Cretaceous period yet found in Europe.

Volcanic Action in the Lipari Islands.—A Royal Commission appointed by the Italian Government to study the phenomena exhibited by the eruptions of the Island of Vulcano in the Lipari Islands during the period from August, 1888, to March, 1890, has just published a voluminous report. A typical eruption of this volcano consists of a huge column of volcanic dust carried up by volumes of steam to a height of several thousands of feet, and this is accompanied, in the more violent explosions, by the ejection of huge bombs of incandescent lava and brilliant electrical discharges. No lava flow, however, occurred during the whole period. It is interesting to note that the neighbouring volcano of Stromboli, though only about thirty-six miles distant, is not influenced by the condition of Vulcano, and that the material ejected from the two volcanoes is different, being blacker and containing less silica and more bases in the case of Stromboli. Hence there must be some subterranean barrier between the sources of lava supply of the volcanoes.

New Determination of the Velocity of Sound.—Regnault many years ago determined the velocity of sound in air by firing a pistol containing one gramme of powder—so as always to produce sound-waves of equal strength—at one end of a long tube, and receiving the sound-wave on a flexible membrane placed at a measured distance inside the tube. When the sound-wave reached this membrane it threw it into vibration, and by means of a small metal disc fixed at its centre the membrane struck against a metallic contact, thus closing an electric circuit, which traced on a chronograph the exact time when the sound-wave reached it. MM. Violle and Vauthier, taking advantage of a subterranean conduit destined to carry water from Rochefort to Grenoble, have recently made a re-determination of the velocity of sound in air by a similar method, but laying special stress on points omitted or left doubtful by Regnault. They found the velocity of sound in dry air at 0° C. to be 1,086 ft. per second. This is a little less than the value usually employed in calculations—viz., 1,093 ft. per second.

TRADE: PRESENT AND FUTURE.

*** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

TIMBER TRADE.—The deliveries from the London docks show a further decrease, amounting in a week to a fall of over 2,000 standards. The uncertainty of the labour market has much to do with this. It is to be hoped that the mid-season and fall will this year improve, and that we shall be able to show an increase over last year. The hardwood trade seems to be fairly busy, judging from recent spirited buying at the sales. Tabasco mahogany was sold at 3¼d., Jamaica mahogany, 40s. per ton, Mexican mahogany from 3½d. to 10d. per ft., and Mexican cedar at 2¾d. A recent sale held at Epping brought forward some hundred fine oak trees at prices varying from 2s. to 4s. per ft. cube over bark.

SHEET METAL TRADE.—In South Wales and Monmouthshire the price of tin plates remains unchanged, but makers are holding out for higher prices. Best charcoal plates are quoted 13s. 9d. to 14s. per box. Dulness reigns in the London tin plate trade, and makers refuse the low prices offered. Manufacturing departments are a little better in various parts of the country, especially in galvanised wares and dairy goods.

COTTON TRADE.—The great lock-out in the cotton trade continues, and there is but little prospect of a settlement being arrived at. Indeed, many do not hesitate to assert that the negotiations are being purposely conducted in as tardy a manner as possible, in order to prolong the stoppage. It is generally thought that the lock-out will last some three weeks longer, while in some cases it is more than probable that work will not be resumed until after the Whitsuntide holidays. Nearly all the mills in Oldham are closed, and there is no anxiety either on the part of the employers or the operatives to resume work. The employers consider that by keeping their mills closed they will not only clear out their stock, but also strike a blow at the operatives; while the latter contend that the curtailment of the supply of yarn will improve the condition of the trade. In Bolton and district the masters have agreed to run their mills four days a week only. In Rochdale and district the look-out has assumed a more serious aspect during the last few days, several of the largest mills which had started working, and which everyone thought would cause the collapse of the lock-out, have stopped again, and for an indefinite time. In addition to the spinners who are "playing them," some of the weaving sheds are working short time, as the material is likely to run short.

SHIPBUILDING TRADE.—Clyde shipbuilding continues depressed. Several new contracts have been fixed, but the output far exceeds in tonnage the new work booked. In all, eight sailing vessels and nineteen steamers were launched during April, the gross tonnage being fully 37,600 tons, an increase of quite 4,000 tons over the output for April, 1891. The total output for the four months ending 30th ult. was over 128,000 tons (gross). The prevailing depression is ascribed to the dearness of fuel and the low freights prevailing. Shipowners, in many instances, refuse to accept carrying contracts at current freightage rates, preferring rather to pay harbour dues for their idle vessels. One result is that several Clyde-built vessels (owned by Glasgow firms) are now "laid up" for want of work. During April Messrs. J. & G. Thompson, Clydebank, secured an order for engines for a second-class cruiser which is being built in one of the Government dockyards, while orders for three sets of engines, aggregating 630 horse-power, were booked by Messrs. Ross & Duncan, of Govan, and one by Messrs. Blackwood & Gordon, Port Glasgow, for triple expansion engines for a foreign steamer. Marine engineers all over the country are feeling the effects of the dulness in the shipbuilding trade, and unless some unexpected development takes place immediately, these industries will be likely to remain slack throughout the summer; indeed, some authorities incline to the belief that a revival will not take place during the present year. West of Scotland steel makers also complain of continued dulness (a substantial reduction of wages is about to be enforced in this trade), while another important Scotch industry—viz., the mineral oil trade—shows unmistakable signs of stagnation.

PLUMBING TRADE.—There is a probability of another strike occurring in Aberdeen, the masters and men having come into conflict on some matters of detail arising out of a strike which occurred a few months ago. A new code of bye-laws, dealing with the relations between the two parties, had been drawn up by the workmen's society, and recently submitted for consideration and approval by the masters. The main point at issue is with regard to the number of apprentices employed in the trade, the men holding that the proportion of apprentices should be one to each journeyman, while the masters, on the other hand, contend that there should be no restriction. A second source of contention is the period of notice to be given on either side in the event of a dispute pending, while the workmen, in addition, ask that when employed at a distance of two miles and over from their place of residence, there should be a weekly allowance of 1s. or 2s. given extra. The masters have had the matter under consideration for some time, and a turn-out seems inevitable.

SILVER AND CUTLERY TRADES.—The Sheffield silver and electro trades have not improved since our last report. In the cutlery trade there is very little alteration, and makers of bone, ivory, and pearl handles complain of the depressed state of business. Great efforts are still being made by makers of files, scissors, knives, razors, and tailors' scissors, to supply the Spanish markets with these productions, in anticipation of the announcement of the new tariffs, which will affect most seriously the future manufacture of these articles.

IRON TRADE.—At Barrow there is no change in the hematite pig iron market. Everything is quiet. No business is being done by makers. Most works are stopped, and only eight furnaces are in blast. Warrants are at 49s. 4d. net cash, and makers are asking 50s. for parcels of mixed numbers of Bessemer iron. Stocks are being reduced considerably. Several mills in the steel department at Barrow are to be restarted this week, including the plate, tin, bar, and Siemens furnaces. Shipbuilders are busy, but want material. Coke is still very scarce. Iron ore is weak. The iron trade in the Rochdale district is getting worse every week. Our Sheffield correspondent writes:—It cannot be expected that pig iron will decline much further in value. It has dropped lately from 49s. 9d. to 48s. 8d. per ton. Forge iron realises 41s. per ton locally. The only branch of trade in which there is much activity appears to be that devoted to the supply of railway material. This industry maintains the good position it occupied at the commencement of the year. Makers of springs, tires, and wheels are well off for orders.

ENGINEERING TRADE.—While, generally speaking, there is little change to report in the condition of the engineering trades of the Lancashire district, yet in one or two localities business appears to be decidedly better than for some weeks past. This is notably the case with Bolton, where, a fair amount of new work coming in, stationary engine builders have been enabled to increase their staff of hands. For the most part, however, this branch of the trade is sharing the general depression which now characterises the engineering industry in many parts of the North of England. Machine tool makers have but little work in hand, and although machinists are still fully engaged in completing existing orders, the unsettled state of the cotton trade has had the effect of restricting local inquiries. One or two firms, however, have secured some orders from abroad, which will keep them busily employed for many months. Locomotive builders report only a small amount of new work coming forward, and there is unfortunately every indication of a very decided slackness occurring in this branch. The shipbuilding and marine engineering trades of the district remain in an extremely depressed condition, and it is reported that not a single new order for a marine engine has been secured by any Mersey establishment for some weeks. The principal shipbuilding yards are still fairly busy with the vessels in hand, but there are no inquiries for new work, and some of the small establishments are almost entirely without occupation of any kind. In the Barrow district, both shipbuilders and engineers continue busy, but the new orders do not appear to be of any very great weight. The iron trade shows but little improvement, and as many of the steel works are stopped, owing either to disputes or scarcity of raw material, there is some difficulty in obtaining boiler plates. Boiler makers are, however, now experiencing the lessening activity which is everywhere becoming general.

CYCLE TRADE.—In Sheffield, the spurt in the cycle trade is maintained, and manufacturers of cycle parts and pneumatic tires are well employed. The makers of the New Rapid cycles have just received an order from a Belgian agent for over two hundred of these machines. As, from their high quality, they cannot be produced at a cheap figure, it shows that our Continental friends know where to look for a good thing, and that they are willing to pay for it.

COAL TRADE.—The strike in Durham, which has caused some irritation and loss in local manufacturing circles, is less sorely felt at the present time. Sheffield firms have discovered that they can obtain supplies of well washed hard coke in the immediate vicinity, which is almost, if not quite, equal in point of quality to the coke hitherto obtained from the North. As there is a difference in price of nearly 8s. per ton in favour of the South Yorks material, it is probable that some portion of the Durham trade will be diverted to this part of the country. There is very little change in the situation. Hematites have risen 3s. per ton since the beginning of the Durham dispute, and are now quoted at 60s. delivered in Sheffield. This heightened price is solely due to the cause mentioned, and on the collapse of the strike, it is anticipated that values will drop to the points they occupied a month or two ago. There is very little improvement in the pig iron markets, but those qualified to judge express hope in the future. Consumers are economising, for what reason is not clear.

IVORY TRADE.—Soft descriptions were in demand at the London auction, and prices were £2 to £3 per cwt. higher. West Coast African was firm at last sale's prices, and, owing to the small quantity of newly arrived ivory, old stock was freely bought. Bangles were the only exception to the general firmness, probably in consequence of several large consignments having been sent back to India on account of trifling defects. Egyptian ivory was selling better than at the previous sales, but still cheap as compared with other qualities. For very defective pieces such low prices as £20 and £25 per cwt. were accepted.

BUILDING TRADE.—There is no lessening of activity in Manchester and district—a large contractor, indeed, finds difficulty in getting sufficient *good* men. In the Rochdale district, bricklayers' labourers are out on strike, the old question of the masters allowing a labourer to each bricklayer being again opened, in addition to some other minor details which the men demand. As the masters declare they will not give way any further, it is likely to be a long job.

SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

*** *In consequence of the great pressure upon the "Shop" columns of* WORK, *contributors are requested to be brief and concise in all future questions and replies.*

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Indiarubber.—VIGILANTIA. — Your experience is a common one. Perhaps the best way to proceed is, first, to cut the surfaces you wish to join so as to produce a good fit, and then moisten them with mineral naphtha, so as to make the opposing surfaces somewhat sticky. When this has been done, apply as cement a solution of indiarubber in mineral naphtha, press the surfaces into close contact, and leave under pressure in a warm place until the naphtha has evaporated.—QUI VIVE.

Inking Ribbons.—J. B. (*Jubbulpore*).—These may be kept damp by the application of a little glycerine and water.—QUI VIVE.

Indiarubber.—RUBBER.—A thick solution of shellac in methylated spirit forms an excellent cement for sticking indiarubber to wood, and will resist moisture. It must, however, be used whilst the wood is still dry; and as you state that the wood to which the rubber is to be cemented is hard, I recommend you to coat it first with a thinner solution of shellac, the rubber being afterwards cemented on with the thicker solution.—QUI VIVE.

Indiarubber.—J. H. (*Oldham*). — Indiarubber cannot be melted without spoiling, and solutions are unsatisfactory for moulding purposes. Commercially, old (vulcanised) rubber is mixed with a proportion of new rubber and sulphur, and then re-vulcanised in the form required. Rubber so prepared is, however, of inferior quality, and its preparation is an expensive process.—QUI VIVE.

Soap-making. — K. L. (*Leeds*).—Seventy per cent. caustic soda may be used, but the result will be inferior, as the large proportion of uncombined carbonate of soda contained in the weaker preparation will have the effect of making the soap prepared from it very harsh, and unfit for any but rough use. If you decide to try the experiment, you should use nearly one-half more of your 70 per cent. than would be required of the 98 per cent. See article on Soap-making, WORK, No. 103.—H. C.

Soap-making.—F. will probably find the information he requires in Watts' "Art of Soap-making," published by Crosby Lockwood & Co., price 9s.—H. C.

Turbine.—New Subscriber.—It is quite possible to do as you say, and more. With a fall of 10 ft. you should get something like 6 h.-p. But so many matters have to be considered, that I think your best course would be to write to Gunther's, of Oldham, and ask them for estimates, giving them full particulars of the proposed arrangement of pipes and gearing. This in the end would be your cheaper plan, because, speaking with a full knowledge of the subject, I know the trouble of casting the vanes accurately. These are made in cores. If you can cast them yourself, they must be done very accurately. If you put them out, then it will be cheaper to order the turbine complete than to have one portion cast to order and make the rest yourself. If, however, you intend to try, I will reply to any specific questions you may put, though to go through the details of the work properly would occupy more space than can be spared in "Shop." A practical work on the subject, which you may study with advantage, is "Hydraulic Motors," by G. R. Bodmer, published by Whittaker & Co., Paternoster Square, London, E.C. Its price is 14s., and you will find every form of turbine illustrated in it, and the necessary formulæ for obtaining dimensions for different conditions of head and velocity, and the curves of the vanes.—J.

Tool-Holder.—A. T. S. (*Bedford*).—(1) I presume you mean tool-holders for chisels and plane-irons. If so, I only know of one general type—that in which the tool is set at a suitable angle with a pivoted appliance, provided with a certain roller at the end opposite to that in which the tool is clamped. The appliance being set at its proper angle, the roller runs with the stone, and the facet of the chisel is maintained at practically a uniform angle. You can get it of Melhuish, Fetter Lane, E.C., or some of the other tool merchants who advertise in Work. (2) No, hardly ever; it is an amateur's crutch. (3) Certainly not; the facets of all cutting tools used by woodworkers should be sensibly hollow. (4) I cannot say; you would have to search through the records of the Patent Office.—J.

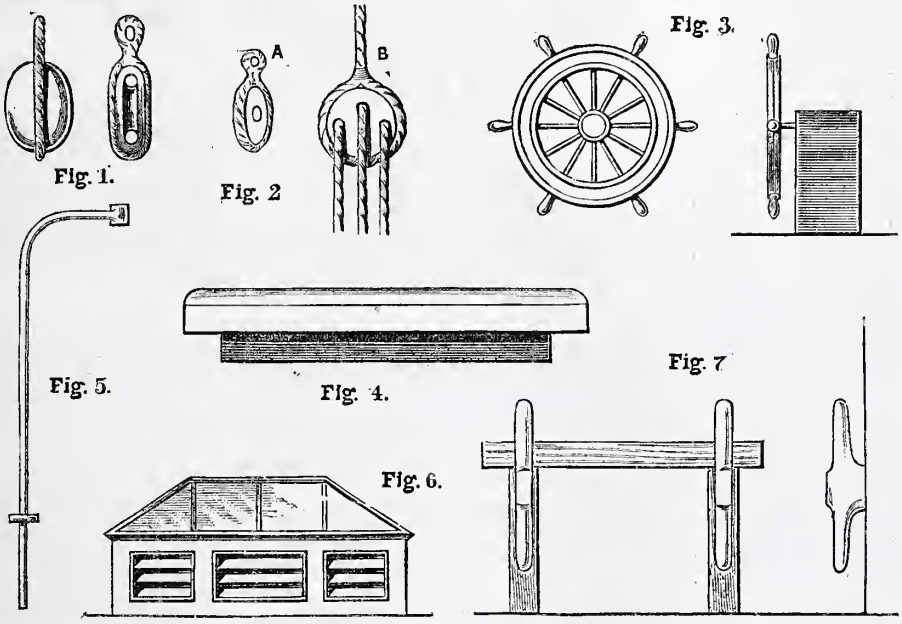
Fake and Buff Ball.—W. W. (*Brentford*).—You will not be able to buy fake, as it is not sold ready for use, but it is made in the following way: Take two hard heelballs and about two-thirds of a white glazing ball, break them up into small pieces, and put them into a small tin box. You can buy proper fake tins; any one will do, but the deeper the rim of the lid is the better, as it will prevent the spirit evaporating when not in use. You just cover the contents of the tin with naphtha, and then put the whole on the hob or in the oven; but the fire must not be fierce, the lid must not be on the box, and it must be well watched, for this process, of course, rarefies the spirit and intensifies its inflammability. White ball is not buff ball, but people sometimes apply that term to the glazing ball spoken of above. The use of fake is to lessen the labour in finishing, for if heelball is ironed on, it is very hard to rub off. It is used after the edge has been knifed, rasped, scraped, sand-papered, inked, dried, and been nicely ironed with warm irons, which gives it, in itself, a good gloss. The fake is rubbed on with the finger, and when it has set a little, rub it off with a nice soft cloth till it leaves a bright even gloss, which should be a jet black. If you want to finish brown work, it is done in the same way, and the fake is made just the same, only all white ball is used, and not any heelball.—W. G.

Martin Mantelpiece.—G. P. U. (*Ulceby*).—Such a mantelpiece as you require only awaits opportunity of publication, which shall not be long.

Positive and Negative Poles.—P. S. (*Leigh*).—(1) The positive pole of an electric battery is that which gives out electricity. The negative pole is that which receives electricity. In other words, when the two elements of a battery are connected to an outside circuit of conductors, the electric current starts from the positive pole of the battery, passes through the conductors—wires and other connections—to the negative pole, and returns by it to the battery. (2) Inside the battery cells, that element is positive which wastes away—is dissolved—and, in dissolving, gives out an electric current. As zinc is generally used in batteries, we may say that zinc is the positive element. The negative element is that which receives the current set up by the positive element, and transmits it to the outer circuit. It therefore follows that the positive element of a cell is the negative pole of the battery, since it gives out a current inside the cell and receives it outside the battery.—G. E. B.

Dry Battery.—R. S. (*Felixstowe*).—(1) Get a zinc cylinder of ⅛ in. zinc, 7 in. by 3 in. Close the edges, and solder a thin strip of zinc over them. Cut a disc of thick zinc to fit in the cylinder, and solder this in to form a bottom. (2) Get a large lump or plate of carbon to go inside the cylinder of zinc, and fit to it a brass terminal. Stand the carbon on a piece of porcelain or glass in the cylinder, and pack the intervening space with equal parts of gypsum and oxide of zinc moistened with chloride of zinc. Seal over with pitch. (3) Yes. Gypsum is plaster-of-Paris or sulphate of lime. Oxide of zinc is the "zinc white" used in paint. Chloride of zinc is the "killed spirits" of the plumber. (4) I do not know the exact ingredients employed in charging the Gassner dry battery, nor their proportions. It is a patented invention. (5) I do not know of any dry battery capable of lighting a 5 c.-p. 8 volt incandescent electric light for two or three hours every night. It would, probably, take seven Gassner cells in series to light up such a lamp, but the light could only be maintained for a period of ten minutes at a time, after which the battery must rest for several minutes before turning on the current again to the lamp. Dry batteries are only employed in intermittent work, and are not suitable for *constant* electric lighting.—G. E. B.

Model Yacht.—T. H. L. (*Newport*).—I send sketch of fittings. Fig. 1 is a single-sheaved block. Make it of boxwood or plane-tree; cut the mortise for pulley; then shape with chisel and rasp. Make a notch round the outside, and fix a loop of cord. The pulley is brass, with a groove on the edge, fixed with a wire pin. Double-sheaved block is made in a similar manner, but with two pulleys. Fig. 2 shows dead-eyes of boxwood—A is the small size, with a groove round the edge; B is for the main shrouds. Fig. 3, steering-wheel. Turn it as a disc, and cut the spokes out; fix handles on the rim; a steel wire axle is fixed in the centre, with a wooden roller, round which the tiller ropes are coiled, and carried round guide-pulleys to each side of the rudder. Fig. 4, cover for hatchway. It should have cork or indiarubber fixed round the rabbet, to prevent water getting in. Fig. 5, davitt for boats, made of strong wire, with an eye formed at the end; two are required for each boat; the boat is hung with blocks and tackle, and is fixed against the bulwarks. Fig. 6, skylight over cabin or saloon; the top is covered with glass, and louvres in the sides. Fig. 7, cleats for holding ends of halliards, made of wood or brass, and fixed on a rail at the foot of the mast, as shown, or on the inside of the bulwarks. You can fix the compass on a small turned pillar in front of the wheel. There is also capstan, windlass, and pump, but I think you will hardly need these.—M.



Model Yacht. Fig. 1.—Single-sheaved Block. Fig. 2.—Dead-eyes. Fig. 3.—Steering-wheel. Fig. 4.—Hatchway Cover. Fig. 5.—Davitt. Fig. 6.—Skylight. Fig. 7.—Cleats.

Winding Dynamo.—C. R. (*Oldham*).—If you wind the field-magnets of your little dynamo with 4 lbs. of No. 22 double cotton-covered copper wire, and the armature with 5 oz. or 6 oz. of No. 22 silk-covered copper wire, and drive it at a speed of 3,000 revolutions per minute, it will, when connected in shunt, develop a current of 2 ampères at a pressure of 25 volts. With this current you may light a 25 volt 10 c.-p. lamp, or two 12 volt 5 c.-p. lamps in series.—G. E. B.

Electric Belt.—A. E. (*Birmingham*).—If you will get the index to Vol. III. of Work, and look through the section devoted to "Shop," you will see numerous references to electric belts, and, on looking up these in back numbers, you may learn how to make a genuine electric belt.—G. E. B.

Galvanometer.—Linesman.—An illustrated article on how to make a linesman's galvanometer is now in the Editor's hands, awaiting space for publication. From this you will learn how to make the instrument. By making the case a little larger, or by making a separate case for a dry battery, and attaching it by brass hooks to the case of the galvanometer when required, you can provide yourself with a portable galvanometer and battery combined. I recommend dry cells for several reasons, apart from that of portability. You will need several pairs of elements to get the necessary E.M.F., and the required number can only be got into the space at your command by using some form of dry battery. The cells may be of papier-mâché or cardboard, well soaked in melted paraffin wax. Each cell may be 2 in. in depth, 1 in. in length, and ½ in. in width. The elements may be silver foil and zinc plate, separated by a pad of blotting-paper, having silver chloride on the side next the silver foil, and zinc chloride on the opposite side.—G. E. B.

Books on Electric Lighting.—Electrolier.—The best and cheapest book on the subject is "Practical Electric Lighting," by A. Bromley Holmes, and I can heartily recommend it to all who, like yourself, wish to know something on the subject for the first time. You will learn much from my articles on "Model Electric Lights," published in Work, Vol. II.—G. E. B.

Glass Embossing.—E. P. (*Birmingham*).—I wish you had said if you wrote as an amateur or professional. It makes a difference sometimes when answering questions. To take your queries in the order you ask them:—(1) Whether you "bought ground glass and etched, or plain glass and afterwards grind it," must depend upon circumstances of which I have no knowledge; all I can say is the first plan would result in a saving of time, which, if you used any quantity of glass, would be very considerable. But why not frost by the gas method, and leave the letters plain? certainly not etch them by liquid as well: that would not be needed, and the frosting would be much finer than ordinary commercial ground glass, which is very coarse by the side of the other. (2) I suppose you mean to cut through the Brunswick black; if so, any sharp-pointed steel tool would do. (3) Fasten it on with Prout's glue if you like. (4) The ordinary kind. (5) Turpentine is used in making Brunswick black to thin it to the proper consistency, so you may use that *if needed*, but be sure and not make it too thin. I always warm Brunswick black (by setting the bottle in front of the fire some time before I want to use it) if it is not very hot weather: whenever I use it for any purpose, I find it works easier, and very seldom needs thinning. (6) The reason you cannot get the black off ground glass is because the surface is so uneven that the tool used will not reach every part; turpentine will take it off, but I think you will succeed far better by using plain glass and the gas process, as I advised in answer to first question. I hope I have made it perfectly plain to you, and shall be glad to help you at any time.—W. E. D., Jr.

German Silver.—Socrates.—Sheet German silver may be obtained from the Berndorf Nickel and German Silver Works, Moorgate Street, E.C.; Messrs. Stedman & Co., Billiter Street, E.C.; or, failing them, Messrs. Barker & Allen, Surrey Street, Sheffield; the prices being, best quality, 1s. 5d. per lb.; second quality, 1s. 4d. per lb.; third quality, 1s. 2d. per lb.; and fourth quality, 1s. 1d. per lb. Ascertain the thickness you require by means of the sheet-metal gauge, or take a sample with you. You may probably have to pay a little more than the prices mentioned above, unless you require a large quantity, in which case you may ask for the usual wholesale terms and discount.—N. M.

Rubber Solution.—C. P. (*Barley, Royston*).—The address of Mr. John Piggott is 117, Cheapside, London, E.C., and probably you could procure the solution named at that establishment. It is procurable of most respectable dealers in rubber goods. Failing Mr. Piggott, you should apply to The Indiarubber, Gutta-percha and Telegraph Co., 106, Cannon Street, London, E.C., which firm can certainly supply you.—Qui Vive.

Tricycle.—W. R. (*Mile End*).—If W. R. will state his wishes more fully, I will be glad to help him in the matter by making a sketch or otherwise.—A. S. P.

Taking Out a Patent.—MEXICO.—This article appeared in WORK, No. 35, bearing date of November 16, 1889.

Model Hot-Air Engine.—G. M. (*London, S.E.*).—I see nothing in the drawing you send which should prevent your engine from going, if only the piston and plunger of the displacer fit fairly well without friction, and the lamp flame plays properly upon the bottom of the heater (it looks too far off). The opening from heater to cylinder seems unnecessarily large; and what you took to be a "wire brace" was the line where the cylindrical body of the engine is cut away to leave two standards to hold bearings for the crank-shaft, these standards being formed of the body tube by cutting out a piece from each side. The water then can be filled up to where you have put the bottom of the wire braces. I think you will get your engine to work all right. You should disconnect the working connecting-rod from the crank, and then, when the lamp is lighted, turn the wheel so as to move the displacer up and down. The working piston being free from the crank, you should see it rise and fall about as much as it would if connected with the crank. I should like to hear you have succeeded.—F. A. M.

Cleaning and Restoring Oil Paintings.—W. C. G. (*Bowes Park*).—If your pictures are only dull and dirty, the defect can be remedied by "oiling out"; or, if not already thickly coated with old varnish, they may, after oiling out, receive a very thin coat of varnish. Should they be covered with several coats of old varnish, each of which has in turn picked up dirt and dust, they then require to be cleaned by means of the old varnish being removed; this is in itself an art, and requires the hand of an expert. Spirits of wine and turpentine are used, but as they attack the paint as well as the old varnish if the further action of the spirits is not arrested at the right time by a free use of water, it is, as I say, a process that requires some experience. However, should you care to experiment on some unimportant canvas, you may work in the following way:—Mix in a cup 2 parts turpentine with 1 part rectified spirits of wine. With a piece of cotton-wool dipped in this solution begin rubbing softly, commencing at the top left-hand corner of the canvas; it is well to attack a small portion at a time—say a surface 3 in. square. As you rub gently, keep sponging with cold, soft water, the secret being to know when you have removed the varnish and reached the paint. That being done, allow the picture to dry slowly but thoroughly; then varnish with the *thinnest* coat you can possibly lay on; this should be done always in a dry atmosphere and out of any current of cold or damp air. One of the best varnishes for this purpose is Sanders' improved picture varnish, prepared and sold only by B. Keen, chemist, Park Street, Bristol, 1s. 6d. per bottle, or mastic varnish may be obtained at any artists' material shop. For oiling out dirty pictures that have dried into the canvas, wash well with water only just off the chill, dry with linen cloth, then polish with silk duster when quite dry; take some boiled linseed oil, put about two or three drops on a good handful of cotton-wool, and, beginning at top left-hand corner, just polish as you would a pair of boots, leaving as little of the oil on as possible; do a small square of the surface at a time; you may then, if desirable, varnish as advised above.—F. B.

III.—QUESTIONS SUBMITTED TO READERS.

*** *The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Skins.—A. B. C. (*Arbroath, N.B.*) writes:—"Will any reader please tell me the best way to fan and soften rabbits' skins thoroughly? I can do the alming part very well."

Musical Reed Brass.—W. C. (*Bulwell*) writes:—"Would some reader give me information how brass is hardened to make reed tongues for organs or harmoniums? Also what special tools are used for the purpose?"

Perspective.—SPECTEMUR AGENDO writes:—"Will some correspondent recommend me a book on practical perspective? I am anxious to learn how to draw articles of furniture in perspective from plans and elevations."

Binding WORK.—J. H. B. (*Pendleton*) writes:—"Will some reader of WORK be so good as to tell me the name and address of some working bookbinder in the neighbourhood of Manchester, and what the charges for binding WORK should be?"

Clock Stand.—G. N. (*Henley-on-Thames*) will thank any reader for an easy ornamental clock stand.

Grinding Scissors, Knives, &c.—OLD MAN writes:—"Will any reader kindly give me instructions for constructing a machine such as is used in the streets for the above purposes? A few hints on grinding, etc., would be thankfully received."

Whitewood Polish.—POLISH writes:—"Will some reader of 'Shop' kindly give a wrinkle as to polishing whitewood without in any way discolouring or obscuring grain of the wood—*i.e.*, a perfectly clear polish, and how to apply same?"

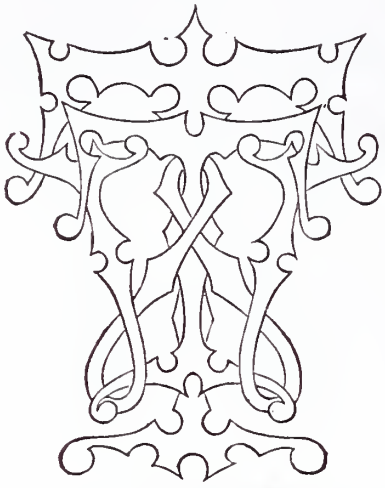
Photo Shutters.—S. M. L. (*Goderich, Canada*) writes:—"I should be very much pleased if some of our amateur or professional readers will give me, through columns of 'Shop,' some sketches of photo shutters suitable for hand cameras, to work behind lens—those that can be operated from outside of camera preferred. Also, will someone explain the principles of shutters that open and close from centre of lens, and made of thin leaves of vulcanite or metal?"

Engraver's Tools.—ENGRAVER WALES writes: "I should like to know where I could obtain tools for engraving names, etc., on brass and metal coffin plates, and where I could get tuition? I am a good writer on coffin plates, but am wishful to learn engraving. Will any reader oblige with full information through this valuable paper?"

Cardboard.—L. G. (*Dorking*) writes:—"Will any reader kindly inform me where I can obtain cardboard suitable for ticket writing?"

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Monogram.—J. B. (*New Cross*) writes to T. W. T. (*London, N.*) (see No. 156, page 830):—"If your bag is polished leather, any oil colours will do; if it is



T. W. T. Monogram.

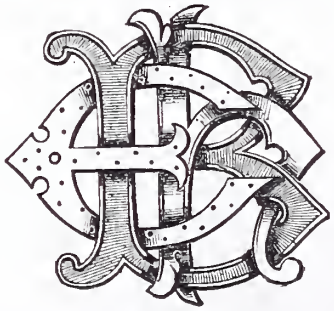
not, you had better use artists' colours, and no oil, only turpentine, as a medium, to prevent a greasy edge appearing. Then varnish with good spirit varnish neatly up to the line. A very effective way to guard against the chance of an unpleasant edge is to put the design in with Brunswick black, then do the letters in with any oil colours, leaving a thin, bright, black edge all round the whole design; this throws the work up wonderfully."

Electric Locomotive Engine.—M. (*Bishop Auckland*) writes to J. J. (*Blackpool*) (see No. 159, page 46):—"You cannot use the engine in its present form, but you could connect the wheels to an electric motor fixed on the tender. You can obtain a motor, or materials for one, from Mr. G. Bowron, electrician, of Praed Street, London, W."

Lathe.—M. (*Bishop Auckland*) writes to RICHMOND VA (see No. 159, page 46):—"Get the book, 'Metal Turning,' advertised on p. 40 of WORK, which will give you directions."

Polishing Paste.—A. A. P. (*South Shields*) writes:—"QUILLDRIVER (see No. 157, page 14) can get a splendid polishing paste for brasses from G. Pemberton, Salisbury Street, South Shields."

H. E. B. Monogram for Metal Working.—F. J. K. (*Tufnell Park, N.*) writes to WIN (see



H. E. B. Monogram.

No. 155, page 814):—"If you are not already suited, perhaps this monogram will answer your purpose; but I must say it is not my business: it's a pleasure."

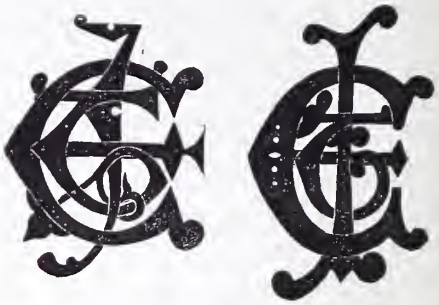
Lantern.—C. A. P. writes, in reply to E. H. L. (*Leicester*) (see No. 157, page 14):—"You will find full description and illustrations of the apparatus you require by reference to page 144, Vol. II. of WORK."

Maguay Lamp.—M. (*Bishop Auckland*) writes to ELECTRIC LIGHT (see No. 150, page 733):—"You can procure this from the Secretary, Sherborne Electrical Installation Company, Dorset."

Blowing Fan.—M. (*Bishop Auckland*) writes to WAREHOUSEMAN (see No. 151, page 750):—"You can procure these from Ernest Scott & Mountain, engineers, Newcastle-on-Tyne; the Union Engineering Co., Pollard Street East, Manchester; or Aland & Co., Commercial Road, Lambeth, London."

Coal-dust.—M. (*Bishop Auckland*) writes to HOUSEHOLDER (see No. 151, page 750):—"This is sometimes mixed with clay into balls and burnt. There is also a process of mixing it with coal-tar, and subjecting it to pressure, forming it into briquettes, but I believe it is a patent."

J. E. T. Monogram.—E. E. GIBBS (*Portsmouth*) writes, in reply to YOUTHFUL READER:—"I enclose two designs for fretwork monogram."



J. E. T. Monogram.

Frame-making Trade.—J. A. (*Smallheath*) writes:—"If SENTINEL (see No. 159, page 46) is a tradesman, I should strongly recommend him to get a good strong mitre-block, shooting-board, and shooting-plane, at a cost from 17s. 6d. to 20s.; or if he would like to make them himself, I will send sketch and full particulars. The mitre-cutters are all very well in their way, but such accurate work cannot be done with them as with tools named above. The main thing with either is practice, and plenty of it."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—CAWD HUD; J. B. (*Ashton-under-Lyne*); OXY; ANXIOUS; S. B. (*Arduick*); J. O. (*Leeds*); T. O. J. (*Wellington*); S. M. H. (*Bootle*); HEN FRIND (*Ludwig*); AB UNO DISCE OMNES; W. M. (*Finsbury Park, N.*); G. B. H. (*Leeds*); J. McC. (*North Brixton*); HANSOT; A. B. C. (*Alnwick*); W. M. (*Northaw*); MOTOR; ELDRID; H. B. P. (*Southport*); J. K. (*Bolton*); E. A. M. (*Birmingham*); J. J. (*Newcastle Emlyn*); F. W. (*Liphook*); H. R. (*Colne*); A. E. S. (*Maidstone*); H. W. (*Smethwick*); W. E. (*Battersea Park Road*); W. B. (*Manchester*); A. P. (*Manchester*); C. H. (*No Address*); BELL; J. W. (*Banbridge*); A NOVICE; F. K. (*Staveley*); A LABOURER; T. G. M. (*Dublin*); W. H. E. (*West Hartlepool*); W. W. (*London, W.*); CONSTANT READER; J. W. G. (*Keighley*); OLD HAND; J. L. (*Bexhill*); H. E. T. (*Harrow Weald*); ANXIOUS; T. P. (*Clifton*); H. H. (*Staines*); J. H. S. (*London*); W. H. (*Failsworth*); COACH PAINTER; YOUNG READER; D. McD. (*Bristol*); H. G. S. (*Bishop Stortford*); G. B. (*East Dulwich*); HOWELL; THROUGH; T. D. (*Liverpool*); MARKWELL; E. A. (*Bethnal Green*); J. K. (*Glasgow*); J. J. C. (*Carnarvon*); P. R. B. (*Hitchin*); H. B. T. (*Brixton*); EDDIFRA; F. B. (*London, E.C.*); TIMA; J. J. (*Shadwell*); ÆOLUS; B. R. P. (*Battersea*); IGNORANT; A. T. C. (*Finsbury Park*); ACCRINGTON; SUFFOLK LAD; DROPSAID; J. B. (*Calderbank*); E. C. M. (*Ipswich*); W. F. (*Birmingham*); J. M. (*Liverpool*); C. J. (*Hoole*); T. M. (*Wakefield*); A. M. (*Glasgow*); H. B. T. (*Brixton*); E. E. (*Eastbourne*); E. E. (*Aberlour-on-Spey*); J. H. S. (*Ripley*); E. C. (*Kingsbridge*); A. S. (*London, W.*).

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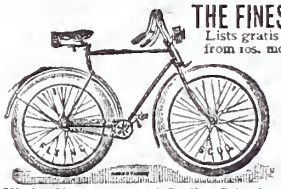

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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VOL. IV.—No. 166.] SATURDAY, MAY 21, 1892. [PRICE ONE PENNY.

WORK WORLD.

LIGNUM-VITÆ is found superior to all other woods for brake blocks, and it is also serviceable for bearings in the form of cylindrical plugs; these are let into the wearing surfaces of the brasses.

* *

A bicycle railway is one of America's newest things. Experiments have been made, and the thing is said to be an assured success. At a dinner recently in honour of the inventor, the conviction obtained that by this system a speed of 200 miles per hour is attainable with perfect safety.

* *

There has been a good deal of doubt about the reliability of anemometers, but recent experiments seem to indicate that a very reliable form for ordinary use is found in the "air-meter." This consists of a single screw blade made of thin aluminium in the form of a portion of a helicoid. The dial should be protected from the weather.

* *

A triplet Safety bicycle has been built and tested on the road. It is said to be the fastest form of cycle yet built. The machine, mounted by three good riders, is reported to have covered ten miles on the road at the rate of 21 miles 538 yards per hour, the last mile being ridden in 2 min. 10 sec. This feat has not yet been accomplished by any single cycle rider.

* *

Polarite is a new metallic substance which is claimed to be remarkably efficient as a filtering medium for water supplies. Local authorities in England have adopted it, and the Egyptian Government has concluded a series of experiments in purifying the waters of the Nile, with the result that Polarite has given satisfaction to the chemists engaged. The water supply of Boston, U.S.A., has also been treated by it.

* *

The Plumbers' Registration Bill is virtually dead, for the present session at least. It may come up before the House again on June 29, but it cannot become law this session on account of the determined opposition on the part of the ironmongers. Many amendments remain to be prefaced to the Bill, which, unless in the main agreed to, will defeat it. We hope not, for it is most essential that the classification of trades should be better defined than has been the case since the old guilds age. Let the plumbers' craft be open, however, to all who can qualify for it.

* *

It has been shown, by a long series of experiments, that diluting the liquid of a galvanic battery by water or alcohol, liquefying either of the metals by mercury, diluting either of these amalgams by mercury, or diluting one solid metal by alloying it with another, has the effect of increasing the mean electro-motive force of the diluted and diluting substances, provided they are mixtures not chemically combined. Thus the electro-motive cell force is increased.

* *

Dr. Schrœder's lens bids fair to cause a stir in the optical world, for it is said to be the only new lens since Petzval's lenses in 1841. The new lens is the product of the investigations and elaborate calculations of a practical and theoretical mathematician of great experience, who, on the introduction of the new Schott Jena glass in 1886, was requested to thoroughly investigate the possibility of constructing a perfect lens, which should be free from roundness and curvature of field, as well as astigmatism, distortion, coma, ghost, and flare.

* *

The Titan crane at Peterhead Works, for setting in place the concrete blocks at the breakwater, has been tested with a full load of 62½ tons at the radius of 100 ft. The crane is the largest travelling crane in the world. It is 75 ft. high. The lifting gear was composed of eight steel wire ropes of a total thickness of 5½ in., and these were attached to two lewis bars, which were passed through the load and fixed at the bottom with T heads. The total weight of the mass put in motion was 550 tons, and the steadiness of the entire body was remarkable.

* *

There is a demand for shorthand writers in Australia, and the following extract of a letter from a magistrate in Fiji should be noted:—"Two months ago there was an examination held in Melbourne for shorthand writers to be licensed to practise in the Courts. Out of thirteen who presented themselves only six passed the test of 120 words a minute, and fewer still the test of 150. There seems, indeed, to be a dearth of shorthand writers in Australia. Sir John Thurston tried to get one for correspondence the other day at £200 per annum and his keep. A young fellow was sent up who turned out quite unable to write with any speed or to read his notes afterwards. He was sent back again, and Sir John commissioned one of the Fiji officials, who has gone on leave, to select another, but he could not get one. The fact is, that Australians are mostly lazy, and have not sufficient application to master shorthand, and those shorthand writers who come out from England rapidly rise beyond correspondence clerkships. The only one I know is now manager of one of the branches of the Union Bank of Australia." London Schools of Shorthand—take note!

* *

The art of moulding is one possessing considerable attractions, and requiring for its satisfactory practice great care and skill. A youth who proposes to make, say, a model engine, would really like to make it himself, and not merely put together a number of purchased parts each complete in itself. The difficulty in carrying out this wish lies in the high melting points of the metals used for the working parts; this cannot be altered, but we may get round it. Take, for instance, a steam-engine cylinder: a piece of brass tubing may be used as lining for the length in which the piston moves and the body of the cylinders with steam passages cast around it, the brass lining tube being embedded in the core. A brass port face for the slide-valve to work on may be fixed to the casting by small countersunk screws, or it may have short screws fixed in it, and be put into the mould so that the casting will be run against it and hold it by the screws. In the covers and gland small brass tubes serve for piston and other rods to work through. The castings may consist of an alloy of six parts lead to one of antimony. The lead is first to be melted and raised to the highest temperature obtainable over an ordinary open fire, and the antimony, broken small, added; the latter will be dissolved by the melted lead, and the resulting metal will be easily cast and sufficiently rigid; the brass linings should be heated before pouring in the metal.

An expensive lightning conductor has just been placed on one of three new chimney stacks, octagonal in section, and over 300 ft. high, belonging to Coats' Paisley thread mills. The conductor is of an improved type, made by a Greenock firm. It is in the form of a ribbon of copper 1¾ in. broad, and ⅜ in. thick. This is attached to the middle of one of the eight sides facing south-west. On the coping of the chimney is a ring of copper similar to the ribbon some 36 ft. in circumference, and out of this ring rise eight vertical rods, harpoon formed at the points, and composed of platinum. This is said to be the most effectual form of conductor yet devised, and some idea of its costliness may be obtained when it is mentioned that it contains 26 cwt. of copper, which, at 1s. per lb., amounts to £145 12s., and this exclusive of the precious metal platinum, other fittings, and labour in the making and fitting up.

HOW TO CONTROL THE GAS-METER.

BY ONE WHO KNOWS.

"Gas companies put a separate governor to each of their lamps." I remember seeing the above statement in a trade circular, I forget for the moment where; it was simply stated as a fact, but to me it spoke volumes.

A very short time afterwards the Company's meter inspector came to take the state of my meter, and left a paper which informed me that from that *moment* the gas would be so much more per 1,000 ft. No notice was given, no right of appeal; simply pay or be put in darkness. It was then that the statement above came fully home to me in all its selfishness.

For a long time I had put up with the annoyance of flaring and screaming gas jets, caused by the varying conditions of pressure in the Company's mains, and the enormous waste of gas for which I hitherto had paid, to say nothing of the half-consumed gas vapours escaping into the room, rendering the atmosphere extremely unhealthy and dangerous. But after this last display of high-handedness on the part of the Company, I decided that I, too, would have a governor to each of my lamps, or lights, and in addition I would have a governor on the main supply pipe, close to the outlet of the meter, and this is the only way you can "control the meter."

It appears strange that, knowing so well as the writer does the benefit to be derived from a good governor, I had not had one before, but although I have had a great deal of experience in gas matters, I let the matter slide, and grumbled and paid; but this is just what I don't want my readers to do. I can assure them that anyone burning the amount of gas necessary for an ordinary household, could not lay out their money to greater advantage—that is to say, with a certain gain of 20 per cent.

The cost of a good main governor, for a moderate consumer, would be about 50s., and a good governor burner about 1s. 6d. It would be invidious on my part to attempt to say whose make of governor was the best, when there are so many good ones.

A self-acting gas-valve or governor to the main supply should be fixed either by the maker or a competent gas-fitter, but the ordinary governor burner can readily be screwed on to the gas fittings by the consumer himself.

Another source of gain to the gas companies, and consequent loss to the consumer, is caused by small escapes of gas, so I will now endeavour to tell you how these can be remedied.

Directly a smell of gas is detected, and there is a doubt as to where it occurs, put out all gas, see that every tap is properly turned off, and watch the unit hand of the index of the gas-meter; by examining this carefully you can tell if the gas is really escaping, and if so, to what extent.

An ordinary gas-burner burns about five feet of gas an hour, so if, in the course of half an hour, the unit hand has not moved, you can be sure there is no escape of gas, unless it is in the fittings beyond the taps, or the smell must arise from some other cause; for instance, a tap being left partly turned on.

If the hand has moved to the extent of one foot in half an hour, you may know there is a serious escape somewhere; and on no account should a light be used to trace it, especially by an amateur, as an escape of this size generally makes itself known so unmistakably. The gas should be turned off at the meter, and a gas-fitter sent for, unless the escape is in a part easily got at, and you feel confident of being able to cope with it; but on no account attempt to do anything while the gas is turned on. If the hand only moves such a trifle in half an hour or so that it can be only just said to move, you can proceed to find the leakage with a degree of confidence, as far as danger is concerned, that you could not have done before examining the index of the meter.

First test by smelling all the brackets and fittings in that part of the house where the smell is, with the various gas burners alight, or, of course, there would not be any gas in the brackets if the tap was not turned on. The brackets and fittings are the seat of five out of every six of small escapes. If you think you have discovered the escape, apply a light to make sure, blowing it out at once if you *have* found it. A tap or two with a small hammer, or a turn of the screw of the tap or cock, or taking the plug of the cock out, and filing the washer of the plug a little thinner, so as to allow the plug to be screwed tighter into its seating, or a touch of white lead, will generally put these escapes to rights. To take out the plug of a bracket it is necessary to turn off the gas at the meter.

If there is a pendant light, particularly examine the cup and ball joint, and the joint of the ceiling-plate with the piping directly above it, being careful not to use a light to test them; for if there happens to be a leakage there, and it lights (as it will), it is very apt to blacken the ceiling. A light should never be applied to a supposed escape against a painted or papered wall or ceiling, or anywhere where you could not at once put your finger on it. If a leakage is found in the cup and ball joint, take the pendant down and the ball joint to pieces, thoroughly clean it, and touch the ground or rubbing parts with a piece of tallow candle. This joint often gets corroded with dirt; sometimes the fact of moving the joint backwards and forwards will put it right, but it is better to take it to pieces and clean it.

If the leakage is found to be in the ceiling-plate, unscrew the pendant and ceiling-plate and temporarily plug the opening or supply left, and then turn on the gas and see if the escape is the connection of the piping and the screwed connection by taking up the floor above; if this is not so, you may be sure it is in the screwing up of the ceiling-plate, and a little white lead on the thread before re-screwing up is generally all that is required.

If you cannot discover the escape in any of the fittings, you must trace the whole of the piping, and test it—first by smelling and afterwards with a light, being careful to keep the light away from that part of the pipe that goes behind skirtings, through walls, or into ceilings, as there may be an accumulation of gas in a confined space. If the pipe is papered over, slit the paper between the pipe and wall with a sharp knife, especially where it is held in position with a gas-hook. Do not apply a light to test a pipe on a papered surface if you have any respect for the paper.

If the escape is not discovered above the floor, there is nothing for it but to take up the floor-boards directly over the pipes—these boards, if not already *screwed* down, should be so when replaced.

A careful examination of all the pipes is sure to show you where the escape is, and it can generally be stopped with a touch of white lead; but if it is any larger than a pinhole it should be properly made good by a gas-fitter, if you cannot manage it yourself.

A periodical examination of the index of the meter should be made to see if there is any escape going on when no gas is alight; for, although you may not detect it, on account of the smell being carried away by a current of air, if it exists at all it is, in most cases, going on the whole of the twenty-four hours, and the meter inspector puts it all down on the card.

There is an instrument used in the trade for testing the soundness of gas-pipes, which hardly comes within the scope of this article, but I hope to give a description of it later on.

HOW TO LEARN DRAWING OFFICE WORK.

BY ARTHUR BOWES, A.M.I.C.E.

Instruments — T-Squares — Adjustable T-Squares—Set-Squares of Wood, Vulcanite, and Celluloid—Special Set-Squares—To Test Set-Squares — Parallel Rulers—Special Forms for spacing Lines—Straight-edges—Testing—Substitute for Straight-edge.

Before entering into a description of the various instruments used in the drawing office, it will perhaps be necessary to remind the reader of what was pointed out in the first of these articles—that a certain acquaintance with the tools and methods of such work will be pre-supposed. It would take up more space than can be spared here to describe at length the varied forms of the thousand and one instruments which are used by the draughtsman, and, in consequence, our attention must be devoted in these columns principally to such recent improvements in the appliances as may be considered comparatively novel. The commoner instruments will only be dealt with to point out the several merits or demerits which belong to them, and to recommend those which have stood the test of experience.

T-*Squares.*—T-squares are usually made of pear-tree or mahogany. However well-

seasoned the wood may have been, it will be found difficult to prevent their warping or bellying in time, and care should be taken to keep them as far as possible in a position free from damp or excessive heat. The form of T-square shown in Fig. 15 is perhaps the most useful for general use. The blade is tapered, thus getting rid of some superfluous weight, and it is secured to the head or stock by screws, as shown. The advantage of this arrangement is that in drawing diagonal lines with the set-square, the latter can be brought along the edge of the T-square past the edge of the drawing-board, as shown in Fig. 16, whereas this cannot be done with those T-squares which have the blade inserted into the thickness of the stock. This latter construction is shown in Fig. 17. It must, however, be said in its favour that a T-square of this latter style can be used from either side of the drawing-board in case the drawing should be longer than the blade of the T-square, while with the former this is impossible. A bevelled strip of ebony is usually attached to the working edge of the blade.

Adjustable T-Squares. — A very useful form of T-square is the one shown in Fig. 18, where the stock or head is in two portions, one being movable on a centre-pin, while the other is permanently fixed at right angles to the blade. By placing the T-square with the movable stock next to the board, the blade can be set to any desired angle, and a series of parallel lines drawn with as much facility as though they were horizontal or perpendicular. For railway and tramway work, or in particular architectural features, such as roof details and classical pediments, it is a convenient instrument, especially when it is remembered that by turning the instrument over the rigid half of the stock can be used as in an ordinary T-square without disturbing the movable head. The arrangement is also of utility in cases where the lines of a drawing are found to have shifted through the contraction or expansion of the paper—a circumstance which is by no means of rare occurrence where the atmosphere of the drawing office is subject to considerable changes of moisture or temperature. In such cases the T-square can be adjusted in a moment to conform with the existing lines. In the T-square we have so far been considering, as shown in Fig. 18, the adjustment is made by simply setting the stock by hand to the desired angle; an American refinement on this method, where the adjustment is made by a regulating screw, is shown in Fig. 19. A somewhat similar arrangement was described in WORK, No. 103, page 827.

Set-Squares. — The style of set-square which meets with most approval is the one shown in Fig. 20, being formed of three slips of mahogany, tongued and pinned at the angles, with slips of ebony to form the working edges. Sometimes the edges are bevelled, but it must be noted that in this case the set-square cannot be reversed to work with the angle either right or left. The chief advantage of this form of set-square is that it has only a small surface in contact with the paper, and so is not liable to soil it by the continuous scrubbing backwards and forwards. Set-squares made of vulcanite have an admirably smooth and sharp edge, but in the matter of accumulating dirt are most objectionable. This appears to be due in a great extent to an electrical attraction for the floating dust of the atmosphere, for if a vulcanite set-square be rubbed briskly with a duster to clean it, the particles of dust will be seen at once to settle upon it in greater profusion than before. Such squares require a frequent scrubbing with soap and water to keep them in decent condition.

An excellent material for set-squares has lately been found in celluloid. Set-squares made of this substance are very light and clean, and are so transparent that the lines of the drawing can be seen through them.

In addition to the usual angles of 45° and 60°, special set-squares are procurable adapted to the various pitches of roofs, slopes, and batters of embankments, angles of nuts, and other standard requirements. A set-square used in setting-out lettering will be described at length in the chapter devoted to that subject.

A useful little article to have by one in many classes of work is a small set-square, measuring not more than an inch and a half on the edges; this is so light that it is moved about very easily and quickly, and yet is large enough for much fine detail work.

To test the right angle of a set-square, a perpendicular is drawn by using the T-square and the set-square together, as shown in Fig. 21. The set-square is then reversed, and another perpendicular drawn which should exactly cover that drawn first. Any error existing in the square will be easily detected, as the amount of discrepancy is doubled in the divergence of the two lines—that is to say, an error of one-hundredth of an inch in the right angle of the square will cause a divergence of one-fiftieth of an inch between the two perpendiculars — an amount which is easily appreciable to the eye.

Parallel Rulers.—Parallel rulers are convenient as enabling the draughtsman to dispense with the T-square and drawing-board, as there is no necessity for the paper to be permanently fastened down when working with these instruments. They are not to be recommended, however, where accuracy of work is a desideratum. There is always the liability of the instrument to slip on the paper to contend with, besides the accumulated errors of judgment which necessarily arise in adjusting the parallels to the existing lines. The old form of parallels, consisting of two straight flat rulers hinged together with brass links, may be dismissed at once as of little use, principally on account of the time taken in stepping the instrument from one position to another. The rolling parallel, on the other hand, is sometimes a very useful instrument. Figs. 22 and 23 show two varieties, the latter having ivory scales on both edges.

As a guide to assist in drawing a number of parallel lines moderately close together, say, for example, in screw-threads or in sectioning, a small ivory wheel is sometimes placed at the end of the brass wheel. The ivory wheel is divided into tenths and twentieths of an inch, and the divisions are read off from a line on the top of the brass

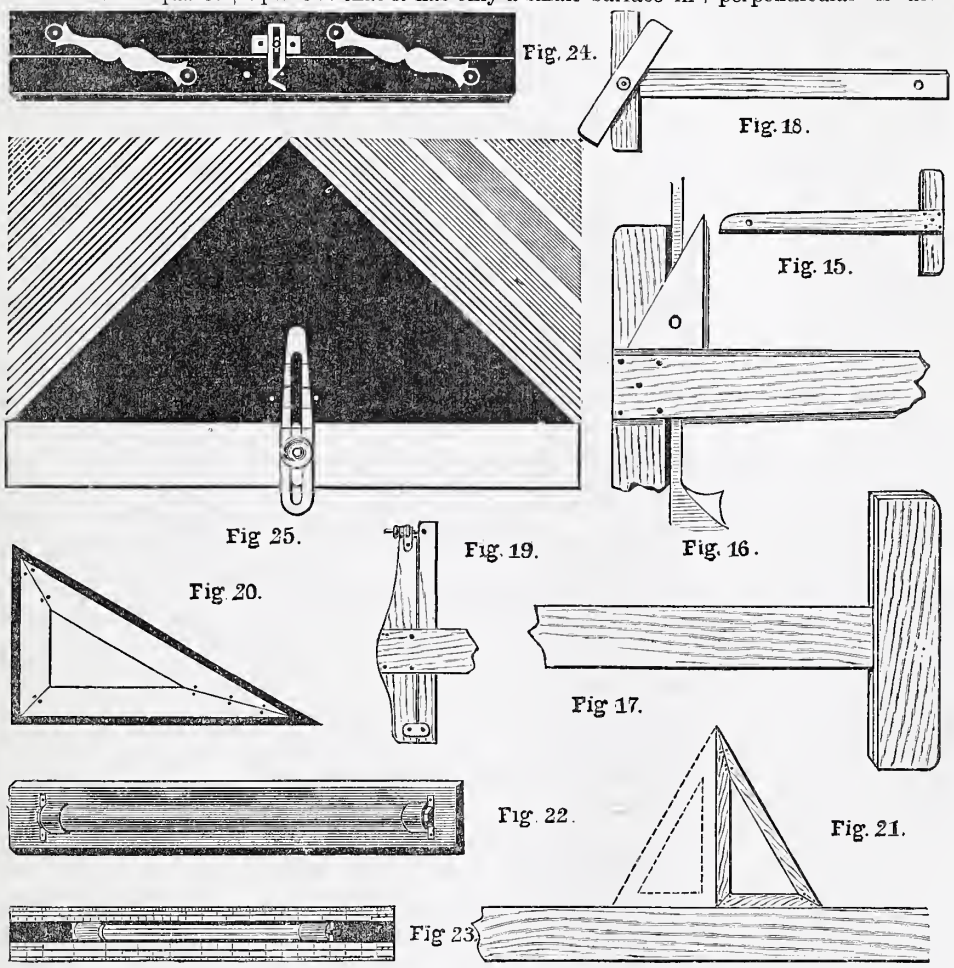


Fig. 15.—T-Square. Fig. 16.—Form of T-Square allowing Set-Square to be used up to extreme edge of Paper. Fig. 17.—T-Square with Blade inserted into solid Stock. Figs. 18 and 19.—T-Squares with adjustable Stocks. Fig. 20.—Set-Square. Fig. 21.—Method of testing Set-Squares. Figs. 22 and 23.—Rolling Parallels. Fig. 24.—Parallels for spacing Lines at regular intervals. Fig. 25.—Set-Square for spacing Lines.

bearing. Several special instruments for the same purpose have been devised, and afford a much safer means of spacing the lines accurately. The one shown in Fig. 24 has a small brass attachment slotted to receive a clamping screw, by means of which it can be fixed in any desired position. An angular piece is cut out of the lower part of the brass slip, and in this space will be seen a small pin, which is attached to the lower half of the parallel ruler. On trying to open the instrument in the usual way, this pin comes in contact with the brass stop, and prevents the parallels opening beyond a certain limit. By altering the position of the sliding piece, the play of the instrument, and consequently the spacing of the lines drawn, can be adjusted as desired. Fig. 25 is a very neat arrangement for effecting the same purpose. In this case a set-square is used with two small pins or stops, which are fixtures. A straight-edge, against which the set-square is used, carries a brass sliding piece of tapered form. The varying taper allows the set-square to be moved to a greater or less extent, according to the adjustment. The tapered tongue is graduated, so that the amount of play of the instrument and spacing of the lines can be adjusted to any definite measurement within the scope of the instrument. It will be seen from an inspection of the figure that the set-square and straight-edge when in use are to be advanced alternately one step to each line drawn.

Straight-edges.—Although the T-square is the instrument most in use for the drawing of straight lines, it is desirable to have at hand straight-edges of various lengths, ranging up to six or eight feet, or for special cases, much longer. For accurate work, steel will naturally be the material used for their construction, though mahogany or pine will generally be sufficient for the longer lengths. A useful size for a steel straight-edge for general use, though the requirements of draughtsmen naturally differ widely, is from eighteen to twenty-four inches in length by an inch and a quarter wide. One edge should be bevelled, and in using the straight-edge for drawing ink lines, the bevel is placed downwards, and prevents the ink from running underneath the straight-edge.

A usual mode of testing the accuracy of a straight-edge is to hold it up to the light, with its edge in contact with the edge of another one. Any discrepancy between the two edges will then make itself visible by the light showing through the spaces. It must be remembered that this is no test of either of the straight-edges being truly straight, but only of their agreement one with the other. A little consideration will show that one straight-edge may be round and the other hollow to just the extent that ensures a perfect fit. To test the accuracy of the line formed by the edge, three straight-edges must be compared, each with both of the other two. If two of these be respectively round and hollow, they cannot both fit the third one, nor can a perfect agreement be obtained amongst all the three until each one is absolutely straight.

An excellent substitute for a long straight-edge will be found in an adaptation of the carpenter's chalk-line. A drawing-pin or needle-pricker being first fixed at one end of the desired line, a length of silk thread or sewing cotton, which has been previously rubbed with blacklead, may be looped over it, and the other end of the thread passed round a needle fixed at the other end of the line. The thread may then be "snapped" against the paper, and the loose blacklead leaves a line sufficiently distinct to enable a firm line to be drawn over it. Or the blacklead may be dispensed with and points pricked with a needle at short intervals, immediately under the line of the thread. These points being afterwards joined up with the help of a shorter straight-edge will give the desired line.

INDUCTION COILS: HOW TO MAKE AND WORK THEM.

BY G. E. BONNEY.

How to Make a Small Spark Coil—The Bobbin for the Coil—The Core of the Coil—The Primary Wire of the Coil—The Secondary Coil of Wire—How to Test the Wire for Continuity—Winding the Secondary Wire—The Automatic Interrupter or Break—Fixing the Parts of the Coil—Plan of Connections—Testing the Power of the Coil.

How to Make a Small Spark Coil.—Having in previous articles on this subject studied some of the principles of construction in making induction coils, we will, in this, set about putting those principles into practice by making a small coil capable of giving a short spark at the terminals of the secondary wire. As this small coil will be the counterpart of larger coils hereinafter to be described, we will exercise the same care in its construction as in that of its larger congeners, and build up its parts piece by piece.

The Bobbin for the Coil.—In the construction of bobbins for coils, a wide licence is allowed in the choice of material for the bobbin ends. In expensive coils, ebonite is employed. In coils of meaner pretentions, any good hard wood may be used for the bobbin ends. Boxwood is rather too brittle, holly and hornbeam are both good tough woods, walnut and mahogany will both serve the purpose, and also take a good polish. The bobbin ends for this small coil may be two discs of hard wood or ebonite $1\frac{1}{2}$ in. in diameter by $\frac{3}{8}$ in. in thickness. They may also be made square, hexagonal, or octagonal, as the shape will not affect the working of the coil; but they should be at least $1\frac{1}{2}$ in. across the widest part. When cut out and made smooth, they should be, if of wood, immersed in hot melted paraffin wax and allowed to remain therein until the wax has well soaked into the pores of the wood, say for a quarter of an hour or twenty minutes. They should then be taken out and all the surplus wax rubbed off whilst still warm. A $\frac{5}{8}$ in. hole should now be cut in the centre of each end with a centre-bit to receive the tube and core to form the body of the coil, and two fine holes pierced through one of the ends near the centre hole to pass the ends of the primary wire through. The body of the bobbin may be of sheet ebonite $\frac{1}{16}$ in. in thickness, and 4 in. in length, rolled into a tube $\frac{5}{8}$ in. in diameter, and glued into the holes in the bobbin ends. It may also be made of papier-mâché of the same thickness well soaked in paraffin, or a thin paper tube may be formed on a round ruler or glass rod, using thin glue to stick the sheets together; but it is advisable to soak this paper tube in melted paraffin before mounting it as a body of the bobbin. Coils have been made with plain wood heads merely polished and varnished, and tubes made of paper soaked in melted beeswax or coated with shellac varnish, but these do not equal paraffin as insulators.

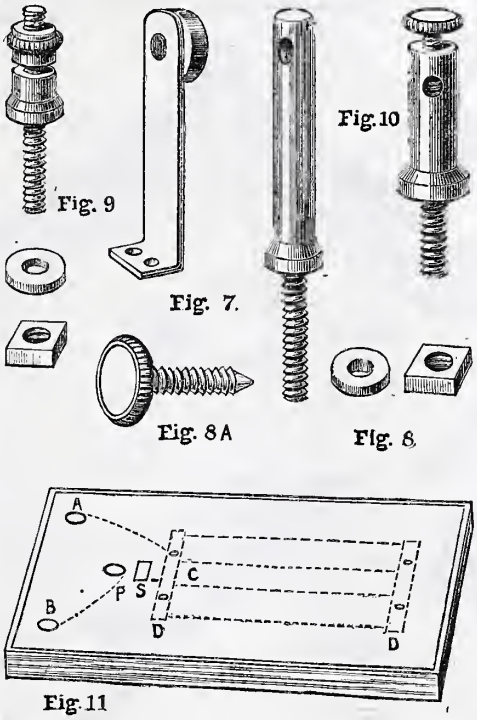
The Core of the Coil.—The coil bobbin may be made up in the following manner, commencing with the core of the coil, and this method is perhaps better than any other for building spark coils. First get a tube with an internal bore as large as the intended core of the coil—in this case $\frac{1}{2}$ in. in diameter—and pack the tube tightly with soft iron wires of No. 20 or No. 22 gauge cut to the length of the required core. This done, tie a piece of strong twine around the protruding end of the bundle and draw it out of the tube whilst winding the twine tightly round it. This done, immerse the bundle of wires in melted paraffin, let it soak therein for a quarter of an hour, then set it up on end to drain and cool. Meanwhile, get some wide tape and soak in the paraffin. Unwind the twine from the core of wires and wind on the paraffined tape until the bundle has been smoothly covered with tape. The ends of the bundle should now be dipped into some good glue and fitted tightly into the bobbin ends, leaving one end of the bundle protruding from one of the ends about $\frac{3}{8}$ in. or $\frac{1}{2}$ in. to form a pole of the magnetic core. When the glue has set and the ends are quite firm, get a strip of strong thin paper soaked in melted paraffin, and envelop the core with two or three layers of this before winding on the primary wire. When coils are built up in this manner, there will be no power lost between primary and core, either by bad insulation or over insulation. Some writers on this subject recommend the ends of the core to be capped with thin iron caps soldered to the ends of the core before soaking in paraffin. This makes the ends compact, but is open to the objections of weakening inductive effects, and liability to retardation of magnetic effects through the use of hard iron. If the ends of the wires forming the core are neatly trimmed to form a smooth end opposite the break, this will be all that is necessary.

The Primary Wire.—The primary wire for this small coil may be of No. 20 or of No. 18 silk-covered copper wire. Pierce a small hole with a fine bradawl through one of the bobbin ends down near the body of the bobbin, and pass one end of the primary wire, to the length of 5 in., through this hole from the inside, then wind on the wire until the tube has been covered with four layers of the wire. Leave 8 in. of the back end free, and pass this out through another small hole made in the same bobbin end as the first. These two wire ends will be used for connecting the coil with the battery, and directions will be given for this further on; at present, coil both of them into spirals around a pencil to keep them out of harm's way, and leave them as two small curls at one end of the bobbin. Before winding on the wire, it will be advisable to see that it is properly covered with silk and to make good any defects observable; and, to make sure of the insulation, it will be advisable to run the wire through some melted paraffin. Now, after winding the coil, it will still further improve the insulation to baste the primary with the hot wax whilst holding it over the vessel in which the wax is melting. Then have some strips of thin strong paper, soak them in paraffin, and envelop the primary with two or three layers of paraffined paper, smoothing all well into a compact coating. This is specially advisable in building the primary of larger coils.

The Secondary Coil of Wire.—The secondary wire of a spark coil must be of soft copper, and should not be of a larger gauge than No. 36 Birmingham wire gauge. It may be of No. 40 with advantage in this small coil, especially if No. 20 be used as a primary wire. It must be continuous

throughout the whole length to be employed in the coil (4 oz. of No. 40, or 6 oz. of No. 36, will be needed for this coil), and free from kinks. To test its continuity, it will be advisable to carefully unwind it from the bobbin on which it is wound when purchased, and to wind it on another bobbin mounted on a metal spindle. Pass the commencing end of the wire through a hole in one of the bobbin ends and clean off the silk covering, then twist the end of the wire around the spindle. Have the galvanometer on the bench, and also a battery of one or two cells, any kind will do; wind the wire from one bobbin to another slowly, and keep a sharp look-out for knots and bare uncovered spots. Should one of the first appear, unfasten it, and test the continuity of the wire by connecting it in circuit with the battery and galvanometer in this way: connect a wire from the battery to the bobbin spindle, the other wire being connected to the galvanometer, then touch the opposite galvanometer stud with the end of the unfastened wire; if the needle moves, the wire is continuous so far, and the knot must be remade by baring the ends, cleaning them, twisting ½ in. of the ends together in the form of a long splice, and tinning the splice with a little solder. The uncovered spot must now be made good with a thread of soft silk wound around the joint to fully cover it. Uncovered spots must be tested in a similar manner by touching them with a wire connected to the galvanometer, and then coating them with silk. If the needle does not move, we may be certain that there is a bad joint or a break in the wire, and must then search back until the fault is found. Sometimes the copper wire is broken, and only the silk covering holding the parts together. Sometimes the wire has been broken and a knot tied with the covered wire. These faults must be made good, and then, when a movement of the galvanometer needle shows that the wire is continuous throughout, it should be run back through melted paraffin, kept hot in a pie-dish by a kind of glue-pot arrangement with hot water in an outer dish. If a small pulley, such as a blind-cord pulley, is put on a piece of bent wire, the covered wire may be run under this whilst held in the hot paraffin, and thus all danger of abrading the silk covering may be avoided.

Winding the Secondary Wire.—The secondary wire may now be wound on the primary whilst the bobbin is being revolved in a lathe or similar machine for producing rotary motion. I hope to give an illustrated description of a coil winder in a future paper. Wind on the secondary wire in the same direction as the primary, having first coated this with two or three layers of paraffined paper. Run the bobbin containing the wire loosely on a round steel or iron spike held in the left hand or fixed on a support at a little distance from the lathe. Pass 8 in. of the first end out through a hole in the coil bobbin end, and coil it in the form of a helix. Revolve the lathe slowly, and guide the wire on by hand. If the hand is held some eight or ten inches away from the coil, and allowed to follow the wire, this will run on evenly in turns side by side as if guiding itself. Some coil makers prefer a turn of foreign post paper soaked in paraffin between each layer of secondary wire; to this I have no objection, providing only one turn is used, as its helps the amateur in winding the next layer. Hot melted paraffin wax may be basted on instead if preferred. Layer after layer must be thus run on regularly side by side and over each other until all the wire has been used. The commencing end of the wire, coiled up as a helix at one end of the bobbin, may now be carefully straightened out, and led in a fine saw-cut up to the top of the bobbin, where it should be soldered to the foot of a small brass pillar to form one terminal of the secondary. The other end of the secondary must be taken to the opposite bobbin end, and there secured to another pillar. These parts will be described further on. The whole bobbin between the ends may now be coated with a piece of silk or a piece of fancy leather bound tight down over the wire, and secured to the underside by a lacing of silk cord. This gives the coil a finished appearance, and it may now be fastened down to the base or stand (made of polished walnut or mahogany, 7 in. by 4 in. by ¾ in.) by four brass screws passing up



Induction Coils. Fig. 7.—Break Spring and Hammer. Fig. 8.—Break Pillar. Fig. 8 A.—Platinum-tipped Contact Screw. Fig. 9.—Terminal Binding Screw, Nut, and Collar. Fig. 10.—Terminal for Secondary Coil. Fig. 11.—Plan of Baseboard for Coil—A, B, Position of Terminals for Primary Wire; C, Core; D, D, Position of Bobbin; P, Break Pillar; S, Position of Break Spring.

through the base—two at each end—into the wooden ends of the bobbin.

The Automatic Interrupter or Break.—When the coil is fixed down to its stand or base, measure the distance from the top of the core to the base of the coil, and cut off a piece of thin sheet brass or German silver ½ in. longer than this to serve as the break spring. That will be, in a coil of 1½ in. in diameter, a strip of spring brass or of spring German silver 1¼ in. in length by ⅜ in. in width. This should not be too stiff, or it will vibrate too quickly for a spark coil. Round one end, smooth the edges, and bend ⅜ in. of the other end to form a foot for the spring. In this drill two small holes for two brass screws. At a spot in the rounded end, exactly opposite the centre of the core when the spring is fastened down in place, drill another ⅛ in. hole to receive the tang of the break hammer. The hammer must be of soft iron with a face of the same diameter as that of the core, and from ⅛ in. to ¼ in. in thickness. The head of a large iron clout nail will do for a small coil. The hammer may be riveted or soldered to the spring as may be deemed convenient. On the opposite side, at the back of the break spring, must be soldered a speck of rather thick platinum foil. This spring (Fig. 7) may now be fixed to the base of the coil with the hammer face at the distance of ¼ in. from the face of the core end, one end of the primary wire being secured under the foot of the spring, or soldered to it before fixing it in its place. The other end of the primary wire will go to a terminal binding screw on the baseboard.

The break pillar shown at Fig. 8 is merely a piece of ⅜ in. brass rod 2 in. in length, turned to the form shown in the figure. In the upper part, opposite the speck of platinum on the break spring, drill and tap a ⅛ in. hole to receive a brass screw ¾ in. in length, furnished with a milled head. The end of this screw must be tipped with platinum wire soldered into a slot cut in the end of the screw. This is named the contact screw. The lower part of the pillar should be turned down to 3/16 in., and a thread cut on ½ in. of this to receive a nut. This part of the pillar will pass through a hole in the baseboard, and the end of a short piece of No. 16 wire will be clipped between the nut and a brass collar to connect the pillar with a terminal binding screw on the base of the coil. These screws are shown at Fig. 9.

Fixing the Parts of the Coil.—At Fig. 11 I give a plan of the base of the coil showing the position of its various parts. The bobbin should be fastened down to the base, midway between the two sides, and with its back end 1 in. in from the edge of the baseboard. The spring of the break should be fastened down to the base so as to bring the hammer face ¼ in. from the end of the core. The break pillar must be fixed near enough to the spring to allow its platinum-tipped screw to just touch the spring when the screw is half-way into the pillar. This will allow room for adjustment both ways. The screw should be furnished with a lock-nut to keep it from getting loose. The two terminal binding screws for the ends of the primary wire will be screwed into the base at the two corners, as marked A and B on the plan. One end of the primary wire will be fastened to the foot of the break spring. From the foot of the break pillar, beneath the base, a short piece of No. 16 wire will connect this with one of the terminal binding screws, as shown by the dotted line from B to P. The other end of the primary will pass down through the base of the coil and be carried under to the terminal binding screw A.

We may now test our coil by connecting a one pint bichromate or chromic acid cell to the terminal screws. Adjust the contact screw until a steady to and fro motion has been obtained, then span the terminals of the secondary with a piece of wire and note the spark. This will not exceed ⅛ in., but the length will be increased after a condenser is added. The terminals may also be spanned with the finger and thumb of one hand if the maker cares to test its stinging shock. Its efficiency as a spark coil will be increased by the use of a condenser and spark dischargers.

SLATERS' WORK.

BY A MASTER SLATER.

Ridges.—The ridges and hips of slated roofs are generally covered with vitrified ridge tiles. These are made in various colours, red, blue, yellow, and white, and of various

shapes: Fig. 9 is plain ridge; Fig. 10, rolled ridge; Fig. 11, capped ridge; Fig. 12, ventilating ridge, used on warehouses and mills; Fig. 13, crested ridge. A groove is formed in the top of the ridge, and the cresting fixed with cement. Ridge tiles are also made of cement concrete, and in dressed freestone, the latter being generally used for grey slating, or in very exposed situations.

Ridges are also made with lead: a wooden roll is fixed on the ridge, and the lead dressed neatly over it. In order to prevent the wind blowing the lead up, cramps of galvanised iron should be screwed on about 3 ft. apart. Ridges of slate are also used. There are three kinds:—Williams' ridge (Fig. 14) is in two pieces, Thomas' ridge (Fig. 15) is in three pieces, Davey's ridge (Fig. 16) is fixed together by cramps, and is fixed the same as ordinary ridge. The joints of these ridges are sometimes rebated.

The ridge tiles should be bedded in lime and hair mortar, and fixed to a line to keep them straight.

When the hips are covered with ridges, a galvanised iron cramp should be fixed at the lower end to prevent the tiles sliding down.

Sometimes the hips are cut so as to meet closely, and the slates are bedded in mastic and oil; sometimes steps of thin sheet lead are inserted at the hip and then turned across the hip, and sometimes a slate roll, with a notch on the underside, is screwed on to finish the hip. When the ridge tiles are not carried down to the hip, the ridge is finished with a tile similar to Fig. 17, or if an ornamental ridge is used, a finial (Fig. 18) is set at the end. The ridges should be pointed with Portland cement, mixed with sifted smith's ashes to darken it.

When three or more ridges intersect each other at the same level, special-made tiles in one piece can be had, by sending a sketch to the makers. These make much better work than mitring the ridge tiles. The tiles are also made to suit different pitched roofs from 50° to 135°, the higher numbers being flattest.

On some old roofs covered with grey slates, the ridge tiles have been obviated by cutting notches in each side of the slate 3 in. from the top, and fitting one into the other; these are called "hangers." The ridge tiles should always be selected to suit the pitch of the roof, so as to bed down with a neat, close joint on the slates.

Pointing.—After the ridges are fixed, if the slates have not been bedded, they are pointed inside with lime and hair mortar: the pointing should be on both sides of the laths and across the joints. The eaves should be well filled up with mortar, and when the slating is carried over a gable wall, the space between the top of the wall and the underside of the slates should be well filled up, to prevent the wind getting in.

When coping or water-tabling is fixed on a gable, the slates should be inserted at least $2\frac{1}{2}$ in. under it, and the joint pointed with Portland cement. When there is no coping on the gable, the slates are made to project a little over, and a broad joint pointed down and cut off on the underside to a rule; this is termed "pointing the skew."

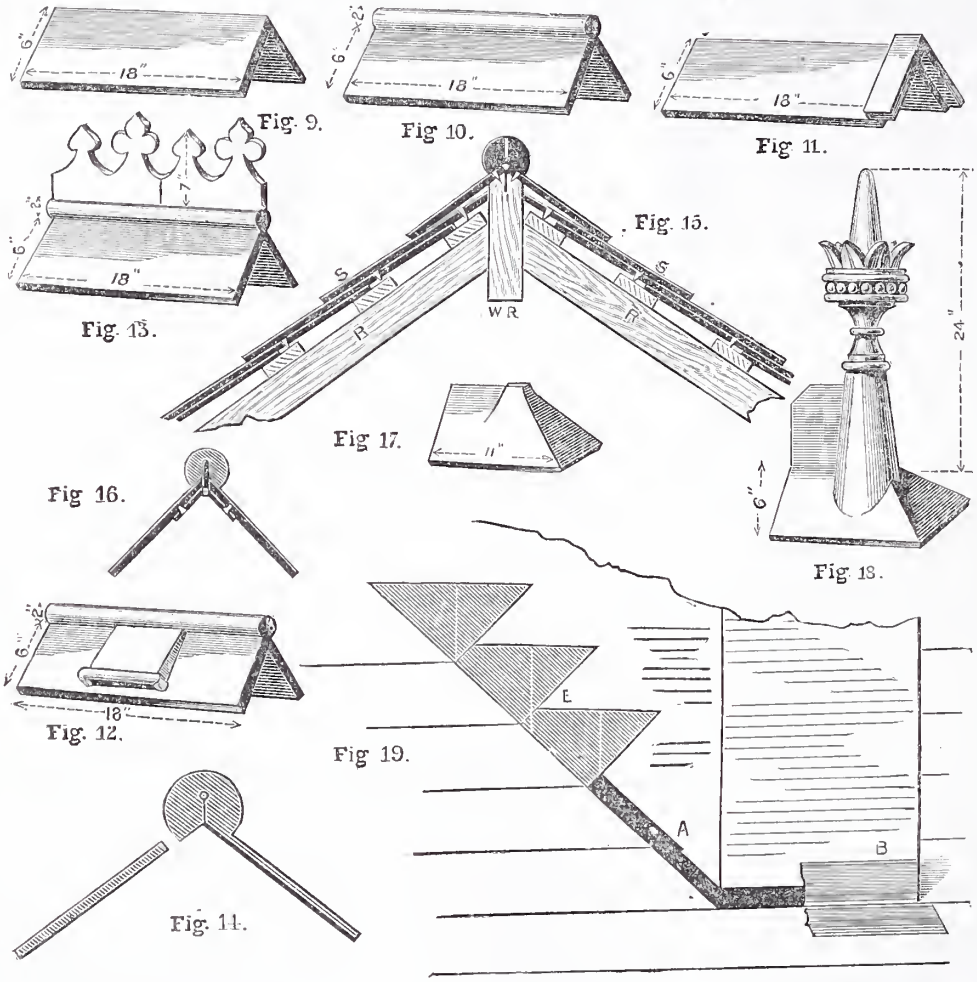
Steps and Flashing.—When slating up to a wall or chimney, lead or zinc steps should be inserted in each course; these are about 6 in. wide, and turned up $1\frac{1}{2}$ in. They should be dressed close up to the wall, and covered with flashing cut into triangular pieces, and fixed into grooves cut in the wall. Sometimes the flashing is put on in one piece, the groove being cut parallel to the slating; the flashings should be pointed with Portland cement. Sometimes the flashings are not put on, and the joint is collared down with mortar or cement, but this will crack sooner or later and let in the wet. Fig. 19 shows steps at A, and flashing at B.

When lathing up to a wall or gable end, a lath $\frac{1}{4}$ in. thick should be nailed under the slate-laths on the end rafter, to throw up the outside of the slates and cause the water to run from it.

In fixing metal skylights, they should be made so that the slates at the top and sides lay on the metal, while the bottom of the skylight should be tilted up, and lay on the slates. For wooden skylights, steps and flashing must be used, the flashing being fixed to a roll on the top edge of the wood.

When a roof is to be repaired which is not stripped to the ridge, as the last course of slates cannot be nailed, they are bedded in mortar or cement, and held up by straps of lead or copper, or by pieces of strong copper wire nailed to the top lath, and bent upwards over the tail of the slates.

Measuring.—Slaters' work is measured by the square of 100 ft., or by the square yard of 9 ft. In measuring the roof of a rectangular building, multiply the length by the girt from one eave to the other, measuring over the ridge, and the product will be the area. In a hipped roof, add the length of the eaves and the ridge together, and divide by two for the average length, and multiply this by the girt for the area of the sides; for the area of the end, multiply the length of the eave by the depth of the spar, and divide the product by two. An allowance of 1 ft. is made for all eaves, hips, and valley gutters to cover the expense of cutting. No deduction is made for ordinary chimneys or skylights, but for large openings, deduct the net area, and allow 1 ft. all round for cutting. For irregular-shaped roofs, multiply the average length of each side by the depth of the spar, and add the products together, adding the eave, hip, or valley measure. Ridges are measured by the lineal foot or yard. Pointing to flashing, skews, etc., are measured by the lineal foot or yard. Lead or line strips are counted by the dozen.



Slaters' Work. Fig. 9.—Plain Ridge. Fig. 10.—Rolled Ridge. Fig. 11.—Capped Ridge. Fig. 12.—Ventilating Ridge. Fig. 13.—Crested Ridge. Fig. 14.—Williams' Ridge. Fig. 15.—Thomas' Ridge. Fig. 16.—Davey's Ridge. Fig. 17.—Ridge End Tile. Fig. 18.—Finial. Fig. 19.—Steps and Flashing.

HOW TO MAKE AND WORK THE SPECTROSCOPE.

BY CHARLES A. PARKER.

Adjustable Slit—Preparation of the Jaws of Slit—Bevelling Jaws—Testing Edges—Connecting-Bars for Jaws—Blacking the Jaws—Collimator Hood—Cutting Opening in Cover of Hood—Fixing Jaws to Cover of Hood.

Having in the previous papers described the construction of a bisulphide of carbon

prism, let us now turn our attention to the preparation of the spectroscope itself, commencing with the adjustable slit (which is shown in plan and section in Figs. 12 and 13). The slit about to be described will doubtless tax the powers of the amateur to the utmost; and those who can successfully execute the remainder of the work, but experience a difficulty in making this portion of the instrument, will do well to call in the aid of some skilled metal-worker. Practically speaking, the essential parts of the slit may be said to consist of a couple of perfectly parallel knife-edges which shall be capable of being opened and shut according to the width of opening desired, this movement usually being effected by means of a sliding piece of metal actuated by a milled screw and spring. The adjustable slit about to be described takes the form of a pair of parallel knife-edges, so arranged as to move in unison by means of a milled screw; and as all the working portions are enclosed in the interior of the collimator hood, it presents an extremely neat and finished appearance.

Commencing with the jaws, cut off a 2⅜ in. length of perfectly flat strap brass, ⅜ in. wide, and barely ⅛ in. thick; then proceed to file one of the long sides of this to a sharp bevel at an angle, something like this:—

In order to ensure an accurate bevel being formed, take a sharp point and draw a straight line along the entire length of the brass before commencing to file the metal: and if this line is situated at about ⅛ in. from the edge to be bevelled, it will afford a very useful guide for the file. A second-cut file should be used for roughing-out the bevel, but a dead-smooth flat file may with advantage be employed for finishing it up true, the greatest possible care being taken to get a correct and well-finished bevel.

When the bevel has been filed up in the manner above directed, the brass should be sawn in half, so as to form two separate jaws, each of which must measure 1⅛ in. long (as shown in Fig. 14) after the ends have been filed up true. The finishing touches are now given to each bevel by rubbing it on a *perfectly level* oilstone until the two jaws—for such they may now be called—will close with a perfectly light-tight join when placed, bevelled edges together, on a sheet of glass and then held up to the light.

If it should happen that a slight hollowness is apparent between the two closed jaws, as is generally the case when first tested, each jaw in succession will require to be again rubbed on the oilstone until a couple of edges have been produced which are perfectly light-tight when held up to the light. It is of the greatest importance that a perfectly level portion of the oilstone should be selected for this operation; otherwise it will surely affect the bevels with round or uneven edges. Too great stress cannot be laid on the importance of carefully finishing off these edges, as an imperfectly-made slit will fail in the very particular for which it is required, and will give horizontal lines in the spectrum. When quite satisfied that the edges of both the jaws are as perfect as it is possible to make them, it will be time to see about joining them together, with the bevels inwards, something similar to a parallel rule. For the two connecting-bars, file up to a uniform size a couple of thin strips of flat brass, each one measuring ¾ in. long and ⅛ in. wide; then, by the aid of a pair of compasses, mark the position for a hole in the exact centre of each bar, and another one at an equal distance from either end (as will be seen by reference to Fig. 15). As it is important to have all three holes planted on the same line, it will be found advisable to first divide the metal with a line longitudinally along the centre, and then cross this one with another line at either end in the position to be occupied by the holes, the latter being afterwards drilled just where the lines cross each other.

When the two bars are quite ready, they should be attached to the jaws by means of screws driven into holes drilled and tapped in the latter. In order to find the exact position for the holes to receive these screws, draw a line across both ends of each jaw, at exactly ⅛ in. distance from the edge of the metal, and another line along the opposite

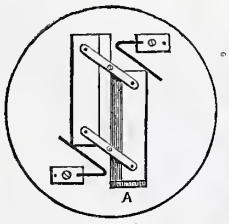


Fig. 12.

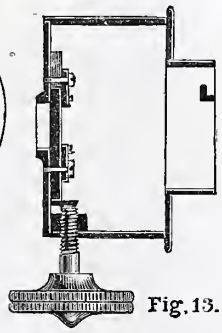


Fig. 13.

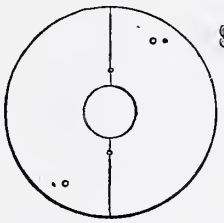


Fig. 16.

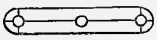


Fig. 15.

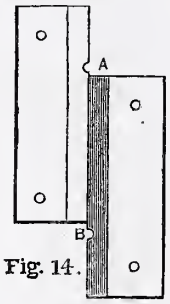


Fig. 14.

The Spectroscope. Fig. 12.—Cover of Hood, with Jaws of Slit attached. Fig. 13.—Section of Collimator Hood. Fig. 14.—Plan of Jaws of Slit. Fig. 15.—Connecting Bar of Jaws. Fig. 16.—Disc fitted to Hood.

sides and parallel to the bevels; and when this has been done, a centre-punch mark, made just where the lines cross each other, will serve to indicate the position for the screw-holes, which are then drilled and tapped to take a couple of small, suitable screws to each jaw. The jaws may now be joined together by the two connecting-bars, which are placed one at each end, and attached to the jaws by means of the screws just fitted, which should be screwed in sufficiently tight to allow them proper freedom without being too easy.

At this stage of the proceedings a small semicircular piece of brass should be soft-soldered to the end of the lower jaw (in the position indicated at A in Fig. 12). It is against this plate that the screw which regulates the width of the slit is made to act.

Before the jaws are attached to the cover of the collimator hood, they should be coloured a dull black by the following chemical process:—

Drop several small pieces of copper wire into a bottle containing nitric acid until it appears to be saturated, when it will refuse to dissolve any more; then pour off all the clear liquid, and dilute this with about three times its bulk of rain-water, when it will be ready for use. Make the work to be blacked rather hot, and then dip it in the liquid—or apply the latter to the surface by means of a soft brush—afterwards heating the article again over a gas or spirit flame until it assumes a good dull or dead black.

If the jaws have been properly adjusted, they will open parallel to about ⅛ in., or will be capable of closing together so perfect as to prevent the passage of any light between the knife-edges. The uniform evenness of the jaws would appear to be merely a matter of very careful grinding upon an oilstone, and accurate fitting; but in actual practice it is scarcely so easy as some might imagine to get them to act properly.

We shall now be ready to prepare the collimator hood, to the cover of which the jaws are attached. For the body of the hood we shall require a stout 1¼ in. ring of drawn brass tubing, 2¼ in. in diameter, to one end of which a stout brass disc is brazed, in order to form a kind of box with a bottom to it. This done, the hood is mounted in a lathe for a slight recess to be turned round the inner edge of the open end, into which a stout disc of brass of suitable size may be tightly sprung in precisely the same manner as the cover of a watch or clock barrel. In point of fact, a disused barrel from a clock or musical-box will be found to answer admirably for the collimator hood, as will be shown later on.

Now take the disc just fitted to the hood (see Fig. 16), and, having first made a punch-mark in the exact centre of the metal on both sides, take a needle-point and draw a straight line across the diameter of the disc, in order to ensure the jaws being correctly centred when they are subsequently attached to the metal. When this has been done, the disc should be turned over to the other side, and then mounted in a lathe for a hole ½ in. in diameter to be cut through the centre of the metal; and if a slight stilt is left to surround the aperture, it will considerably add to the appearance of the instrument when finished. In any case, however, it will be found advisable to clean up the surfaces of the metal before removing it from the lathe.

Thus prepared, the disc will be ready to receive the jaws. Take a pair of dividers, and, having adjusted them to the exact distance between the central holes in the connecting-bars of the jaws, make a couple of corresponding marks, one on either side of the opening in the disc and on the central line previously scratched across the disc (as will be seen by reference to Fig. 16, which clearly shows the position of the holes). A couple of holes are now drilled and tapped in the position indicated, and then fitted with suitable screws, for the purpose of affixing the jaws to the plate; but before this is done it will be necessary to take a rat-tailed file and make a slight groove at one end of the knife-edge of each jaw (in the position indicated at A and B, Fig. 14). This is a necessary precaution; otherwise the knife-edges will come hard against the stems of the screws by which the jaws are attached to the disc; but, at the same time, great care should be exercised in filing these grooves, as it is undesirable to make the cuts deeper than is absolutely required.

It will add considerably to the appearance of the collimator hood if the cover or disc is finished off a good dead black by the chemical process previously described. This would require to be done before the jaws are affixed to it, and it would be needful to exercise great care in the subsequent operations, so as not to spoil the surface.

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WHAT IS BI-METALLISM?—As there is a somewhat increased activity just now amongst bi-metallists, it may not be uninteresting to point out what bi-metallism really means. In this country gold is the only legal tender for debts exceeding 40s. Bi-metallists want silver to be raised to the same rank as gold in this respect, and to be made a legal tender for debts of any amount. If it were left to the option of debtors to pay in either of two metals, clearly they would always choose the cheaper metal, or, rather, the metal that involved the least outlay to themselves. For instance, suppose a debt of £100, and suppose that at the time it was contracted that the gold in 100 sovereigns were equal in value to the silver in 2,000 shillings, such a debt would be fairly discharged by the payment of either 100 sovereigns or 2,000 shillings. Suppose, however, that before the debt were paid silver were to fall, say to the price it is now —viz., about 40d. per ounce—then, as an ounce of silver is coined into $5\frac{1}{2}$ shillings, the silver in $5\frac{1}{2}$ shillings would be worth only 3s. 4d., or the sixth part of a sovereign, and the silver in one shilling would be worth the sixth part of a sovereign divided by $5\frac{1}{2}$, or $\frac{1}{33}$rd of a sovereign; 2,000 shillings, which were the equivalent of 100 sovereigns when a shilling was worth $\frac{1}{20}$th of a sovereign, would now fall far short of that, and would be worth just over £60 10s. To prevent creditors from being defrauded in this wholesale manner, the bi-metallist proposes to fix by legal enactment the price of silver in terms of gold—usually in the proportion of about 15 to 1—so that 15 oz. or 15 lb. of silver shall always be of the same value as one ounce or one pound of gold. Just now the ratio of silver to gold is about $23\frac{1}{2}$ to 1, so that to make 15 oz. of silver equal to $23\frac{1}{2}$ oz. would be a very fine thing for the proprietors of silver, just as it would be a very fine thing for the proprietors of other commodities to have their prices raised by more than half as much again. Of course, if any other class except those interested in silver came forward with a demand that their commodities should be increased in price by the legislature, they would not get a hearing at all. The reason that bi-metallists are listened to is because our silver coins pass current at a value so much above the value of the metal they are made of. They think that because an artificial value is conferred upon the coins, a similarly artificial value can be given to silver all round. This is just the same as if it were proposed to give the value of bank-notes to the paper they are made of.

STEAM BY CREOSOTE.—Ere another winter is upon us, large works and factories where the generating of steam is a necessity will probably become protected against the loss and inconvenience occasioned by the recent coal strikes. Among the substitutes for coal, our experience of creosote deserves to be regarded. In the case to which we particularly refer there were three double furnace boilers, and a single pipe or jet was applied to two furnaces of one boiler and one furnace of the other, the furnace not in use being closed so as to prevent any air passing in. The creosote was put into a wrought-iron tank, in which a steam coil was placed to melt the creosote, which then flowed into the pipes leading to the furnaces, where it was "sprayed" by the jet of steam and blown through the flues, producing a beautiful clear frame, perfectly free from smoke, and leaving all the heating surface perfectly free from soot or any other non-conducting deposit. Although the engine was at full work, a slight tap on the regulating cock would cause the steam to blow off at the safety-valve, and generate more than the engine could use, the heat being so great that pumice-stone was quickly run into glass; in fact, it was almost impossible to use the apparatus at its full power. As the result, it was found that, weight for weight, it did three times the duty of coal, was easily managed—in fact, one man could have easily tended a dozen furnaces—and that there was nothing to go wrong in the apparatus. So soon, however, as the facts relating to its use became known, speculators and others stepped in, and what up to then could almost be had for taking it away, or at the most at a farthing a gallon, went up to $2\frac{1}{2}$d. and 3d., at which price it was found no cheaper than coal: so the matter gradually dropped, and can only be profitably used by those who have the control of the market or the production of the material. Extended experience of its use has shown it to be capable of evaporating from 20 lb. to 26 lb. of water for each pound used; and as the products of its combustion are free from sulphur, and it produces a clear, clean flame of almost any length, there ought to be many purposes for which, if even the cost were the same as coal, its employment would confer a great benefit. In Russia locomotives and steamships are worked by the aid of mineral oil, and are found very convenient and reliable, as well as economical. In England some locomotives are at work using ordinary gas tar, but we do not think this so suitable for the purpose as the creosote or mineral oil. The men working the latter have given us a high character of their powers and convenience, and we believe that experience will soon render them of extended adoption from the better results obtained. The fuel question is a very important matter in ordinary household life; but when we step into the broad area of commercial usage the matter assumes an enormous magnitude—so great and widespread are the interests concerned.

BENT IRON WORK, AND HOW TO DO IT.

BY J. H.

A Screen.

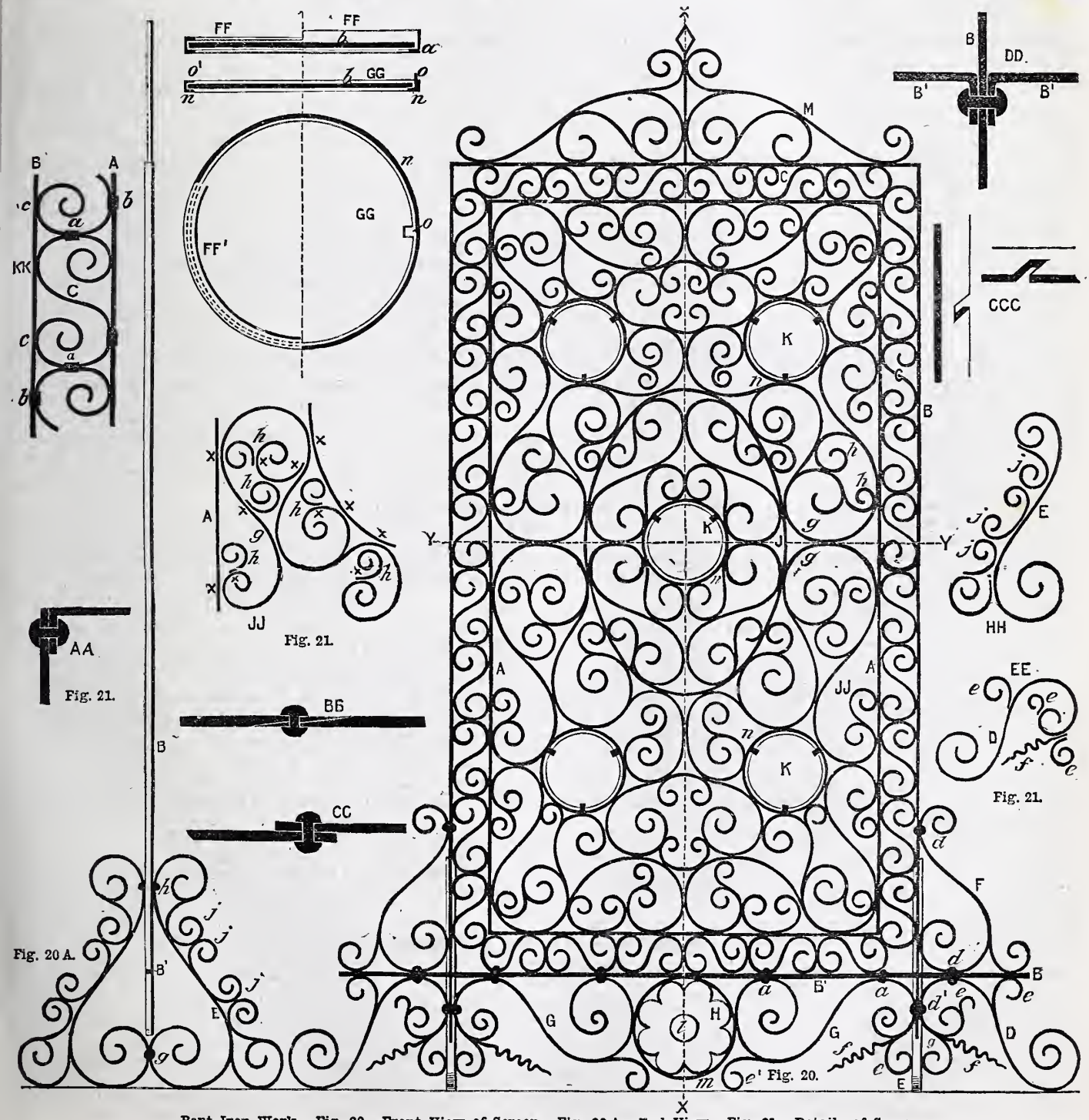
Proportion of Screen—Iron in Framing—Construction of Framing: The Inner Frame — The Outer Frame — Precautions—Uniting Scroll Work—The Clips —Supporting Scrolls — Their Details—Feet—Bottom Curves—Centre Rosette—The Panel, Glass Discs, and Scrolls—Modes of Securing Discs—Second Method —Top Ornament.

Proportion of Screen.—The screen (Fig. 20) is a design suitable for the fire, or for ornament merely. Its height may be from 2 ft. 6 in. to 4 ft. 6 in., and other dimensions in proportion. It should be drawn out to full size, a scale being selected proportional between the illustration and the size of the screen intended to be made. There is a little heavy work in the framing, but the whole of the tracery is formed of the thin strips of iron.

Iron in Framing.—The framing is formed of iron bar, having a section of $\frac{3}{8}$ in. by $\frac{1}{16}$ in., or $\frac{1}{2}$ in. by $\frac{1}{16}$ in. There are inner and outer frames, A and B respectively, connected with the scroll work, C. I cannot properly indicate the joints in the general figure, but give them in detail (Fig. 21).

Construction of Framing: the Inner Frame.—The inner framing, A A, may be made of one strip, or more. If short lengths of iron only are available, then joints may be made at the corners, or at any positions that may be convenient, by the method shown in Fig. 21, A A, turning down the ends and riveting them to the verticals, the rivets being either of the cup or of the countersunk form. If, however, a strip sufficiently long is available, then it may be bent round at three corners and riveted at the fourth, in the fashion also shown at A A; or it may be bent round at all four corners and riveted in the centre of a length, as in Fig. 21, B B, the joint being made of the scarfed form and riveted. The latter is the neatest method. Or the joint may be lapped merely, and riveted as at C C; this, however, is not neat. The corners to be bent are well hammered over the keen edge of an anvil or of a block of metal.

The Outer Frame.—The outer frame, B, is almost of necessity made in separate pieces. It is true the top and sides of the frame might be bent round in one piece and fitted



Bent Iron Work. Fig. 20.—Front View of Screen. Fig. 20 A.—End View. Fig. 21.—Details of Screen.

into the horizontal, B′, with a half-lap joint (Fig. 21, C C C), and if solder were run round, and the adjacent scroll brackets well secured, the frame would be firm. But the better plan is to fit the bar, B′, in three lengths to the verticals, B, with turned-down ends and rivets, as shown in Fig. 21, D D. The strength of the bar is thus preserved entire.

Precautions.—When putting large frames like these together, two points have to be observed: to hammer the bars quite straight in the directions of both width and thickness, and to take care that the frames are free from winding when riveted together.

Uniting Scroll Work.—The two frames are united by means of the scrolls, C (Figs. 20 and 21), made of iron ⅜ in. wide. They are arranged symmetrically on each side of the centre line, X—X. As there are so many precisely alike, one should be made first and tried between the frames, and when corrected, all the others should be tested by that one as a pattern.

The Clips.—When fixing scroll work, security is assured by as many clips as the parts will conveniently take. I do not show the clips in the general view. The enlarged Fig. 21, K K, shows them, as used for these scrolls. The scrolls are united to each other at their ends, *a*, *a*, and to the verticals A and B at two points, *b*, *b*. They could, of course, be also fastened at *c*, *c*, but this is unnecessary, as the clips shown in the figure are amply sufficient to afford security and rigidity to the parts.

Supporting Scrolls.—Upon the scrolls, D, E (Fig. 20), the weight of the screen is supported, and they cannot, therefore, be made of the thin strips, but must be of the same section as the verticals, or about ½ in. by $\frac{1}{16}$ in. It will be better, too, though not so necessary, that the scrolls, F, be of the same strong section, and so also may G. Being of thick section, these scrolls will be riveted, and not clamped to the verticals, B, and to the horizontal, B′, at *d d*, the rivets being of the snapped form, as shown, or else countersunk. These scrolls cannot be bent with pliers, but must be hammered over the anvil-beak, either while cold or at a red heat. They will be tried upon the drawing, and each upon its fellow, for symmetry.

Their Details.—The scrolls are formed of more than one piece, as seen in the detailed view (Fig. 21, E E), where the parts are slightly separated to enable them to be easily distinguished from one another. Thus, *e e* are formed of separate pieces, and fastened to D. The best way to fasten these is either by soft soldering or brazing, and the joint can be scarfed to make the scrolls appear as if worked from one piece. The tendrils at *f* are made, again, of separate strips, and inserted and brazed between the two scrolls, all being held together with solder.

Feet.—The feet, E (Figs. 20 and 20A), which stand out sideways, are required to give steadiness of base. These are made of the same heavy section as the framing. They are riveted together at the bottom curve, *g*, and are united at the top curve, at *h*, to B, with stout clips or with spelter. In these, E is the main curve, to which the smaller, merely ornamental, curves are fastened with clips or with solder. These several distinct parts are shown separated at Fig. 21, H H.

Bottom Curves.—The curves, G, may be made either of stout or of thin strips. It is better to make them of heavy section—½ in. by $\frac{1}{16}$ in. These will be riveted at *d′*, at the end, a single rivet passing through D, G, and B. The minor scrolls, *e′*, and the tendrils, *f′*, are soldered or brazed, as in the case of those on the opposite side of B.

Centre Rosette.—The centre, H, of the bottom portion is a flower, or rosette, made of copper. In this example there are two such, placed back to back, fastened to each other with the rivet, *l*, that also forms the centre boss or disc. These flowers are cut from sheet copper of thin gauge, and after the dentations are formed by filing, the surface is hollowed with a round-faced punch upon a block of pitch or prepared bedding, used in repoussé work. The circle, *m*, that encloses the flower, is of iron, and is soldered, or fastened with rivets, to G G. I shall have more to say about copper floral ornaments later on.

The Panel, Glass Discs, and Scrolls.—The panel of the screen is tastefully relieved by the coloured glass discs, K. These can be purchased of almost any glazier. As the scroll work covers a large area, every point of contact ought to be firmly secured with a clip. The main curves, *g*, form the connection between A and the ellipse, J, and also partly support the frames that enclose four of the glass discs. The curves above the line, Y Y, are not symmetrical with those below, because the ellipse is placed above the middle line of the panel; but all the corresponding curves to right and left of the vertical centre line, X—X, are symmetrical, so that, when one set has been worked, the corresponding set will be tried upon them. All the minor curves, *h*, are fastened to the main ones with ordinary clips. The clips are not shown in Fig. 20, but at J J (Fig. 21) an enlarged view of the corresponding part, marked J J in Fig. 20, is shown, with its several scrolls, *h*, separated, and the positions of the clips are indicated by crosses.

The curves enclosed by the ellipse, J, are secured with clips, both to one another and to the ellipse.

Modes of Securing Discs.—The glass discs, K, may be held in position in either one of two ways. A strip of thin iron, *a*, can be bent (Fig. 21, F F) into an angular section, turned into a circle, and soldered at the ends. Then the disc of glass, *b*, can be laid upon the horizontal flange, and the top edge of *a* burnished or turned over by pressure, to cover and enclose the edge of the glass, as at Fig. 21, F F′.

Second Method.—But this is a rather troublesome job, and the following will answer equally well, and it is the method I have shown in Fig. 20. Make a true ring, *n*, of the ordinary iron strips, and solder three or four short strips (Fig. 21, G G, *o*) to the outside of the rings equidistantly. Next unite the rings at their points of contact with the scrolls by means of the ordinary clips. Then the glass discs, *b*, will be slipped in, and the free ends of the short strips, *o*, turned over against the face of the glass, as at *o′*.

Top Ornament.—The ornament, M, at the top of the screen calls for no remark. It is made of the thin ⅜ in. strips, and bent, and held with clips similarly to the other scroll work.

MODEL BOAT-MAKING FOR BOYS.

BY A CRAFTSMAN.

Bulwarks—Stand—Rudder—Painting Hull—Deck Fittings—Capstan.

The hull must next be thoroughly sand-papered all over, to make it as smooth as possible, and the bulwarks fitted on. These are made of ¼ in. material, walnut-wood being perhaps the most suitable. They are fixed on to the deck with nails or screws at such a distance from the edge that a ledge ¼ in. wide projects all round. A half-rounded strip of wood (C D, Fig. 8) is then fastened round the outside of the hull slightly above the water-line, and is brought to a point at the bows. A thin piece of sheet copper is nailed across the bows from the bulwarks down to the metal keel, to prevent the wood from being damaged in case a collision occurs.

The stand is the next part that must be constructed. Its shape is represented by Fig. 5. It consists of two upright pieces of wood, supported at a certain distance apart by a stout wooden bar. It is generally constructed of oak, and slits are cut half-way down the centre of each of the uprights, of such a width that the keel will fit loosely into them.

The shape of the rudder is shown in Fig. 6. Its upper part, which is rounded, is made to fit into the brass tube which was passed through the deck, and is of such a length that about 1 in. projects above the deck. The top of the part which projects is reduced in size for a short length, and a piece of brass tube is fitted on to it.

In Fig. 6, A is the brass wire, B the brass tube, C the rounded part of the rudder, D the part which is in the water. The brass wire, A, is about 3 in. long, and is used for turning the rudder. Instead of having its end curled up as shown in Fig. 6, a small wooden handle may be attached to it. The rudder can be fixed in any position by the brass arrangement shown in Fig. 7. It consists of a piece of brass (A B) which is about ¾ in. in height, and has a series of notches cut in its upper edge. It is fastened down to the deck in a curved position, almost above the rudder, by brass flanges, which are soldered on to it and screwed down to the deck. The brass wire coming from the upper part of the rudder is placed in any of the notches which holds it in the requisite position, and is so bent that it presses downwards, and cannot therefore spring upwards.

The hull, as far as you have now advanced with it, is shown fixed in its stand in Fig. 8, where the ledge of the deck which projects is represented by the double line A B, and the rounded strip of wood which you fastened just above the water-line by C D.

Before going any further it will be best to paint the hull. All cracks and holes must be stopped up with putty, and the paint laid on in thin even coats. The upper part, from the top of the bulwarks to C D (see Fig. 8), is usually painted black. The lower part, with the exception of the keel, if the latter is made of lead, can be painted with vermilion, dark red, or brown paint. The belt may be painted white or gold. When all the coats of paint have been laid on, the whole must be varnished. The deck can be varnished or left plain, as you please.

The deck fittings must now be arranged in their places. Fig. 9 is a plan showing how the deck fittings of a two-masted vessel can be arranged. The rectangles A, B, and C are hatchways, those represented by the letter D are skylights, E is a piece of wood which holds the end of the bowsprit, F is the capstan, G is a piece of wood which supports the anchor, H is a hole into which the foremast is fitted with the aid of a socket, I is a similar hole for the mainmast, J is the binnacle containing the compass, K is the top of the rudder, L is the brass arrangement for fixing the top of the rudder, and the lines denoted by the letter M are brass wires along which ropes attached to the jibs and

mainsails slide in tacking. The short lines or dashes near the mast holes are cleats on to which the ropes which regulate the sails are fastened. The number and size of the deck fittings vary according to the taste of the constructor. They are easily made, or can be bought ready-made at several shops. If you are making a boat about 4 ft. or 5 ft. long, a small brass bell, in imitation of those used on real ships, may be suspended in front of the mainmast, and several swivel cannons may be fastened on the deck in various positions. A few small boats may also be secured on to or suspended above the deck, in such positions that they will not interfere with the free motion of the sails.

It is best to settle on the number and size of the deck fittings before the deck is fitted on. The holes to receive them must be neatly cut out with a keyhole saw or bored with a centre-bit.

The simplest kind of hatchway is made by constructing a box of thin wood without any top or bottom to it, and of such a size that it will fit tightly into the hole previously cut in the deck, and project a little above it. A lid is made to slightly overlap it, and is fastened on with two hinges. A hole may be cut in the lid, and fitted with a piece of glass to form a skylight. It can be fitted with some fastening arrangement to keep it firmly down, so that no water can get into the hold. The skylights may be constructed in the same way that the hatchways are, only with glass roofs instead of wooden lids; or they may consist of plain pieces of glass let into the deck.

For circular skylights, lenses fastened into a round hole with putty can be used. They may also be constructed in the forms shown in Figs. 10 and 11; but these are rather complicated: they should only be used on a 5 ft. boat. The pieces of glass are fastened into the wood with putty, and protected by pieces of brass wire fastened across them. The skylights can also be constructed of an oval or hexagonal shape, and may have curved roofs.

The piece of wood (E, Fig. 9) which holds the end of the bowsprit is shown in Fig. 12. A hole of the same size as the bowsprit is bored about half-way through it, and it is fastened down to the deck with two screws.

The capstan is shaped something like Fig. 13. It is turned out of boxwood, and its lower part is made smaller than the rest, so that it can be fitted into a hole bored in the deck. The rope from the anchor is tied on to its middle part and wound round it. It can be made with a cog-wheel and spring catch arrangement, so that the rope can be wound up by simply turning it round. A hole is bored through the bulwarks near the capstan for the anchor chain to pass through, and a small piece of brass tube is fitted into it to prevent its sides from being worn away. The support for the anchor (G, Fig. 9) is simply a flat piece of wood fitted into the lower part of the bulwarks. A loop of string hanging down from it holds up the fluke of the anchor. One end of a long piece of chain or whip-cord is attached to the anchor, and the other end is fastened to the capstan, round which the remaining part of it is wound.

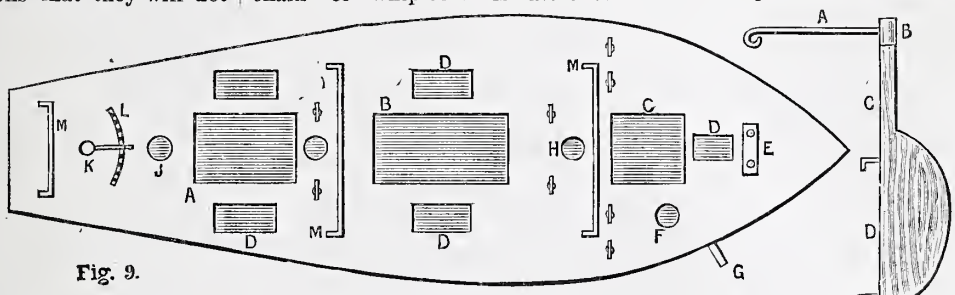


Fig. 9.

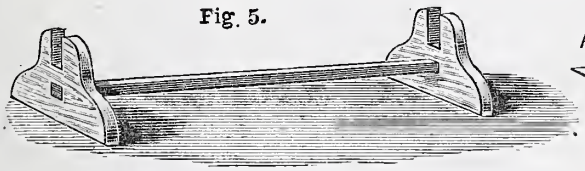


Fig. 5.

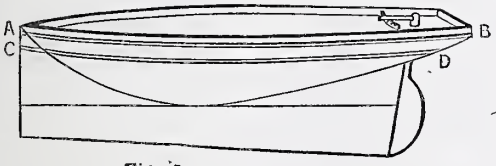


Fig. 8

Fig. 6.

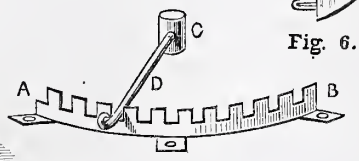
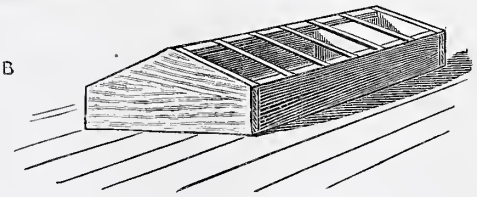


Fig. 7.



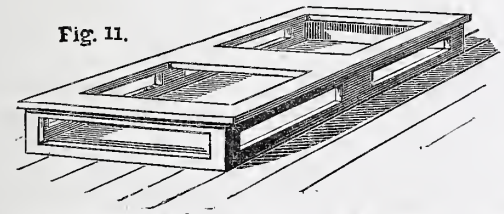


Fig. 11.

Fig. 12.

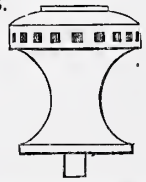


Fig. 13.

Model Boat-Making for Boys. Fig. 5.—Stand for Boat. Fig. 6.—Rudder—A, Brass Wire; B, Brass Tube; C, Rudder Rod; D, Rudder. Fig. 7.—Steering Apparatus—A B, Piece of Brass; C, Top of Rudder; D, Brass Wire. Fig. 8.—View of Hull completed. Fig. 9.—Plan of Deck, showing Description of Fittings—A, B, C, Hatchways; D, Skylight; E, Socket for Bowsprit; F, Capstan; G, Beam for Suspending Anchor; H, Socket for Foremast; I, Socket for Mainmast; J, Binnacle; K, Top of Rudder; L, Brass Rackwork; M, Sliding Arrangements for Sheets. Fig. 10.—Skylight for Deck. Fig. 11.—Skylight for Deck. Fig. 12.—Socket for Bowsprit. Fig. 13.—Capstan.

SCIENCE TO DATE.

The New Star.—Mr. Anderson, the discoverer of the new star in Auriga, wrote to *Nature* in the following terms, which need no comment: "My case is one that can afford encouragement to even the humblest of amateurs. . . . All the means I had at my disposal on the morning, when I made sure that a strange body was present in the sky, were Klein's 'Star Atlas' and a small pocket telescope which magnifies ten times."

Extraordinary Calculator.—A young man was presented lately at one of the meetings of the Academy of Sciences at Paris with the most marvellous powers of mental calculation. Without seeing the figures, which were read to him, he performed the following subtraction almost instantly:

4,123,547,238,445,523,831
1,248,126,138,234,128,910

He was next asked, "What number is it, the sum of the square and cube of which is equal to 3,600?" "It is 15," he said in a few minutes. Then, whilst he calculated the age of M. Betrand in seconds, he was asked to find the value of $\sqrt{\sqrt{4801}-1}$. In two or three minutes he had mentally solved them both. A commission of the Academy has been appointed to inquire into this marvellous faculty.

Carbon and Barium.—M. Maquenne has found that when barium is heated with carbon to a high temperature, the two elements combine, forming a compound — C_2Ba — which may be regarded as acetylene—C_2H_2—in which the two atoms of hydrogen have been replaced by an atom of Ba. To prepare the substance, an amalgam of 1 part barium and 4 parts mercury is heated with powdered retort charcoal in an atmosphere of hydrogen. When the temperature reaches a red heat, and all the mercury is expelled, an energetic reaction takes place between the barium and the carbon, and the new substance is obtained as a grey friable mass. Barium acetylide, as it may be called, can be heated to redness without alteration, but when thrown into water, it is decomposed with effervescence, giving rise to acetylene gas, which may thus be obtained in a remarkably pure state.

Pure Boron.—Up to the present time the element boron has never been prepared in a pure state, but recently Moissan has succeeded in obtaining it by reducing fused boric acid with metallic magnesium. Pure boron thus obtained is a brown powder. A study of its properties is to be undertaken.

Tobacco.—Researches which have been carried on by the Agricultural Department at Washington tend to show that the special aroma of each kind of tobacco, which is developed especially during and after fermentation, is due to micro-organisms. Each variety of tobacco has its special bacterium, and by inoculating inferior qualities of tobacco with the bacteria of the finest qualities, the former acquire the taste and aroma of the latter. If this is true—and experiment will decide—smokers will probably be able to enjoy the finest tobaccos without paying more than moderate prices.

New Use for the Electric Light.—Experiments have been made in the Bay of San Francisco with regard to the employment of the electric light for fishing purposes. A strong light was sunk below the water, and it is stated that fish of every species were attracted and caught in large numbers.

Ancient Races in Africa.—Explorations made amongst the ruins of the Great Zimbabwa, in Mashonaland, by Mr. Bent and his wife and Mr. Swan have raised some interesting questions. Mr. Bent has come to the conclusion that the ruins were not in any way connected with any known African race. It seems that the ruins formed a garrison for the protection of a gold-producing race, and that there is little doubt but that the builders and workers came from Arabia.

TRADE: PRESENT AND FUTURE.

*** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

PLUMBING AND GLAZING TRADES.—In Bolton and district plumbers and glaziers have struck work on a question of "country money"—6d. per day for country work—which, though paid for a time, has been stopped. In Aberdeen the plumbers' dispute has been settled, most of the proposals put forward by the men being agreed to.

SILVER AND ELECTRO TRADES.—Our Sheffield correspondent writes:—There are signs that the depression which has characterised the silver plate trade is lifting. America is taking increased quantities of goods, specially designed and got up for that market.

METAL TRADE.—The copper market has been quiet, only a moderate amount of business being done. Values opened at £45 12s. 6d. cash, and gradually declined. Prices, however, subsequently recovered, and the market closed at £45 8s. 9d. cash. The total stocks in Liverpool, London, Swansea, and Havre show a decrease of 229 tons for the fortnight. Yellow metal sheets are 5d. to 5⅛d. per lb. Tin market irregular, closing at £93 12s. 6d. for Straits, £93 17s. 6d. for Australian, £96 to £97 for English, and £76 to £89 for Peruvian, according to quality. Lead market has been quiet, and closed at £10 10s. to £10 11s. 3d. for Spanish, and £10 13s. 9d. to £10 16s. for English. Spelter market is also dull, values declining to £21 15s., but closing at £25 5s. per ton. Quicksilver quiet but steady at £16 14s. per bottle for Spanish. Bar silver has been irregular; prices, varying between 39¾d. to 40$\frac{1}{16}$d., closed at 38⅞d. Antimony, market firm at £45 to £46 per ton. In Aberdeen the tinsmiths are exceedingly slack.

TIMBER TRADE.—The import of timber during the last month has been on an average scale, but of deals and boards it has been exceptionally light. Mahogany wood of good size remains firm, but small and inferior wood is not wanted, and the markets are heavily stocked. Cedar, good-sized wood, is in satisfactory demand, there having been no imports, but stocks are heavy.

COKE TRADE.—Durham cokes have risen about 10s. per ton above contract prices, and are rising.

CYCLE TRADE.—There is no sign of the price of first-class cycles falling off. A well-known firm has just booked an order for thirty specially light racers at £30 apiece, and they have an offer for twenty more at £45, list price, provided they are reduced to a certain weight. Most of the Coventry cycle factories are working from twenty to thirty hours' overtime per week. In Sheffield the cycle sections are extremely busy, though not so well employed as they were a fortnight ago. Activity still prevails in Birmingham, Coventry, and other centres. Several Coventry firms are now making, and in other cases making preparations for making, their own stampings and accessories, which it has hitherto been the rule to buy from Birmingham and other places. It is estimated that at least half a million of money is thus paid away annually by Coventry manufacturers.

CARPENTRY AND JOINERY TRADES.—The state of trade in Aberdeen is very good, men being in demand both in the city and district. In Rochdale and district the stone-masons are on strike for ½d. an hour advance in wages. The bricklayers' labourers are at work again. Painters and plumbers are, as a rule, busy.

COTTON TRADE.—The dispute in the cotton trade, which has been agitating Lancashire for some time past, has been settled. By the terms of the settlement the operatives have virtually gained the whole of the demands for which the Stalybridge hands were originally agitating. Another correspondent writes:—It cannot be said that either side has obtained any very great advantage, although each claim to have accomplished their object. The employers have agreed that when bad work is proved, the men shall be entitled to compensation for loss of wages until that grievance is removed; but, on the other hand, the question of the employment of non-unionist labour has been left in abeyance, and this practically amounts to a gain by the employers. In Rochdale and district the lock-out is over, so that much trouble for many classes of operatives is averted.

ENGINEERING TRADE.—The unsatisfactory state of trade still continues, and as far as can at present be ascertained, there is little prospect of any improvement taking place for some considerable time. Some of the builders of large stationary engines in the Bolton district have lately booked some good orders for large mill engines, principally for export, while in the Barrow district both shipbuilders and engineers continue busy, the latter being principally occupied in converting compound marine engines to those of the triple expansion or quadruple expansion types. Most of the machine tool makers continue to report a great scarcity of orders, and boiler makers, who, up to within a few weeks, have continued fairly busy, now find new work with difficulty. Locomotive builders have very little new work coming forward, and the large machinists, while still busy completing orders in hand, have very little new work in prospect. The change in the iron market is slight, but in a favourable direction. Both for raw and manufactured material, however, buyers still purchase for immediate requirements only. A fair amount of business is reported in some of the district branches, but in almost every case the orders are not of any considerable weight. As contracts expire consumers are only renewing them for quantities considerably less than usual. In the steel trade a stronger tone prevails, but both in raw and manufactured material prices are irregular and unstable.

FILE AND STEEL TRADE.—Sheffield file and steel makers who are supplying the Spanish markets are very busy.

IRON AND STEEL TRADES.—The Sheffield rolling mills are far from busy. This falling-off is in a measure due to the late "stop week." But for the strike at Durham, the Bessemer, spring, and wheel and axle works would remain busy until the close of the year.

GRANITE POLISHERS' TRADE.—The Aberdeen men and masters have agreed that overtime to the extent of one hundred and sixty hours in a year shall be allowed, to be paid for as time and a quarter; and beyond that limit overtime shall be paid for as time and a half, with thirty days' notice of any strike or lock-out. Trade is, on the whole, good, and the prospects better.

SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

I.—LETTERS FROM CORRESPONDENTS.

Plumbing.—JOURNEYMAN PLUMBER writes:—"Ironmongers do the majority of tinker's work. Why should they touch the plumbing trade? We plumbers might just as well start and sell ironmongery. When the Plumbers' Registration Bill becomes law, it will not prevent them from soldering tins, etc., which is all they can expect; such work is not plumbing."—[Glad to know your views. Undoubtedly it will be a good thing for the plumbers to enrol themselves into a select body, and the Bill should protect your craft. Certainly householders will rejoice to be freed from the unqualified plumber! You know the saying, "Every man to his trade."—ED.]

Hobbyists' Emporiums.—BONÂ FIDE writes:—"In your leaderette on Hobbyists' Emporiums, in WORK, No. 160, you suggest a much-needed want among workers and hobbyists. Could not an Amateur Co-operative Society be formed among the readers of WORK, who would open depôts or bazaars in various towns for the disposal of their work? There might be exhibitions, and sales of the goods during the exhibition, or by auction at the close of such. I should be pleased to have the opinion of fellow-readers on the subject."—[Our readers should let us have their views.—ED.]

Celluloid Collars.—J. C. K. (*London, N.W.*) writes:—"One who wore them complained of their turning yellow, and of their breaking at the button-holes after three months' wear, to a friend who wore them longer with more satisfaction, and was advised what to do. Cut an inch slit in the front button-holes to get on and off easily, and wash with a little soap and water and an old tooth-brush the soiled parts of the collar each time it is taken off; the result will be comfort and cleanliness, giving longer wear."

Personally Conducted Lectures.—H. S. G. (*London, S.W.*) writes:—"Mr. Abbot, F.G.S., the lecturer on Gems, etc., at the Horological Institute, Northampton Square, E.C., has lately given two demonstrations—one at Jermyn Street Museum of Practical Geology, the other at the Mineral Gallery, Natural History Museum, South Kensington. They were both well attended; but if they were better known, there would have been a hundred members of the jewellery trade present, instead of the dozen or two actually there. To be taken from case to case, and in each one to have the best examples picked out and discoursed on, surely no better or more useful hours can be spent anyhow! Now that such lectures have been started in one direction, is it not possible to arrange for parties in other trades too? Would the keepers or curators of the different museums consent to guide and explain their treasures to parties from the different polytechnics? I for one should like to find these national treasure-houses much more used and appreciated."—[Possibly keepers and curators will address the Editor of WORK on this subject.—ED.]

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Papier-Mâché.—CAP-À-PIE.—Articles appeared in WORK, Nos. 3, 6, 12, 17, 22, 25.

Mineral-Water Boxes.—BOXER.—Purchase the stain of any oil and colourman, and apply it yourself to taste. Then stencil your name over the stain. Your name you will get cut for a small outlay from any stencil-cutter in Birmingham.

Designing.—STUDENT.—There will shortly be placed before the readers of WORK an original series of papers, which, it is hoped, will enable them to set about learning the art of designing.—ED.

Technical Class Work.—TEACHER.—If you, or indeed any other teacher of technical work carried on in classes throughout the country, will communicate with us as to your work and wants, we will endeavour to assist you in WORK.—ED.

Graining.—F. P. S. (*Hemel Hempstead*).—Articles on the above appeared in Nos. 55, 62, 65, 69, 72, 76, 79, 84, 89, 93, 95, 98, 100, and 103 of WORK.—ED.

Sheet Metal Work.—R. F. (*Kirkintilloch*).—Articles on the above appeared in Nos. 67, 71, 78, 81, 93, 127, 134, and 138 of WORK.—ED.

Vibration of Sewing-Machine.—W. H. W. (*Lambeth*).—Your question, which seems a very simple one, is really very difficult to answer. You say your machine (a well-known make) vibrates during running to a disagreeable degree. It is very difficult to locate the point of vibration in such a complicated piece of mechanism as a sewing-machine; there are so many wearing surfaces, any of which may be the cause and seat of the mischief of which you complain. But if the vibration reaches the table, as it would seem from your letter it does, the best way for you to do would be to examine the framework, and tighten any loose bolts or screws you may come across. There is bound to be a great deal of vibration in a machine with a reciprocating shuttle such as yours, but the table and its frame ought to be rigid enough to withstand it. If, however, it is not thus rigid, the vibration will make itself felt on the arms of the operator. Want of oil is also a frequent cause of undue vibration, and this should be carefully attended to. Without seeing the machine, I could scarcely advise you any further; but if you could tell me rather more fully where the evil seems to be situated, I could, perhaps, do better for you. I am writing a series of articles for WORK, in which I hope to deal exhaustively with sewing-machines. They will, no doubt, with the Editor's permission, appear very shortly.—CYCLOPS.

Bichromate Battery.—H. McM. (*Bootle*).—As the volume of current obtainable from any battery is dependent upon the internal resistance of the cells, it is most important that the internal resistance be kept low when a large volume of current is desired from a battery. As the internal resistance of a cell is lessened by the use of large plates and the nearness of the plates in the solution, it follows that you will get more current from your bichromate battery if you have the zinc rods 8 in. by ½ in. replaced by zinc plates 8 in. by 4 in., so placed between each pair of carbon plates as to leave only ¼ in. of space between them. As, then, the probable resistance of each cell will be about ·08 ohm, and the E.M.F. of each cell 2 volts, the ampères of current obtainable from a battery of three cells arranged in series will probably be: $\frac{\text{E.M.F. } 2 \times 3 = 6}{\text{R } \cdot 08 \times 3 = \cdot 24} = 25$ ampères. This could be obtained only for a moment or two on short circuit. As your accumulator cells have only ¼ sq. ft. of positive surface in each cell, you will only get a charge of 2 ampères in each cell. By connecting two accumulator cells in series with the bichromate battery of three cells in series, you may get the above-named charge in one and a half hours.—G. E. B.

Electric Belts.—J. S. (*Sheffield*).—Information respecting electric belts appeared in "Shop," on pp. 174, 203, 204, 251, 315, 349, 396, 413, 427, 588, and 796, Vol. III. of WORK.—G. E. B.

Wells' Dynamo.—EDISON.—From the sketches enclosed with your letter, I should think the machine is an elongated simplex dynamo. I cannot, however, express an opinion on its merits without seeing the dynamo and learning more about it than is reported in your letter. If Mr. Wells wishes to have my opinion respecting the value of his dynamo, I shall be very pleased to hear from him direct.—G. E. B.

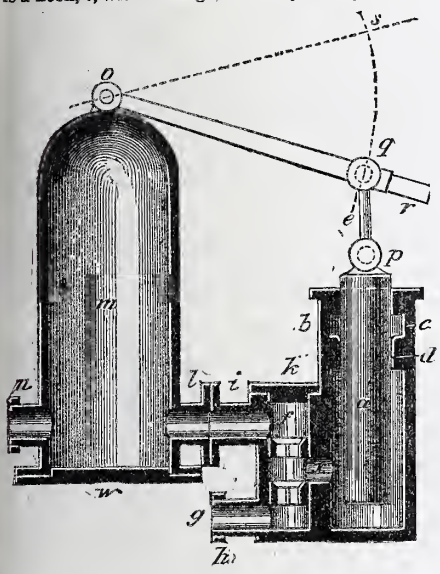
Electrician.—J. P. H. (*Hull*).—You are at perfect liberty to style yourself an electrician and have this title placed on your business cards. I know of no law forbidding you to advertise yourself as an "electrician by examination": in fact, you have both a legal and moral right to this qualification, seeing that you have successfully passed an examination in electricity and magnetism.—G. E. B.

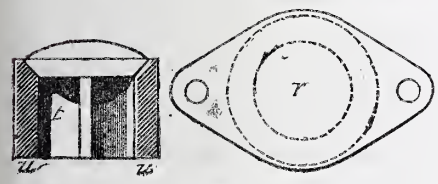
Dynamo for Arc Light.—R. M. (*Barnsbury*).—If you will let me know the size and horse-power of your model engine, I will give you the dimensions of a dynamo to be worked with it. I cannot plan a dynamo to work three arc lights unless I know the candle-power of the arc lamps, nor can I plan a machine to be worked by a model engine unless I know the horse-power of the engine.—G. E. B.

Steel Spindles and Levers for Anti-vibrator.—CYCLIST will not be able to obtain these ready-made, but any blacksmith will make the spindles for him if shown the article in WORK

No. 130, p. 407. The levers he will have to make a pattern of as described, and have them cast in malleable iron at a foundry. They will probably not cost more than if purchased ready-made.—CYCLOPS.

Portable Hand-Pump.—J. S. (*Ramsbottom*).—I subjoin a vertical section of a force-pump drawn to a scale of 1½ in. to a foot, and details half full size, which, I think, will give you the information you require. The plunger, *a*, is 2 in. in diameter by 9½ in. long, and has a stroke of 6 in. It may be turned out of the solid and draw-filed, that it may work easily in the leather collar in the recess, *c*; it has an eye at *p*, and is connected by a link, *e*, which has forked ends, with the lever, *r o*. This lever is fulcrumined at *o* to a double lug cast on the air-vessel, *m*. The connecting pins at *o*, *p*, and *q* should be ⅜ in. diameter, turned to fit bored holes in the parts connected. The plunger works in a barrel, *b*, cast in one piece, with a valve-box, *f*. A passage, *x*, makes communication between the pump-barrel and valve-box. At the lower part of the valve-box is a neck, *g*, with a collar, *h*, to screw on to retain the coupling of the suction hose; at the upper part is a neck, *i*, with a flange, whereby it may be bolted





Portable Hand Pump.

to the flange of the neck, *l*, on the air-vessel. The valve-box is closed by a cover, *k*, shown enlarged in plan at *v*. The air-vessel, *m*, has a discharge neck, *n*, shown with a screw collar to retain a hose coupling; it is closed at the bottom by a cover, *w*. The air-vessel is 5 in. inside diameter, and 14 in. high; it may be of copper or cast-iron. The connections may be made with ⅜ in. bolts, canvas spread with a mixture of white and red lead being placed between the surfaces brought into contact. The valves are plain three-ribbed stalk valves, as shown enlarged at *t*, the metal of the valves being ⅛ in. thick throughout; the valves are turned to fit bored seatings, *u u*, which are also turned outside to form a tight fit in the bored-out valve-chamber, *f*. The top seating should be a shade larger than the lower one, to allow the latter to pass freely down to its place in the valve-box. To the squared end, *r*, of the lever, *r o*, a socketed handle is to be fitted, of such length that the hand is 18 in. from the pin, *q*. A guard may be arranged to limit the travel of the lever to the arc, *q s*. The object of the air-vessel, *m*, is to maintain a continuous stream of water. By using a longer lever greater heights of jet may be obtained. The thickness of the barrel and valve-box is nowhere less than ⅜ in., and the air-vessel, if of cast-iron, may be the same. The whole arrangement may be bolted down to a timber-carriage mounted on wheels.—F. C.

Air-Pump.—J. S. (*Bath*) asks for "drawing of an air-pump to work with a wheel to be driven by a small engine." Will J. S. kindly state his ease definitely? Is it for practical use, such as for rarefication or condensing in connection with some branch of business, for lecture-table use, or for mere amusement? To work an air-pump with a steam-engine, unless on a somewhat costly scale, would be a most unsatisfactory mode, and to work a mere model it would be more unsatisfactory still. J. S. is aware that for a steam-engine to work satisfactorily, the resistance to be overcome must be somewhat continuous, but working an air-pump the resistance rapidly increases with each stroke. Until a more definite question is presented, I am afraid to answer would only be to waste valuable space in "Shop." If J. S. will say what he really wants, I will help him if possible, or hand him over to someone who can.—O. B.

Safety Bicycle.—H. F. (*Taplow*).—(1) To find the gearing of a machine, multiply the diameter in inches of the driving wheel by the number of teeth in the chain wheel on the crank shaft; then divide the result by the number of teeth in the hub of driving wheel, thus:

Driving wheel	30 in.
Chain wheel teeth	16
	180
	30
Hub wheel teeth 9)	480
Result	$53\frac{3}{9}$ in.

Or thus:

Driving wheel	28 in.
Chain wheel teeth	20
Hub wheel teeth 9)	560
Result	$62\frac{2}{9}$ in.

The gearing of safeties is fully described in its place in "Safety Construction," Vol. III. of WORK. (2) To remove a keyed-on crank is a difficult matter without the requisite tools. To attempt it by hammering, if it is firmly fixed, is sure to damage something. Repairers have an instrument that will *start* the most obstinate crank. My advice would be: Take the machine to one of these gentlemen.—A. S. P.

Telephones.—TELEPHONIC.—I am pleased to learn that you have been able to make a pair of telephones from the instructions given, but sorry that you have not succeeded in connecting them up with one line wire. I could not make the diagram any plainer if I repeated it, so you might try and master it. If you cannot, try and draw out a diagram of what you think is meant, and send it to me through WORK, and I will try and put you right if you are wrong.—W. D.

Telephone.—S. F. C. (*Stoke Newington*).—Full instructions have been given in WORK for making a telephone. There is, therefore, no need to give the name of any other publication. If you have No. 28, you will find full instructions for making receivers, and in No. 36 a transmitter, and many given hints as to batteries and connecting up. Look up these numbers if you have them, and if not, procure them from the publishers, and begin your work; and if you find anything wanting to be explained or described further, please write again.—W. D.

Incubator.—A. J. J. (*Tipton*).—An "ordinary" thermometer will not do. In the first place, it will be too long, and in the second place, it is more than likely to be incorrect at 106 deg. Not one in a dozen is correct often, and I have found them as much as three and four degrees out. Don't spoil your ship for a ha'porth of tar.—LEGHORN.

Contract.—J. D. B. (*Ilkeston*).—If the agreement to pay £2 a week is not stamped, you cannot legally enforce payment. You can, however, get it stamped now, but it will cost £10; and as your claim will be for nine weeks, is it worth spending £10 and running the risk of a lawsuit to gain £18? You had better consult a solicitor before doing so. I should advise you to try and induce the contractor to allow you something for the inconvenience rather than resort to legal proceedings. The withholding of £40 for two months will date from the time the architect certifies that all the work has been completed. If the down-pipes are out of the run of ordinary spouting, and are not particularly specified, you will be liable for extra payment.—M.

Engineering.—S. M. L. (*Goderich, Canada*).—The firm referred to by you is still in business. The goods would take about three months. You had better write again; if this fails, employ an agent here.—M.

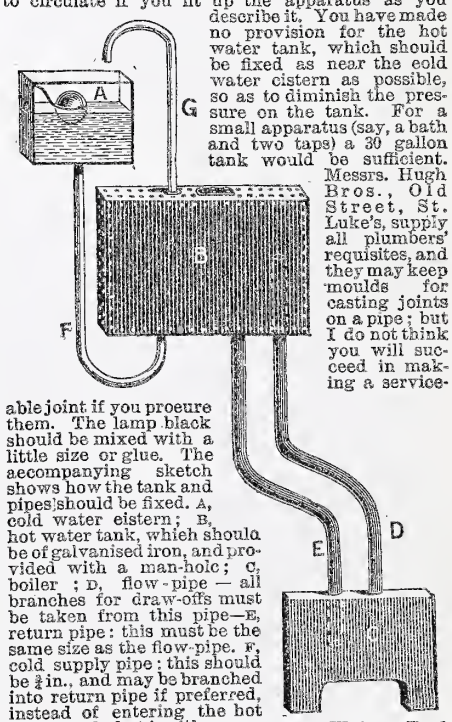
Sulphuric Acid.—R. P. (*Boulogne-sur-Mer*).—The address of the firm that have a new method for the transport of sulphuric acid is the Blaydon Manure & Alkali Co., Blaydon, near Newcastle-on-Tyne.

Oak Armchair.—H. W. F. (*London, N.*).—(1) To fumigate your oak chair, you will require an air-tight box large enough to hold the chair when glued up. The liquid ammonia is placed on the bottom in an open dish; for the size of box you require it will take ½ pint. But this does not give the black-brown colour of old oak, such as is usually seen on the kind of chair you have made. Personally, I use asphaltum dissolved in turps, and "fill in" with black filling; and I know a dealer in curios who makes his antiques in woodwork by wiping them over with Brunswick black thinned down with turps. (2) As to your query of what should be the proper dimensions of a chair without arms, it is difficult to answer without knowing the kind of suite you are making. The chief consideration should be comfort. A chair from which you can slide forward, and in which, when seated, the legs are propped up clear of the seat, and in which the head rolls hither and thither in quest of a resting-place, should be avoided. (3) You will do well to read the whole of the articles on "An Armchair: How to Make the Frame and Upholster it," in No. 78, Vol. II., p. 409; No. 82, p. 481; No. 89, p. 595; No. 100, p. 730; No. 102, p. 807, of WORK.—LIFEBOAT.

Gas-Engine Valves.—SNAP.—You ask where you can get valves for your gas-engine, but you do not say what sort of valves. What can I say to help you? The obvious answer is: Get the valves from the maker of your gas-engine.—F. A. M.

Punching Holes.—SUBSCRIBER.—Lay the bar upon a sloping lump of cast or wrought iron sloped to the same angle as the bar, and having a hole in it a trifle larger than the hole to be punched. The punch can then be used in a vertical direction. A small punch should be employed in the first place, and the hole drifted afterwards to size required. The bedding block should be provided with a set-off or flange turned down to fall over the edge of the anvil, to prevent it from being driven back by the force of the blows upon the punch. The heels must be welded on roughly as rings, and thinned down on the top face afterwards.—J.

Kitchen Boiler Supply.—NIGEL.—I am sorry to have to inform you that your sketch is entirely wrong, and that it is impossible for the water to circulate if you fit up the apparatus as you describe it. You have made no provision for the hot water tank, which should be fixed as near the cold water cistern as possible, so as to diminish the pressure on the tank. For a small apparatus (say, a bath and two taps) a 30 gallon tank would be sufficient. Messrs. Hugh Bros., Old Street, St. Luke's, supply all plumbers' requisites, and they may keep moulds for casting joints on a pipe; but I do not think you will succeed in making a serviceable joint if you procure them. The lamp black should be mixed with a little size or glue. The accompanying sketch shows how the tank and pipes should be fixed. A, cold water cistern; B, hot water tank, which should be of galvanised iron, and provided with a man-hole; C, boiler; D, flow-pipe—all branches for draw-offs must be taken from this pipe—E, return pipe: this must be the same size as the flow-pipe. F, cold supply pipe: this should be ¾ in., and may be branched into return pipe if preferred, instead of entering the hot water tank, but in either case should be syphoned, as shown, to prevent the hot water from entering cold water cistern. G, expansion or steam pipe, which should be ¾ in.—T. W.



Hot Water Tank and Pipe.

Incubator.—J. B. (*Burton-on-Trent*).—I expect, from your description, that the damper is not properly balanced—*i.e.*, too heavy at the large end. Your lifting rod is also too large, and therefore too heavy. Your tube is too small to work properly with such a heavy rod. Had you followed my instructions to the letter you would have had no trouble. *Remedy:* See that damper is accurately balanced; substitute for your not quite ⅛ in. rod a piece of fine wire (hard-drawn wire is best), and you will probably get over your difficulty; if not, the only remedy is a larger tube. I presume you have diluted your ether as described. Neat ether might help to cause your trouble, being in itself too sensitive. Four ounces of mercury should be quite sufficient. If you cannot now overcome your difficulty, write again.—LEGHORN.

Dissolving Rubber.—INDIARUBBER.—Solutions of indiarubber cannot be satisfactorily moulded. For moulding purposes, the rubber requires to be mixed very intimately with sulphur, and then moulded by the aid of heat and pressure. The satisfactory preparation of the sulphur compound, however, involves the use of powerful and expensive apparatus, and it is better for an amateur to purchase rubber composition ready prepared, which may be done at any large shop at which rubber goods are made a speciality.—QUI VIVE.

Harness' Constant Current Battery.—CONSTANT CURRENT.—This so-called "constant current" battery is only a modified form of the Leclanché battery, known in other hands as the Victoria Leclanché. It is a square walnut box fitted up with carbon rods enveloped in canvas, with zinc

outside this, the whole being covered with pitch. It is no more suited for a constant current than the ordinary Leclanché; in fact, less suitable, because the cells are very small and soon become exhausted. When they are exhausted, they are very difficult to repair and recharge. You will have to melt out the pitch, and get out the elements whilst the pitch is hot. The chances are ten to one that you will smash most of the carbon and mess the whole so much with pitch as to become useless. They are recharged by packing the carbons in new canvas bags with broken carbon and peroxide of manganese, and charging the cells with the usual salammoniac solution. The recharging process, however, does not pay, so it is cheaper to have new cells.—G. E. B.

Book on Electric Machines.—JEFF (*Chester*).—I do not know of a better book on the subject than Bottone's "Electrical Instrument Making for Amateurs," advertised in the first number of Vol. IV. of WORK. The magneto-electric machine and the shocking machine are both described in that book. If you want a book describing other electric machines and instruments, get "Electricity in the Service of Man," published by Cassell & Co.—G. E. B.

Drill-Chuck.—W. M. (*Portland*).—We could hardly read your questions. I think with the angle you show, you will require a finer pitched screw than ¾ in. iron gas, which is what I suppose you intend to use; I would have a thread of 20 to the inch, and think even then you will have none too much hold. Anyone who has a slide-lathe should be able to cut the threads for you. I confess I don't like the look of the chuck. Draw it again as closed on a small drill, and you will see there is hardly any of the conical surface left to bear on the jaws. Also, when chuck is open, as you have drawn it, there is nothing to prevent the top jaw dropping on the lower one, and then it might come right out at the front.—F. A. M.

Incandescent Electric Lamp.—P. S. (*Leigh*).—If the wire inside the globe of an incandescent electric lamp were of the same thickness as the wire outside the globe, it would be necessary to increase the volume of the current considerably—probably some three or four times as much—to get a light from it, since it would carry some three or four times as much current without becoming white hot. Reasoning the opposite way, if the wire inside and out were the same, both would become white hot at the same time. Apart from this, however, the wires are of different material, and this is most important. The loop of wire inside the globe is made of carbon, the two strips of wire passing through the glass are of platinum, and the conducting wires of the line are of copper. It is the carbon wire which becomes white hot and gives out light.—G. E. B.

Storage Battery.—G. W. W. (*South Shields*).—Storage batteries, accumulators, and secondary batteries, are all names given to batteries employed in storing the surplus electric energy generated by dynamo-electric machines. The construction of accumulators has been described and illustrated in No. 101, Vol. II. of WORK. Any size of storage battery may be charged with a ten-candle power dynamo, providing the commutator of the dynamo has more than two divisions, and the armature is of the ring or drum type. Dynamos with only one coil in the armature, and only a two-part commutator, are useless for this purpose, because the battery will discharge itself across the commutator almost as fast as it gets charged. If you have a dynamo with a ring or drum armature and a commutator of several parts, you may charge a storage battery, but the charging process will occupy a long time, because the volume of current obtainable from a 10 c.-p. dynamo is very small. Kindly get No. 101, and learn from that how to make a storage battery.—G. E. B.

Mysterious Clock.—AMATEUR wishes to know where he can obtain the Geneva watch movements required for the above. Below I give the addresses of some refiners in London to whom he might apply, but I cannot guarantee that they will supply him: Messrs. Bryer & Sons, Barbican, E.C., Messrs. Robertson, Aldersgate Street, E.C., and Messrs. S. Roper & Sons, Garnault Place, Clerkenwell. If still unsuccessful, he might try Mr. Cox, watch repairer to the trade, Clerkenwell Road, E.C., or Mr. A. T. Boon, Great Sutton Street, E.C.—C. A. P.

Breeding Cages.—E. P. (*Southampton*).—Can you get wood already planed for making bird-cages? No, unless you order it. Wood that professional bird-cage makers use is 8 cut or 10 cut deal; you would find no difficulty in planing nice clean pine if it is cut into 6 ft. lengths. I would advise you to read up articles on "Bird-Cage Making," in Nos. 54 and 108 of WORK.—F. H.

III.—QUESTIONS SUBMITTED TO READERS.

**** *The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Small Power Engine.—HALIFAX writes:—"I have a pair of steam cylinders, size of bore 4 in. × 10½ in. long, which I intend using for a double horizontal engine; the sizes of ports are ⅜ in. × 1¼ in., exhaust do, ½ in. × 1¼ in. (1) Are these large enough for the engine to work advantageously? (2) The cylinders will be coupled by the steam-chest, centres of cylinders 12 in. apart; what diameter should the crank-shaft be in bent wrought iron? (3) What diameter piston-rods in milled steel to work on the plan of the ½-horse power by F. A. M.? (4) What size steam-pipe to supply the two cylinders, and what size exhaust-pipe for each cylinder? (5) What size and weight fly-wheel will be required? (6) What would be the estimated effective power of such an engine at, say, 50 lbs. pressure? N.B.—The stroke would be 8 in. (7) Would a double cylinder engine be equal in power to two single cylinder engines (separate) of the same size cylinders, etc.? (8) Will anyone give me the address of one or more London firms where I could get a few malleable iron castings from my own patterns, as I cannot find one by any advertisements?"

Japan.—PENHOLDER writes:—"I want to japan penholders black, red, and green. Can anyone give me formula for wood, and also steel?"

Slide Rule.—W. W. (*Carbrook*) writes:—"Would any reader tell me where I can buy this book, viz., 'The Handbook of the Slide Rule' (Bayley)? It is out of print. Also the best slide rule and book on the same?"

Tin Moulds.—X. Y. Z. (*Liverpool*) writes:—"Will some kind reader inform me how to make hollow tin moulds in different designs? The moulds are required for making *papier-mâché* models."

Cricket Balls.—F. H. C. (*Slingsby*) will be obliged for a solution suitable for coating over the lapping on cricket balls, to give the lapping a more solid and durable surface.

Soap-making.—A. C. (*Manchester*) will thank any reader for full particulars regarding cheap soap-making.

Case for Stuffed Birds.—IVY LEAF writes:—"Would some kind reader give me a detailed design for the above? Dimensions—1 ft. 6 in. wide, 2 ft. 6 in. high, 3 ft. 6 in. long."

Crystoleum Painting.—HANSOT writes:—"I should be greatly obliged if any fellow-reader could inform me where I may obtain an instruction book on crystoleum painting."

Acts of Parliament.—J. H. S. (*London, S.E.*) writes:—"Can any reader give me names and prices (and where to buy) of any Acts bearing on engines and boilers, such as 'Road Locomotives' Acts,' 'Smoke Acts,' 'Boiler Inspection Acts,' etc.?"—[Try Messrs. Eyre & Spottiswoode, New Street Square, London, E.C.].

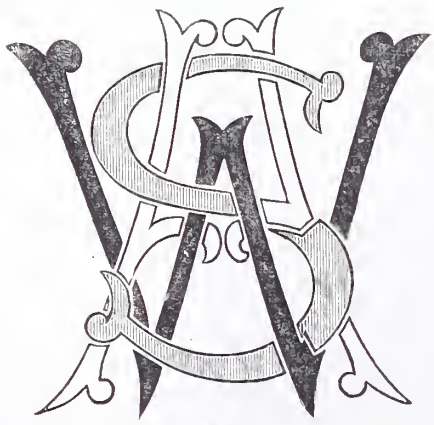
French Polishing in Lathe.—J. H. S. (*Tooley Street*) writes:—"Will someone be kind enough to tell me how to French-polish my work in the lathe after I have turned it—plain polishing light articles in pitch pine, beech, and oak; no colouring, only polishing?"

School Banner.—A. M. (*Glasgow*) writes:—"As the summer will soon be on us again—which is the special time for excursions—would any of your numerous readers kindly give me full instructions as to design, measurements, materials, etc., that would enable me to make a Sabbath School bannerette?"

Jewellery Gilding.—JEWELLER writes:—"Can any of your readers inform me how to mix chloride of gold for gilding without battery? I have a recipe from two works on electro-plating and gilding, in which the following quantities are given: gold chloride, 1 part; acid carbonate potassium, 31 parts; to be mixed with acid carbonate potassium, 30 parts; water, 200 parts. I have asked at several chemists for acid carbonate of potassium, and am told there is no such chemical. I should be glad to know what this is."

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

W. S. A. Monogram.—W. F. C. (*Coventry*) writes:—"I enclose simple sketch for monogram for W. S. A. (*Kentish Town*)."



W. S. A. Monogram.

Mill Bills.—EDDIFRA writes to W. H. J. (*Brentwood*) (see No. 155, page 814):—"Heat the mill bills to blood-red, and plunge them in water, or use a mixture of the following: 1 oz. arsenic, 1 oz. sal ammoniac, 1 oz. sal prunella, 4 gallons water."

Small Brass Castings.—M. (*Bishop Auckland*) writes to E. L. (*Woolwich*) (see No. 157, page 14):—"If you look at the 'Sale and Exchange' column of WORK, you will see where to get brass castings. Use wax and resin melted together, or gutta-percha, for the moulds."

Chip Carving.—J. A. (*Birmingham*) writes (see No. 159, page 46):—"I should recommend PETERBORO' to buy Miss Eleanor Rowe's 'Hints on Chip Carving,' to be obtained at the School of Art Wood Carving, City and Guilds Institute, Exhibition Road, South Kensington."

Chip Carving.—CAROLUS REX writes, in reply to PETERBORO' (see No. 159, page 46):—"PETERBORO' cannot use the *nom de plume* of CONSTANT READER, or he would have seen the two admirable papers on Chip Carving which appeared in Nos. 64 (p. 185) and 74 (p. 351) of Vol. II. of WORK. The first paper gives all requisite instructions as to the drawing of designs and the tools used, while the second embodies a good selection of designs, suitable for an immense variety of work. Let PETERBORO' get the entire volume if he wants to shine as a wood-carver; he will never invest a similar sum to better advantage."

Setting Tiles.—M. (*Bishop Auckland*) writes to PEN (see No. 161, page 78):—"Fix a lath the height of one course of tiles above the edge of sink, the face being straight, and projecting as far as the tiles are to project. Mark a line on the top edge of sink corresponding to the face of the lath, and bed the tiles between the lath and the line in Portland cement or plaster-of-Paris. As soon as one course has set, raise the lath to the height of another course of tiles, and so on till finished. It is a good plan to fix a rebated lath of hardwood on the top course of tiles to prevent them being loosened. The tiles must be well soaked in water before fixing."

Ice.—C. M. W. writes to J. J. McQ. (see No. 161, page 78):—"Ice may be kept a considerable time if stood upon a wooden rack covered with a damp blanket in a draughty position. The water from the melted ice should get away freely, as water is a much greater enemy than air."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—C. J. (*Redhill*); ANXIOUS GUNNER; G. B. (*Accrington*); K. M. M. (*Caterham*); F. T. (*Rochdale*); H. Y. W. (*Bromley*); C. M. S. (*Evesham*); A. J. C. (*Falfield*); R. C. M. (*Leicester*); A. O. (*Wortley*); J. J. (*Barrow-in-Furness*); J. H. (*Edinburgh*); H. J. G. (*London*); ENQUIRER; H. C. (*Ilkeston*); GAS ENGINE; J. S. (*Amsterdam*); MANIO; T. H. P. (*Huddersfield*); O. ST. O. (*East Dulwich*); A. R. (*Aberdeen*); J. B. (*Halstead*); W. L. (*New Swindon*); EFFBEE; H. W. T. (*Harrow Weald*); J. J. F. (*Southampton*); METAL; H. F. S. (*Hammersmith*); E. C. (*Kirkgate*); D. S. B. (*Dundee*); S. P. (*Plymouth*); W. P. (*Glasgow*); J. W. R. (*Finsbury Park*); F. A. (*Leicester*); W. P. W. A. (*Bishopstone*); A. R. (*Molesey*); G. A. L. (*Peckham*); INVENTO; IVY LEAF; J. G. (*London*); F. A. N. (*Hackney, E.*); JEWELLER; F. E. V. (*Hackney*); SUSPENSE; W. A. C. J. (*Newcastle-on-Tyne*).

NOTICE TO READERS.

THE Editor desires to draw attention to the following special papers which will appear among the usual contents of next week's issue of WORK—*i.e.*, No. 167:—

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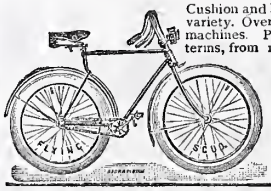

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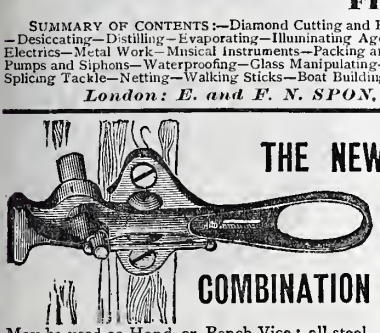

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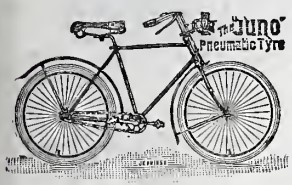

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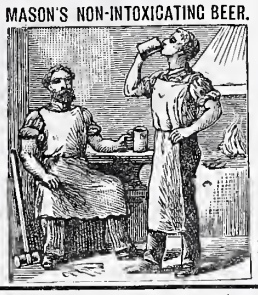

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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Vol. IV.—No. 167.] SATURDAY, MAY 28, 1892. [Price One Penny.

WORK WORLD.

A new elastic wheel is expected to turn out a rival to the pneumatic tire for cycles. Used on a hansom cab, it is reported to have given better results than the ordinary rubber tire, while it possesses three times its durability for wear. Bicyclists should look to this.

* *

The grouted concrete block system has been used in the construction of the new quay at Great Yarmouth, 2,103 ft. in length. The work has been carried out in one-third the time, and at less than half the cost that would have been incurred had the method of depositing concrete *in situ* been used.

* *

Sewing machines which will pierce half an inch of leather have been known for some time, but this performance is quite outrun by the claim made for a sewing machine brought out in Chicago, U.S.A., that it has pierced wood $\frac{3}{8}$ in. thick, and also $\frac{1}{8}$ in. thickness of brass placed between pieces of leather. Where does the application come in?

* *

A very large Swiss locomotive will be fitted with dynamos of a total of 1,500 horse-power, which could be increased up to 2,000 horse-power. The power will be transmitted to eight electro-motors, arranged on the same number of axles. This locomotive will attain a higher speed than is usual with steam locomotives, and trials of its capabilities are shortly to be made. We await results.

* *

The Birmingham Ear and Throat Hospital now adopt the electric light for illumination, and also for the laryngoseopic and other important surgical instruments in the consulting rooms. It has given great satisfaction to the medical officers and committee. This hospital is the first in the United Kingdom to utilise the electric light for its surgical purposes. London, hurry up.

* *

The American 125-ton steam hammer is used for forging ingots weighing from 30 tons to 70 tons into armour plates varying from 4 in. to 18 in. in thickness. They vary from 15 ft. to 22 ft. long, and are about 6 ft. 6 in. wide. The ingot usually takes three heatings; the first sixty hours. It is then hammered into plate form before it gets cold. The other heats are about five and three hours respectively, and the plates are finished cold.

* *

Carriage shaft-tips are coming to the fore. These are to lessen the seriousness of street accidents by which the shafts of vehicles injure people when crushing into them. The shaft-tips have rubber wheels standing forward from the end. A blow from one of these would be less harmful than from a metal tip. They serve a further purpose of preventing the ends of the shafts digging into the roadway and shattering the shafts when a horse falls.

* *

Mr. Crookes was very interesting at the recent Royal Society Conversazione. He showed some experiments with a modification of Tesla's apparatus, and obtained an alternating electric current showing 1,000,000 alternations per second. The electro-motive force was about 10,000 volts, and yet the spark discharges could be taken on the hand with only a slight pricking sensation. There is a wide field of research open for experimenting on static electricity.

* *

There is a feeling in Manchester that engineers would be foolish to send specimens of their work to the Chicago Exhibition, since Americans had already copied English work to too large an extent. The existing tariff prevented anything but the coarsest goods going into America, and it is felt to be unwise for manufacturers to assist in making rods to beat themselves by sending over the best work to be copied by unscrupulous competitors. Cannot the Chicago Commissioners do something to overcome this deterring element?

* *

A new portable steel bridge has been constructed for a Russian engineer corps. All the sections are made perfectly uniform, so that when it is required to build the bridge, the various pieces can be taken indiscriminately, no markings of the parts being necessary. All the sections, the heaviest of which only weighs 354·2 lb., are rectilinear, thus greatly facilitating transport. No rivets are used, but tenons with wedge-keys. The bridge can be put up in one hour and fifty minutes, is 100 ft. long, of a total weight of $22\frac{3}{4}$ tons, and of 8 tons capacity. The distance between the girders is 9 ft. 8 in.

* *

Plant warfare reads strange. To subsist, however, plants, when crowded in the ground, battle with each other and with more intensity when different species hold each other locked in a death-grip for mastery beneath the earth's surface. To comprehend this needs wide observation during a long period of time. The broad wild heaths and moorlands of England will furnish conclusive illustrations of plant warfare. The growths indigenous to heaths are, for light land, the furze, the broom, the fern, the bramble, the blackthorn, the ash, elm, and oak, to name only a few of the prevailing heath growths. The furze will, in root warfare, master the broom, the fern will vanquish the furze, the bramble will overcome both the furze and fern, the blackthorn will rise above the bramble, the ash will obliterate the blackthorn, and the oak will outlive the ash. The elm will, perhaps, be equally potent over the ash.

* *

The congested traffic of London is mainly attributable to the horses and carts of the carrying trade. The horses are estimated to number 25,000, worth £1,250,000. They work about seventy hours in each week. Their buying price is about £60, and after five years' use their selling price is about £10. 100,000 men and boys have to wait on this traffic and these horses. A novel rule prevails as to estimating food cost at 3d. per inch of height per week; a shilling a hand height means 16s. per week for a 16-hand horse. It costs more to carry goods across London by van than a hundred miles by rail. To carry the termini across London would relieve the congested streets, and be a national gain. To exclude all railway and general booking offices from main streets would facilitate London traffic of carriages to an incalculable extent. To bridge or subway main thoroughfares would be another gain. All will have to be done—the sooner the better. We say the London County Council might do worse than take up the London street traffic question.

HOW TO RENEW A PANE OF GLASS.

BY E. DICKER.

A LITTLE information on the above subject will, I feel sure, be gladly accepted by many, considering the great inconvenience which is often felt by the breaking of a window-pane, and having to wait a day or two, or sometimes longer, before you can get it put in.

In the first place, a proper hacking-knife and a putty-knife should be provided (cost, about 8d. each). After knocking out all the pieces of broken glass, you can, with a small hammer, carefully hack or cut out the old putty with the hacking-knife and small hammer, taking care that the knife does not cut the bars, or get damaged against that portion of the broken glass behind the putty.

If the putty is very hard, it can be softened by holding a red-hot iron against it, taking care not to burn the woodwork or crack the next square. A very good thing for this is an old poker, with the square part bent at a right angle to the handle or stem. You must make it red-hot at the junction of the square and round parts before attempting to bend it, and it can be bent back again after using it. Thoroughly clean out all the putty from the rebates. Now measure the size of your glass, being careful not to get it too large; any glass merchant will cut for you at the rate of about 4½d. per foot super. In measuring glass, you give the size in inches, not in *feet* and *inches*; also state what weight or thickness you require. I give a short table, showing what is meant by weight of glass—

Glass about	1-12th	of an	inch	thick is called	15 oz.
,,	1-10th	,,	,,	,,	21 oz.
,,	1-9th	,,	,,	,,	26 oz.

That is to say, it weighs so many ounces to every superficial foot.

Now put a layer of very soft putty all round the inside rebate, and gently press the square of glass into its place, being careful to press it uniformly, and not more in one part than another, or you will be very apt to crack it. Secure it in its place with four small brads, driven in so that they only just clip the glass; next proceed to putty the outside all round with the putty-knife; and then, taking one side at a time, form a nice clean bevel on the putty by decisively drawing the knife along, resting it on the bar and on the glass, keeping the bevel so that you do not see it through the glass from the inside. It is rather a troublesome job for an amateur to finish off the mitres nicely, but it is very simple if you have patience.

Do not attempt to scrape off the fine strips of putty left on the glass, but brush them off with a dusting-brush. Very often a novice makes a clean bevel, and then spoils it in scraping off the superfluous putty. Now clean off the inside putty, carefully stopping-in any little places the bedding has not filled up. Sometimes it is found that it is very difficult to get at a square of glass by sitting on the window-sill—in fact, in many instances it is impossible to do so. If such is the case, you must take the sash out. To do this, take out one side sash bead, get hold of the sash cord, and pull the weight right up to the sash pulley, then gently drive a clout-headed nail through the cord into the pulley style just below the pulley, to keep the weight up; treat the other side in the same manner, and then undo the cords from the sash and take it out. You will then find you can glaze the square of glass so comfortably that it pays for the trouble of taking the sash out, even in cases where it is not absolutely necessary.

RUSTIC CARPENTRY: A ROSERY WALK.

BY ARTHUR YORKE.

PURPOSES OF THE DESIGN—MATERIALS—CONSTRUCTION—ROOFING—REFERENCE TO FORMER ARTICLES.

Purposes of the Design.—The rustic construction which forms the subject of the present set of illustrations is intended primarily as a trellis over which to train roses of those kinds which require such support, to form a shady and fragrant walk, and generally to contribute to the adornment of the flower garden. A secondary one may also be found for it where a covered path of ornamental character is desired, as it sometimes is in connection with suburban and other dwellings where there is no carriage approach to the door. It can readily be adapted so as to form a roofed-in track from a door to the public roadway; and the means of so adapting it will be explained further on.

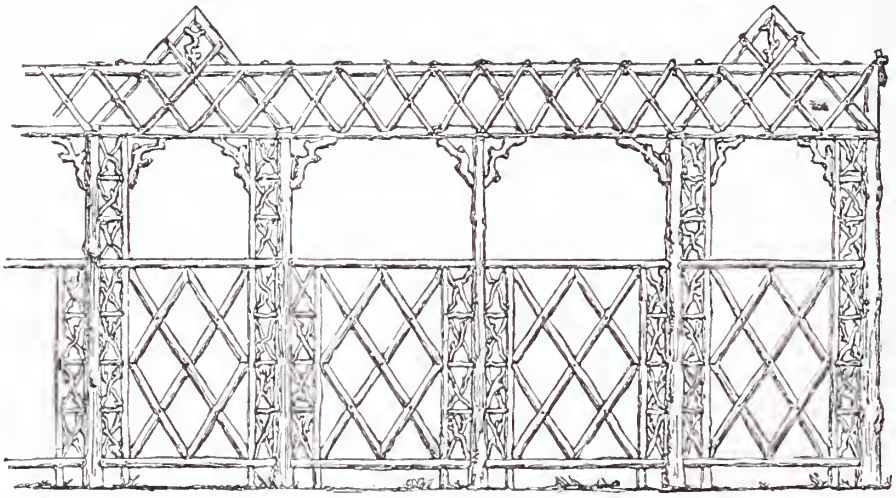


Fig. 1.—A Rosery Walk: Elevation.

Materials.—These will be entirely of rough wood in its natural bark. For the posts fir poles of some kind should be chosen, and larch is especially to be preferred both as regards durability and appearance. All the smaller pieces which show as straight stuff may well be of the same kind of wood as the posts, though for the finer rods hazel will not come amiss. It will be seen that in the mere filling-in much crooked stuff is used, and for this apple branches, or indeed almost anything that comes to hand, will suffice.

Construction.—Our rosery walk is 4 ft. wide, and the rustic erection is carried on two rows of pillars or collar-posts ranged at intervals of 3 ft. These posts should be let into the ground 2 ft., and well rammed in. They should have an average diameter of 3 in. or 3½ in., except in the case of each third one, as that which in Fig. 1 is seen standing in the middle of the portion with the lower roof; such pillars may be smaller as having little weight to bear, and will look better than they would do if equal in size to the others. Resting on the line of posts lies the wall-plate (A A, Fig. 2), the top of which is 5 ft. 6 in. from the ground line.

From each group of four large collar-posts rise four rafters (B, B, Fig. 2), meeting at top pyramid-wise. They rise to a height from the ground of 7 ft. 6 in., and have, therefore, to be 3 ft. 4 in. long. Half-way up them—that is, 6 ft. 6 in. from the ground line—the purlins (C, C, Fig. 2) are nailed upon them. Figs. 1 and 2 alike show how the space between wall-plate and purlin is filled in, and Fig. 2 shows how the space, 7 ft. 3 in. long, stretching from one pyramidal portion to the next, is covered with a flat roof of open rustic work lying upon the purlins. This space, it will be observed, is chiefly filled in with crooked stuff.

Fig. 3 shows how the upper part of the rosery would appear at one of its ends, and this figure may also explain how the roof would be in section—the shaded parts give the form of the roof in its lower portions; whilst if we imagine the cross-piece, D (which is on a level with the purlins), to be removed, we have with the dotted lines, B, B, a section through the middle of one of the higher pyramidal portions.

The object which appears over the middle of the entrance is supposed to be a rough knot or a piece of root.

The filling-in of the sides of our rosery is plainly shown in the elevation, Fig. 1. For its better preservation from damp, this work is kept 4 in. from the ground.

Roofing.—Let us now suppose that, as was suggested above, the design is to be utilised for a dry path with a covering of metal or other light material. We shall then do well to keep the whole roof to the level of the pyramidal portions—a ridge-piece will have to be used—and the rafters, instead of following the present arrangement, will meet in pairs opposite to the pillars. Instead of round stuff, also, we shall then do well to use halved stuff for our rafters and purlins, the sawn side being uppermost. The space between ridge-piece and purlin can then be filled in the same manner as that between purlin and wall-plate.

Reference to Former Articles.—Before proceeding further with the present group of papers on rustic carpentry for garden purposes, it will be well to direct the reader's attention to those which have already appeared on the same subject, since in them will be found much useful information on the proper kinds of wood, methods of construction, and other practical matters which it would be superfluous to repeat. These will be found in Vol. I., p. 247 (No. 16), Vol. II., pp. 65, 101, 149, 197 (Nos. 57, 59, 62, 65), and Vol. III., pp. 129, 161, 193, 225, 257, 289 (Nos. 113, 115, 117, 119, 121, 123). Attention is

specially called to the first-named of these articles as containing necessary elementary information.

TIPS FOR FRENCH POLISHERS: REPOLISHING.

BY LIFEBOAT.

Repolishing — Faded Polish — Removing the Upper Surface of Polish — Taking the Work Apart—Sweating—Bruises—Colouring-up and Matching by means of Red Oil—Stains—Dyed Polish and Dry Colours —Finishing-off.

Repolishing, though essentially the same as French polishing, calls forth the higher qualities and tact of the workman; for, having once mastered the fundamental principle of polishing, it is a comparatively easy task to give to a plain piece of wood a level and lustrous surface; and by the aid of stains that can be bought ready prepared a reasonable imitation of any given wood can be obtained with a minimum of labour. But to the workman that would wish to hold his own against all comers, and call himself a practical or professional man, it is not enough that he should be able to stain and polish a plain piece of wood. No! far from it that his knowledge should end here.

Faded Polish.—The stains with which he is familiar to stain his common woods will be of no avail to him when restoring polish that has faded and turned sickly-looking from damp or exposure to the sun. He may be called upon to restore such a faded article, and his patron may not care to go to the expense of having the old polish removed by scraping, etc., and the article polished up again.

Removing the Upper Surface of Polish.—It may be more convenient to both parties that the upper surface only of the polish shall be removed, the faded portion coloured up to match its surroundings, and the whole repolished.

If the polish is not very bad, it is generally sufficient to well smooth down with a piece of worn glass-paper. Should it, however, be much scratched or faded, it is better to sprinkle it with methylated spirits, and well rub — with a circular movement — with No. 1 glass-paper, when it will be found that the upper surface only of the polish will be removed, instead of fetching it out of the grain, which would be the case if the scraper was used.

Before any repolishing is done, it is advisable that the article should be first washed with common washing soda and water (a cupful to a gallon of warm water) to remove any dirt, furniture paste, etc., using a little pumice powder or powdered bath brick to assist.

Taking the Work Apart.—It will simplify our work somewhat by taking apart as much as convenient. Thus it is a good plan to unhinge all doors, remove all carvings that may be screwed on from the back —not forgetting to put some tallying mark on—and remove all knobs, brass fittings, etc. The doors can be better handled on the bench, and the corners of panels worked up better; the carvings can be varnished better, and if it be a chiffonier we have in hand, and the carvings are planted on, as is often done, a much cleaner job is made if we first remove these; for, be as careful as you may, you will find it a difficult task to polish inside the intricacies of the open carvings equal to the flat surface.

Sweating. — The cracked, fretful, and greasy appearance of polished work after it has stood a few weeks or months is called, in polisher's parlance, "sweating." The why and wherefore of this appearance is difficult to determine without knowing something of the inner workings or conditions under which it was done. It may be that the workman was "sweated" in price, so had to scamp his work, either by putting on an insufficient body of polish, or

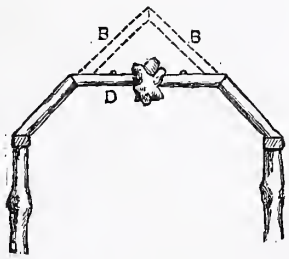


Fig. 3.—Entrance, showing Two Sections of Roof.

the use of cheap, inferior, or adulterated materials; or it may be that the greater part, such as filling and bodying-in, was done by boy or girl labour, and they may have been *too* lavish in the use of oil; or it may be that the fault lies in the "filling-in" being of too oily or greasy a nature, such as Russian tallow, which is sometimes used. The glaze rubber may have been used too freely on a greasy foundation, thus giving a brilliancy at the expense of permanency. Not alone can the blame be all put upon the "poor shiners," as they are sometimes called. The cabinet-maker may have cleaned off his work *too* soon after laying on his veneer, so causing the veneer to crack, the blame for which may be, and, indeed, often *is*, put upon the polisher's shoulders.

These are but a few of the causes for which we must look for "sweating." A whole chapter might easily be devoted to the subject. What concerns us most at present is its removal, and the restoring of the original polish.

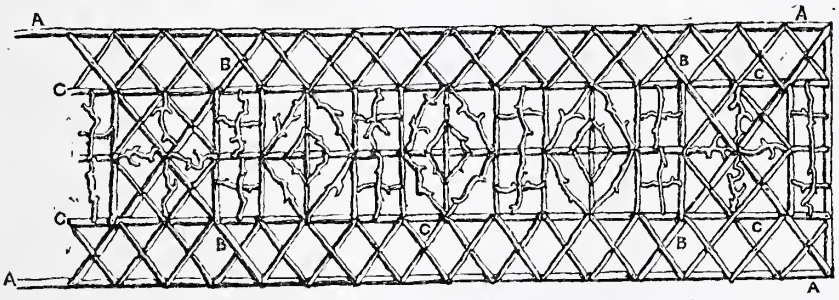


Fig. 2.—Plan of Roof.

Bruises.—The necessary cleaning-off of dirt, etc., having been accomplished, look to the bruises, either scraping out or bringing up level, by means of a hot iron and wet brown-paper, or by filling up with "Hard Stopping"—how to make and use which, refer to Work, No. 150, Vol. III., page 726. This being done, and having made good all defective parts, wipe all over with an oily rag: it assists the new polish to take more kindly to the old. It will probably be found that in scraping out the bruises and in cleaning-off level any new piece, and the consequent cleaning-off the polish, that it leaves a light patch. More especially will this be the case if the damaged portion has been previously coloured-up by means of stains, dry colours, or dyed polish.

Colouring-up or Matching.—If the job in hand is of mahogany, it is generally sufficient to wipe over the damaged portion with red oil (alkanet root steeped in linseed-oil), working up with red polish. Should it, however, be of walnut, I have matched many a little place and scratches in soft resinous varnish by wiping over with asphaltum dissolved in turps (one pennyworth to ½ pint turps). Should the place, however, be a piece of sap or other light portion, having previously gone over the light portion several times with the polish rubber to prevent the grain from rising, take a small tuft of wadding, saturate it with 3 parts of methylated spirits to 1 part of polish; take up on this a small quantity of Vandyke brown or brown umber, press and mix well on the back of a worn piece of glass-paper, wipe carefully over the light portions, thinning out with spirits if too dark, picking up a little more colour with, perchance, a little black if not dark enough.

The wavy appearance may be given by a tremulous movement of the hand, and a mottled appearance by a little dabbing with a badger softener or clean, soft dusting-brush while the colour is still wet. Black and red veins may be given by picking up a little dry black or red stain on the corner of the tuft of wadding and applying it carefully, taking some surrounding portion as a pattern. If the job is of rosewood, use a little red stain and dry black in combination; if birch or oak, use yellow ochre. If the job in hand is a large one, and requires staining all over, and you feel it is not possible to gain the desired result by means of dyed polish applied with the rubber, mix the colours in a pot, 3 parts of spirit to 1 of polish, and apply with a camel's-hair brush. It is better to give two or more coats thus of weak stain than one strong one; you are not so liable to get it patchy.

Allow a few minutes to elapse for the stain to set, then smooth down with a piece of worn, fine glass-paper, and give a coat of thin brush polish or spirit varnish to set the colours previous to polishing, which can be proceeded with in about ten minutes Mahogany, rosewood, and walnut goods, if not inlaid, are generally improved by working up with polish just tinged by the addition of a little red stain (made by dissolving two pennyworth of Bismarck brown in ½ pint of spirits); other colours may be mixed with polish to be applied with the rubber. But in using these dyed polishes, do not forget to leave off with that rubber when you have just the right tinge; it is better to take another rubber, and finish off with clear polish. Many a job has a patchwork appearance for want of this precaution.

Finishing-off.—In repolishing, the foundation being already laid, the polish is not required quite so thick as in polishing from the bare wood; and in the final stage, or finishing-off, any trace of greasiness may be effectually removed by well rubbing with a swab of clean, soft rag, fairly damp (not wet) with spirits, on the face of which has been sprinkled a few drops of glaze.

HOW TO MAKE A PHONOGRAPH.

BY WILLIAM DUFF.

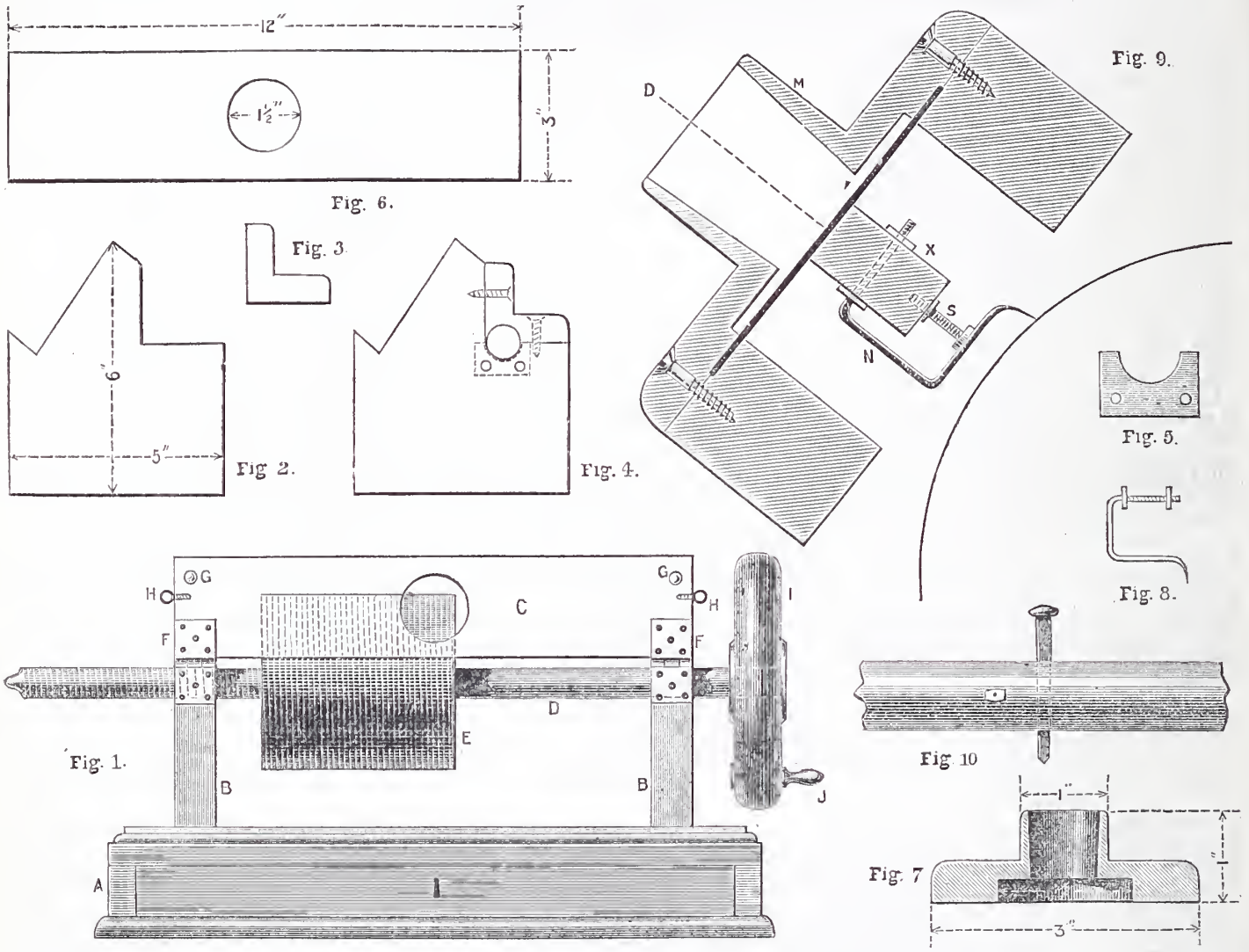
INTRODUCTION — PROPHECIES REGARDING CERTAIN INVENTIONS — THEIR FULFILMENTS — THE TELEPHONE—THE ELECTRIC LIGHT—ACCUMULATORS—THE PERFECTED PHONOGRAPH—THE PHONOGRAPH AS A SCIENTIFIC TOY—THE PRINCIPLE OF THE PHONOGRAPH.

DURING the last few years a great many very wonderful things have happened. All the great forces of Nature seem to have suddenly become more obedient to the will of man than hitherto. It is not only that new inventions are being brought to light day after day, but time-honoured institutions, such as the steam-engine, are being roused to greater energy. We can travel faster both by land and sea now than we could do a few years ago. We used to think the "needle telegraph" of Professor Wheatstone a marvellous invention, and the operating clerk who could transmit twenty or thirty words per minute a paragon of expertness; but this is very much altered now, for with the present systems as many as 400 words per minute can be sent along a single wire, and five or six messages conveyed over one wire at the same time without the least danger of them becoming jumbled or mixed up.

Sometimes, however, the shadow which the coming event has cast before it is greater than the reality. For instance, when the telephone was first talked about we were almost afraid to speak its name; for it was going to reveal all secrets—every word that we uttered was going to be heard, not only by our next-door neighbour, but by those living at the extremes of the earth. If a wire was simply passed through the keyhole of our door we were to be at the mercy of the unprincipled gossip or scandal-monger. But, fortunately, it has fallen short of this, and we know that even with the best of instruments, fitted in the most approved manner, general conversation is by no means a possibility—in fact, we must speak very deliberately and listen very attentively if we want to use it at all. Still, we have the telephone, and, although it has not fulfilled the dream of its inventors, it serves a very useful purpose in our every-day business life.

We have become so well used to puffs about the electric light, that when we hear of anything very wonderful going to happen in this direction we invariably look out for the proverbial grain of salt. That it is making rapid strides towards becoming the best of artificial lights I will not deny; but it is far from holding the position which has been prophesied for it. For instance, in the beginning of the year 1879 one of the London dailies stated that Mr. Edison could at that time supply this light for practical domestic purposes at less than half the price of gas. About the same time the whole scientific world was startled with the intelligence that a Frenchman had discovered a method of storing electricity; and immediately there arose the cry that this wonderful power was going to do everything for us. It would, of course, displace steam and all other motive-powers, gas and all other illuminants. The accumulator or "secondary battery, charged with electricity, would be delivered to the consumer like other goods, and returned empty to be charged again"; but this prophecy has not yet been fulfilled. Accumulators have their sphere of action, but just now it is limited.

Let not the reader imagine that I write these things in a carping, peevish spirit. Far be it from me. I am just as ready to



A Phonograph. Fig. 1.—Front Elevation of Phonograph with Mouthpiece and Diaphragm removed—A, Base with Drawer; B, B, Standards or Uprights; C, Top hinged to Uprights; D, Iron or Steel Shaft, one end screwed; E, Cylinder; F, F, Hinges; G, G, Brass Knobs; H, H, Brass Eyes to take a Hook not shown in the Figure; I, Heavy Fly-wheel; J, Handle. Figs. 2, 3, and 4.—Details of Standards or Uprights. Fig. 5.—Brass Plate in which the Screw Thread of the Shaft works, shown by Dotted Lines in Fig. 4. Fig. 6.—Top with Hole in Centre. Fig. 7.—Section of Mouthpiece. Fig. 8.—Stylus or Needle. Fig. 9.—Section of Mouthpiece, Top, etc.—M, Mouthpiece; D, Diaphragm of the Thin Ferrotype Plate; N, Stylus or Needle; S, Adjusting Screw; X, Block of Wood or Cork holding the Needle and attached to Diaphragm; the Curved Line shows the Cylinder. Fig. 10.—Portion of Shaft showing the Nails to keep the Cylinder from turning on Shaft.

hail a new thing and puff its merits as anyone; but an invention in the hands of its originator is not quite the same as it is before the public, and we must excuse him if he does over-estimate its usefulness.

You will be quite ready now for the statement that I am going to make regarding the "perfected phonograph." It is simply this: I have no hesitation in saying that it will be a long time before this instrument does all that has been prophesied regarding it—in fact, I do not believe that it ever will. There has been too much claimed for it. It is going to be the business correspondent of the future, the shorthand-writer of the future—to take entirely the place of the pen—and those who have been foolish enough to spend their time in learning to write may fall back, and Gillot and Heath may shut up their factories. In fact, the newspaper offices may shut up, and beat their type into foil, for we need not bother reading any more. We can have the news talked to us while we chip the top of our egg and munch our toast at the breakfast-table. All the great speeches will be delivered, not only in the words, but in the accents of the speaker.

In the evenings we can draw in our chair to the fire, and sit comfortably there while our favourite soprano or tenor is turned on. The great singers are not going to sing any more in public; they will sing their songs in the quiet of their own rooms to the phonograph, and retail the phonograms at a price within the reach of all.

These are but a few of the things that have been foretold of the phonograph. That it will accomplish all this I am sure it never will, and I am just as sure it will be a long time before it finds itself at home on the merchant's desk, which seems the most sensible part of the prophecy.

As a scientific toy, the phonograph has enjoyed a somewhat lengthened popularity, and attempts have been made again and again to raise it from that position. As a scientific toy the writer of the present articles has known it for many years, and as such he now presents it to the readers of WORK, with the assurance that many a pleasant evening may be spent in its company.

The instrument which I am going to describe is very simple in design, requiring no special tools or machinery to construct it, the only part presenting any difficulty being the stylus or needle. The perfected phonograph is, on the other hand, a very complicated machine, the chief part of which lies in the motor which is employed to give that regularity of motion which its inventor considers a *sine quâ non*.

The phonograph is an instrument which can reproduce articulate sounds spoken into it. The voice of the speaker is directed into a funnel which converges the sonorous waves upon a diaphragm carrying a style. The vibrations of the diaphragm are impressed by means of this style upon a sheet of tinfoil, which is fixed on the outside of a cylinder to which a spiral motion is given—*i.e.*, when turning the handle the cylinder travels endwise. After this has been done the cylinder with the tinfoil on it is shifted back to its original position, the style is brought into contact with the foil as at first, and the cylinder is then turned as before. The indented record is thus passed beneath the style, and forces it and the attached diaphragm to execute movements resembling their original movements. The diaphragm accordingly emits sounds which are imitations of those previously spoken or sung into it. In my next paper I will enter fully into the particulars of construction.

MICRO-PHOTOGRAPHY WORK.

BY ARTHUR RENAUD (B.A. OXON.).

MANUFACTURE OF NEGATIVES REQUIRED FOR LANTERN SLIDES — DIFFERENT DEVELOPERS SUITABLE FOR THE WORK.

THE actual manufacture of lantern-slide negatives from the object under the microscope can be achieved by any method in which the operator is most expert. It will be found that a great deal of the character of the result depends on the subject to be taken. The preparations should be perfectly clean, with the object sufficiently flat to allow of being focussed sharply all over. Certain objects, in which yellow or yellowish-brown colours exist, will not transmit light, or so imperfectly as to be hardly available for photography. When mounting objects, if they are intended to be photographed, it will be found a good plan to bleach many of them—such as insects and their parts by long maceration in turpentine, and sections of dark-coloured wood by nitric acid, etc.

The negative should not be over-exposed; at the same time under-exposure for lantern slides is complete ruin, as all the finest details of the object are wanted. A long exposure and a development with a strongly restrained developer is perhaps a good plan, as the details are thus secured, and yet a thin, misty image from over-exposure is avoided. Plates exposed to gas or lamp-light will be found to take longer to *commence* developing than those exposed to sunlight; once begun, however, it goes on easily enough, and quite as perfect pictures as those produced by sunlight may readily be obtained. The time of exposure is not easily judged, as it is so dependent on the nature of each object. Practical experiment will be your only guide. A negative with good strong contrasts is to be aimed at, as if required for making lantern slides, the slide will be certain to follow the lead of the negative from which it is produced, and, if that is thin and wanting in contrast, the lantern slide will almost inevitably be the same, and give a washed-out picture in the lantern.

The ferrous oxalate developer is well known, and can be found in any of the innumerable text-books of photography published. It has great advantages of its own, but, unfortunately, it also has disadvantages, one of which is that it is not so easy to compensate for under- or over-exposure with this developer. For those who prefer the old pyrogallic acid developer there is a method of development with sodic sulphite, which gives black tones instead of yellow ones—an important consideration when developing the negative, and absolutely necessary in the case of the lantern slide. The formula I prefer is known as Berkeley's—A: Pyrogallic acid, 1 oz.; sodic sulphite, 4 oz.; ammonium bromide, 600 grs.; citric acid, 60 grs.; water, up to 12 oz. B: Strongest liquor ammonia (·880), 2 parts; distilled water, 1 part.

A is mixed by dissolving the sodic sulphite and bromide of ammonia in hot water, adding the citric acid. When these are dissolved the solution is poured over the pyrogallic acid, and the mixture is then made up to 12 fluid oz. with more water. When about to develop, 1 dr. of A is diluted to 2 oz. with water, and successive small portions of B, beginning with about 5 drops, are added to it in another vessel until the picture appears. Development will be much slower than without the sulphite, etc., but the result will be a dense black negative, which will give an equally black lantern slide, all the details being very sharply drawn, and therefore very suitable for enlarging.

The hydroquinone developer is considered by many to be *the* developer *par excellence* for lantern slides. I give a formula used with Thomas' plates, which gives extremely good results—No. 1: hydroquinone, 160 grs.; sodium sulphite, 2 oz.; citric acid, 60 grs.; potassium bromide, 40 grs.; water, up to 20 oz. No. 2: sodium hydrate, 760 grs.; water up to 20 oz.

In cold weather equal parts of Nos. 1 and 2 are used, but in hot weather many workers have found this too strong, and it is preferable to dilute it with an equal quantity of water, adding an extra 3 or 4 grs. of bromide of potassium for every 1 oz. of developer. If the plate is over-exposed, the high lights can be brought up with this diluted developer; and the detail afterwards brought out by using the normal developer—*i.e.*, equal parts of each.

I am supposing that the actual details of development are known to the reader, as plenty of information has been given in former numbers of this paper. Guides also abound, priced from sixpence upwards. One of the best and about the latest published is that by Mr. J. Eaton Fearn. This is a shilling book, and in it you will find a chapter on lantern-slide making, which will supplement my instructions. Of the older guides, Burton's "Modern Photography" gives you the most for your shilling, and there is a "Beginner's Guide," at sixpence, published by Messrs. Perken & Rayment. Another admirable and much larger work is Marion & Co.'s "Practical Guide to Photography"; this costs half-a-crown.

It is possible to produce stereoscopic photographs of microscopic objects, but the apparatus required is rather elaborate; and, as it is not strictly available for lantern slides, I will refer my readers to page 256 of Dr. Lionel Beale's book on "How to Work with the Microscope," where various methods will be found. The simplest is certainly that of Mr. Heisch, who recommended an adapter for the object-glass, carrying a tube which can be turned half round by a lever outside. In this tube is another which has a stop to cut off half the pencil of light proceeding from the object-glass; when this sliding tube is placed in proximity to the back lens of the objective, the field on the ground glass of the camera is equally illuminated in all positions of the stop. Now the first picture is taken on half the prepared plate, and the stop is turned round until it is in a position directly opposite where it was during the first exposure. The other half of the plate is now placed in position, and a second exposure takes place. The two pictures combined give a stereoscopic effect. In the case of thick objects the near surface should be focussed for one picture and the farther surface for the other.

AN EASILY-CONSTRUCTED AIR COMPRESSOR.

BY T. R. BLACKETT.

INTRODUCTION—CLASS OF COMPRESSOR—CAST-IRON WORK—STEAM CYLINDER—PARTICULARS OF DITTO — AIR CYLINDER — PARTICULARS OF DITTO—BED-PLATE—PISTON, FLY-WHEEL, ETC. —WROUGHT-IRON WORK—AIR RECEIVER.

IT is my intention in this article to give the proper working detail of an air compressor

and receiver, these details having been taken from one in every day use in a manufactory. To convey my meaning clearly to my readers, so that one and all may grasp the design, etc., I have selected what may be termed a "single acting air compressor."

It will be seen by the general view, that by adopting this design we shall be able to do away with both connecting-rod and horizontal motion bars, the compressor resembling the form of donkey pump that one sees on board ship in the engine-room, but in the present instance we have it horizontal instead of vertical.

We will commence in the first instance with the cast-iron work, assuming that we have the services of a pattern-maker handy. Fig. 1 will give us sufficient idea of the form of steam cylinder we require, which, when finished, should be of the following dimensions:—Diameter, 8 in.; thickness of metal to be $\frac{5}{8}$ in.; length of cylinder (that is, from face to face) to be 1 ft. $3\frac{1}{2}$ in.; so that the pistons having a stroke of 1 ft., and the spigot of the cylinder cover being let into the cylinder $\frac{3}{8}$ in., there will be a clearance of $\frac{3}{8}$ in. at each end of the stroke for the piston. We must remember that the piston is 2 in. thick.

Having so far determined that our cylinder shall be one of 8 in. diameter and 12 in. stroke, we will now attend to the dimensions of steam and exhaust ports. Let us say for the area of steam port that area of cylinders in square inches÷12 will be a very good proportion, which will be $4\frac{1}{8}$ in. nearly, say $4\frac{1}{8}$ in. area. Now for the length of steam port, let us say, diameter of cylinder in inches ×·7, which will be 5·6 in., say $5\frac{1}{2}$ in., which will be near enough for all practical purposes. Then for the width of the steam port, which is found by dividing the area of the port—that is, $4\frac{1}{8}$ in.—by its length, which is $5\frac{1}{2}$ in.; this will give us, roughly speaking, $\frac{3}{4}$ in.

This system of getting out the sizes for cylinders I have found from practice to answer very well indeed, but many engineers have, of course, their likes and prejudices on such matters. Let us now make the width of our exhaust port $1\frac{5}{8}$ in., which will also be a good proportion. The width of bar from the edge of steam port to the edge of the exhaust port is to be $\frac{7}{8}$ in.

The cylinder covers for this cylinder to be as per sketch, which, I think, will convey sufficient information that any practical pattern-maker will grasp at a glance.

Let us now turn our attention to the air cylinder. It is to be 6 in. in diameter, and the same stroke as the steam cylinder; the thickness of metal to be $\frac{5}{8}$ in., and thickness of its flange at the back end to be $\frac{3}{4}$ in. It will be seen in this case that the one cylinder cover of the air cylinder is minus the usual spigot, and contains also the necessary suction and delivery valves (Fig. 2). With regard to the bed-plate, it must be of $\frac{3}{4}$ in. section at its weakest part, and have what are known as chipping pieces on each end, so that the two cylinders when planed can be firmly bolted down to it.

For the remainder of our cast-iron work we must look to the eccentric sheave, slide valve, and the steam and air pistons, not forgetting the fly-wheel.

Now, if we were to allow no "lap" on the slide, the *travel* of the valve would be only twice the width of the steam port, which would be $1\frac{1}{2}$ in. But as we must cut off steam before the end of the stroke, we will give the valve $\frac{1}{4}$ in. "lap"; this will make the *travel* of the valve equal to 2 in., therefore we must give the eccentric sheave 1 in. throw—*i.e.*, the distance from *a* to *a*, Fig. 3. The eccentric sheave in this case to be a plain disc of metal, as shown in the figure. Next take the slide valve as per sketch (Fig. 4), so as to be connected up by a through slide spindle, which scarcely needs explanation.

We will next make the steam piston. It is to be 8 in. diameter, and to have two grooves turned in it to receive the piston rings, the grooves to be $\frac{5}{16}$ in. deep and $\frac{1}{2}$ in. broad.

Then the air piston is to be 6 in. diameter, and to have two grooves turned in it also, $\frac{3}{8}$ in. broad and $\frac{5}{16}$ in. deep; these, of course, are the finished sizes, and care must be taken that proper allowances are made for shrinkage when the patterns are first made. The piston rings in both these cases to be made of cast-iron, their diameter to be, when turned, $8\frac{5}{16}$ in. for the steam piston and $6\frac{1}{4}$ in. for the air piston; this is, of course, before they are cut and fitted to their respective cylinders.

A very good style for piston rings is to bore out the inside first to the required size, and then shift the job in the chuck, so that we have one side of the ring, say, $\frac{3}{32}$ in. thinner than the other ($\frac{3}{32}$ in. would answer very well in the present instance); this is the part that we would have to cut and fit the ring to the cylinder. It will be seen that by adopting this method the thickest part of the ring opposite the cut would have a tendency to spring open the ring, more so than if we had turned the whole ring of equal section. The fly-wheel should be about 3 ft. 3 in. diameter, and about 3 cwt. in weight.

The wrought-iron work will be our next consideration. The crank shaft, which can be bought at any forging company's works ready made, to be as per sketch (Fig. 5).

Then the two piston-rods to unite in one common crosshead (as shown in Fig. 1), secured by bolts through distant pieces at x x, and having a nice split crank-pin brass for the crank-pin to work in. This means of changing a reciprocating motion into a circular one answers our purpose at the present time fairly well.

Here we have the principal instructions necessary for constructing an ordinary single-acting air-compressing engine which will give a continuous supply of air at a pressure of 35 lbs. per square inch through a 1 in. delivery pipe, the engine to run at the rate of 100 revolutions per minute.

These air engines, as they are sometimes called, are used extensively in our large chemical industries for drilling rock, and for other purposes too numerous to think of. Now with regard to our air receiver. It is a well-known fact that the best shape of receiver is that of an egg—that is, for standing any great pressure. Well, the next best will be a cylinder, so we must just have a receiver cast in the form of a cylinder

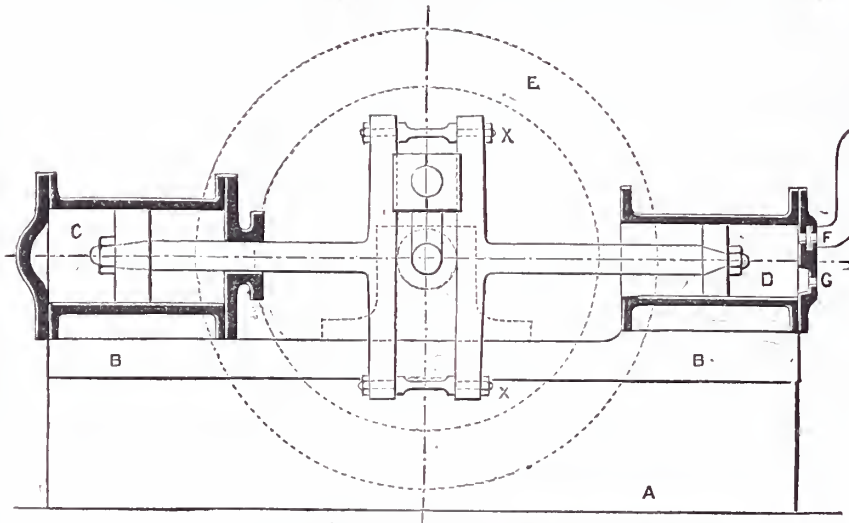


Fig. 1.

Fig. 2.

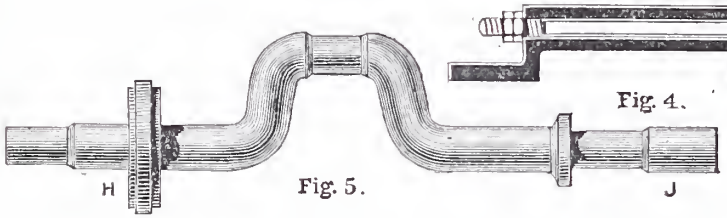


Fig. 5.

Fig. 4.

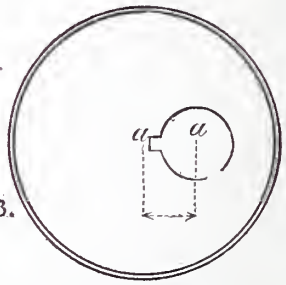


Fig. 3.

Air Compressor. Fig. 1.—General View of Air Compressor—A, Foundation to be of Stone or Concrete; B, Bed-plate; C, Steam Cylinder; D, Air Cylinder; E, Fly-wheel; F, Delivery Valve; G, Suction Valve. Fig. 2.—Showing Suction and Delivery Valves—F, Delivery Valve; G, Suction Valve. Fig. 3.—Giving Throw of Eccentric Sheave from *a* to *a*. Fig. 4.—Giving Sectional View of Slide Valve. Fig. 5.—Crank Shaft for Air Compressor—H, Eccentric Sheave; J, Fly-wheel End.

closed at each end, and of the same thickness as the air cylinder of the engine. This receiver must be fitted with a pressure gauge, a blow-off cock, and a spring-loaded safety valve, as well as any other necessary stop valves connected to the system that the air compressor and receiver has to work.

HOW TO MAKE A CHEAP SPIRIT LAMP, BUNSEN BURNER, BLOWPIPES, ETC.

BY H. B. STOCKS.

USUAL FORM OF GLASS SPIRIT LAMP—CHEAP FORM—MATERIALS REQUIRED—METHOD OF MAKING—COST—BUNSEN BURNER—UTILITY OF THE BURNER — CONSTRUCTION — MATERIALS REQUIRED—METHOD OF MAKING—METHOD OF ADJUSTING GAS AND AIR—USEFUL BLOWPIPE ADJUNCT.

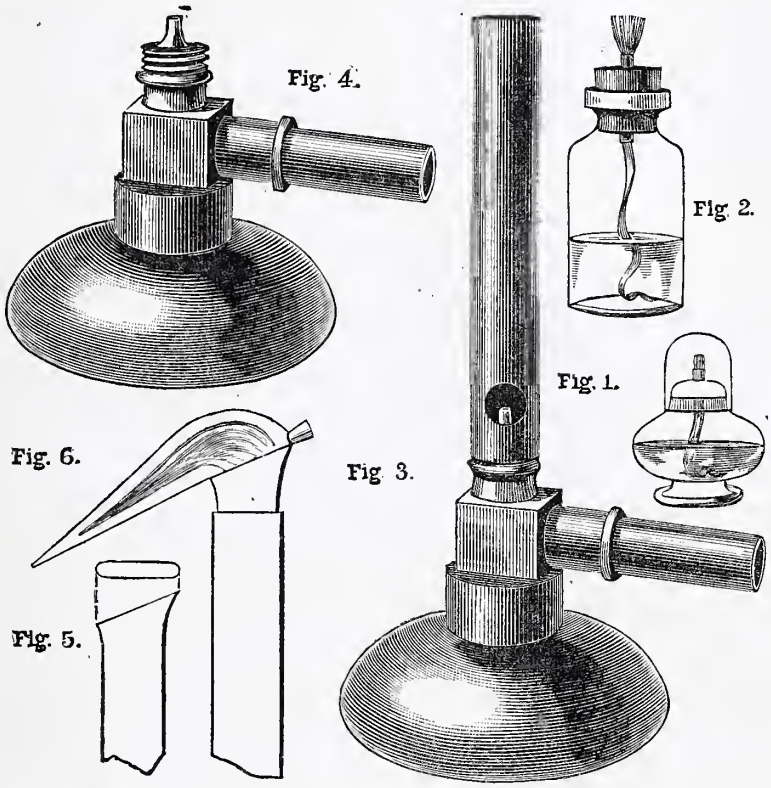
I HAVE noticed in WORK a growing interest in heat-giving appliances. Certainly no one could have a greater name, so far as gas-heating appliances are concerned, than Fletcher of Warrington; but it is within the reach of all to make their own appliances, even if they do not at the same time make a great name.

I have spent some little time in elaborating the simplest forms of spirit lamp, Bunsen burner, and blowpipes, and intend in the following lines to describe them. The description will, I hope, be useful to those studying chemistry, and to those in trade who need such appliances.

Spirit Lamp.—The spirit lamp which we see usually in chemical laboratories consists of a glass vessel to hold the spirit, with an earthenware or brass tube in the mouth of it through which the wick passes, and over this is a glass cap ground to fit on the lower vessel so as to prevent evaporation when the lamp is not in use (Fig. 1). There are other forms of spirit lamps used by plumbers, differing in the material of which they are made. There is described the making of one on p. 696, Vol. II. of WORK.

What I wish to describe is a cheap form of the glass spirit lamp. Provide yourself with a two-ounce wide-mouthed bottle and cork to fit it, the holder portion of a penholder, some unwoven cotton wick, and methylated spirit. By means of pliers break off the portion of the holder which grips the pen, and you then have a steel tube. Make a hole in the centre of the cork to fit the tube—with a little pressure and moistening the tube itself will make the hole—and push the tube half-way through the cork. Make a smaller hole in the cork by means of red-hot wire; this will allow air to enter as the spirit escapes. Pull the wick through the tube, leaving plenty of it out. Put some spirit in the bottle, cork up tight, and light, and you will find you have got a very fair spirit lamp for 3d. or 4d. (Fig. 2). The Bunsen burner—known to some as the atmospheric burner—was invented by the chemist of that name. It is a most useful appliance. It burns with a blue flame when properly adjusted, gives out great heat, but practically no light; and when a cold body is brought into the flame it does not deposit soot, which distinguishes it from any other burner except the spirit lamp. Since the original burner was made numberless others have been invented, besides gas stoves, gas furnaces, and gas cooking and heating appliances, all of which depend upon the same phenomena as presented by the simple burner.

In Fig. 3 you see the ordinary Bunsen burner. It will be seen that there are holes at the base of the upright tube, through which air is drawn by the gas itself as it ascends the tube. Fig. 4 shows the base of the burner with the tube unscrewed, to show the small jet through which the gas issues.



Chemical Appliances. Fig. 1.—Spirit Lamp. Fig. 2.—Cheaply-made Spirit Lamp. Fig. 3.—Bunsen Burner. Fig. 4.—Bunsen Burner with Tube unscrewed. Fig. 5.—Brass Tube cut. Fig. 6.—Directed Flame of Burner.

To make a Bunsen burner the following materials will be necessary:—A piece of brass tube $3\frac{1}{2}$ in. long, $\frac{1}{2}$ in. diameter (external); a piece of tube $\frac{3}{8}$ in. in diameter, $1\frac{1}{2}$ in. long; a brass boss similar to those on an ordinary bracket, but without a tap; a brass elbow tube; also a piece of tubing with very fine bore (small bit of tube from an old oil-can will do).

Commence by soldering the elbow-piece on to the brass boss, and notice that the tube, with a screw cut for gallery, must be uppermost. If the large tube is not of very thick brass, it will be a little too large for our purpose. Cut out a piece of very thin sheet brass, $\frac{1}{2}$ in. by $1\frac{1}{4}$ in.; turn it up into a cylinder and solder *inside* the large tube; then tap the tube inside so that it will screw on the male thread of the elbow-piece. At the same end of the large tube on which you have tapped a thread, drill two holes of about $\frac{3}{8}$ in. diameter, exactly opposite to each other, and centres $\frac{5}{8}$ in. from the end of the tube.

The tube with fine bore must be about $\frac{3}{4}$ in. to 1 in. long, and requires to be soldered inside the vertical tube of the elbow-piece, and allowed to project about half an inch. If it is too small, plug around it with a little sheet lead, but keeping the small tube perfectly vertical and also in the centre of the outer tube, then solder. If you now screw on the larger outer tube, and also screw the $1\frac{1}{2}$ in. tube into the side opening, the burner is theoretically complete. Fix the indiarubber tube from the gas supply on to the side tube, and let us see if the burner is practically complete. If, after lighting, the flame burns with a purplish-blue colour, the air and gas are being delivered to the burner in the right proportion. If the flame is yellow at the tip there is too much gas supplied, so plug up the hole in the small tube to a slight extent. If the gas burns with a green flame and hissing noise, then the air-holes are too large. To remedy this, cut out a piece of sheet brass about $\frac{3}{4}$ in. wide and $1\frac{3}{4}$ in. long, and drill in it two holes, each $\frac{3}{8}$ in. in diameter, and at a distance of $\frac{1}{2}$ in.—centres $\frac{3}{16}$ in. further—from each end of sheet; turn it up into the form of a tube, and push it on to the large tube of burner until it covers the air-holes. By turning until the two sets of holes do not quite correspond, the proper amount of air may be delivered to the burner.

If the Bunsen burner is needed for blowpipe work, the following arrangement will be found very useful for supporting the blowpipe, and will allow of the flame being blown downwards upon a charcoal or other support. Get a piece of brass tube 4 in. long, $\frac{3}{8}$ in. in diameter. Cut obliquely at one end (Fig. 5); soften this end by heating in the flame of the burner you have made, and quench it in water, then flatten it out carefully until the opening is a mere narrow slit. By dropping this inside the Bunsen burner, and closing the air-holes, a wide flame will result, which, by resting the nozzle of the blowpipe on the edge of the tube, may be blown downwards or upwards if required (Fig. 6). For spirit lamps, see pp. 696, 763, Vol. II.; pp. 16 and 269, Vol. III. For Bunsen burner, see p. 615, Vol. II.; also p. 368, Vol. II., and p. 181, Vol. III., for uses to which they may be applied, etc.

I quite agree with "F. B. C." (see p. 615) that the cost of a Bunsen burner is slight, but it is my impression that those who learn to make their own apparatus will know best how to use them, and therefore there will be a material gain.

In my next paper I propose to deal with the subject of "How to Make Cheap Blowpipes." I understand that the Editor of WORK intends to give much attention to the subject of Chemistry and Chemical Appliances in WORK, and, such being the case, my readers cannot do better than bring this, and subsequent articles, under the notice of schoolboys and the thousands of students who take an interest in chemistry.

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WATCH TRADE DRUDGERY.—While the whole country is being stirred up for the reduction of hours of labour, some of our best mechanics are wearing their lives away in protracted hours of business, running to twelve and fourteen hours a day. This is very noticeable in the watch trade, where it is not unusual to find an assistant at the bench who also serves at the counter. It is not easy to pick up a good watch hand, and therefore some masters, if they have one who interests himself in his employer's welfare, work him to the failing point, and give him assistants who are frequently worse than useless—for surely this applies to men whose work is returned as faulty, to be re-dealt with by other juniors, or, perhaps, the principal. We think that a man who is placed in charge of a watchmaker and jewellers' shop to serve customers should not be required to also work at his bench on a Saturday evening, which is usually a busy one in small provincial towns. The masters would not lose in the long run by a relaxation in this direction, as their assistants would then be more inclined to stop with them than to leave and start in business on their own accounts, and add to the long list of those who trade on credit, and from sheer necessity reduce the prices for repairing jobs. How, too, with such excessive hours can an assistant be supposed to have his wits about him to cope with fraudulent customers and swindlers?

SHEFFIELD FILE INDUSTRY.—There seems little doubt that this industry is in jeopardy at home—this arising partly from the activity of American and German trading houses, and the lethargic state of the home makers. The following letter, which has reached a Sheffield firm, speaks for itself:—"We are obliged to you for your letter of the 17th instant giving us the names of machine-cut file makers in Sheffield. We shall most likely be in Sheffield this week, so shall call on the firms you name. We have hitherto been using some very finely cut files made in America, but we think that Sheffield ought to be able to make files with anywhere, although up to the present we have not been able to get what we require." Sheffield will do well to take this hint, and abandon all old-fashioned prejudices. Manufacturers might also take a wrinkle with advantage to themselves from the Americans, whose custom is to "vacation" their superintendents, with whom they generally associate some long-headed practical workman, who, as a reward for signal service, and with their salaries going on and a liberal allowance for expenses, they send to England or other countries to combine business with pleasure, and in the pursuit of which they find means to visit the various workshops and manufactories connected with their crafts, taking notes of all interesting processes. This is frequently done by American firms, and answers a double purpose, giving the men a thorough rest and renewed health, and means for acquiring information, which is made use of as opportunity serves. If we are to hold our own with foreign competitors, English makers ought to be availing themselves of similar opportunities where they exist. The suggestion of "Workers' Holidays," made a few weeks since in a leaderette in WORK, would be one step in the right direction. It does take some time, however, to prove to the home trader that his position is not so secure as he feels it to be.

WINDOW CLEANING DEATHS.—Another lamentable accident to a domestic servant at Holloway, who lost her balance while cleaning a second floor window, and fell mortally crushed, recalls the miserable practice of employing girls to stand on a window-ledge at a great height for the purpose of cleaning windows. Most London windows can, or might be, easily displaced and pulled into the room. There are many very good patents for this purpose, costing but little more than the ordinary sash and frame, and many of the patents can be adapted to the existing frames; and even with new sashes, etc., £2 a window would cover the cost of most of them. Seeing the cost is, comparatively speaking, so trifling, it is surprising there are not more reversible sashes, that can easily be cleaned from the inside, in use than there are. £2 for a human life! An invention for suspending or hanging sashes has just been patented. Instead of employing for each sash two balance weights as hitherto, one only is used, the sash cords attached to one sash passing over pulleys at the top of the frame, and over pulleys secured to a balance weight, and returning over pulleys in the top of the frame and passing down to the other sash, to which they are secured. The frame, with the sashes, is then hung to an outer frame, and opens into the room like a casement or door, with the weight on the hanging side. The fact of opening this casement with the sliding sashes in not only renders the cleaning an easy matter, but at once exposes the lines, etc., in case of a breakage, and when it is shut and secured it is both air- and water-tight, and nobody could tell it from an ordinary sash and frame, especially from the outside. This method is equally applicable to ordinary windows having fixed frames, and if the patentee can supply the whole thing complete ready for fixing at the same rate as the ordinary sash and frame in common use, then one of the most diabolical of death traps for servants should be compulsorily made to disappear. There is no reason, too, why other inventions in the same direction should not be forthcoming.

DESIGN AND DECORATION OF ALL AGES.

BY M. H. C. L.

Assyrian.

Intrinsically, Assyria gives less ground than Egypt for interesting research in the field of decorative art; but it is important in the history of design because of the effect it has had on the art of modern nations, through its influence on Greece.

We have no tomb sculptures and paintings like those of Egypt, no objects buried with the dead such as we find in many pagan countries, notably in the tombs of Etruria and in those of ancient Scandinavia. It is to the sculptures from the old palaces, which the excavations of Sir Henry Layard and Sir Henry Rawlinson have brought to light, and the strange carvings found on the rocks, that we turn for a knowledge of their pictorial, which was also their decorative, art, to these, and to the copper bowls and dishes, the painted tiles, and the fragments of pottery, and to the delicately cut seals and cylinders discovered by the excavators among the *débris* collected about ruins.

The sculptured walls of the Assyrian palaces give pictorial histories of the doings of the kings; their marches with their armies over rocky country, through marshes, and by rivers; their conflicts with the enemy, the burning of towns and battering down of fortresses; their triumphant returns with troops of captives, the peculiarities of whose dress and method of wearing the hair prove to modern research from what countries they were taken. Often these captives are represented with bound hands or carrying burdens; sometimes taking part in labours such as the removal of one

Assyrian Ornaments. Fig. 1.—Sacred Tree. Fig. 2.—From Obelisk of Assur-Nasir-Pal. Fig. 3.—From Bronze Gates of Shalmaneser II. Figs. 4 and 5.—Trees. Fig. 6.—Palm-Tree. Fig. 7.—Lilies carved in Stone. Fig. 8.—From Border of Bronze Dish. Fig. 9.—Border of Dish. Fig. 10.—Libation poured by Assur-Banan-Pal. Fig. 11.—Cylinder from Cyprus. Fig. 12.—Chalcedony Cylinder (Assyrian). Figs. 13 and 14.—Figures carved on Stone, giving privileges to Ritti Marduk. Fig. 15.—Bronze Bowl, Palace at Nimroud. Fig. 16.—Terra-cotta from Kalch. Fig. 17.—Guilloche Border. Fig. 18.—Top of Babylonian Boundary Stone, B.C. 870. Fig. 19.—Assyrian Palmetta or Honeysuckle.

of the colossal bulls, which are the first facts in the history of Assyria to make an impression on the mind of childhood. Sometimes they are shown being subjected to the horrible tortures which are such an odious witness to Eastern cruelty. There is much less of the religious element in Assyrian representation than in the Egyptian; but the king was the great high priest of his people, and he is depicted in the sacred chambers, and on the cylinders, engaged in offering sacrifice. We also find representations of the Assyrian gods, both in gigantic sculptures and in bas-relief: Assur and the Fish-god, with whom the account of Dagon in Samuel has made us familiar; the Assyrian Hercules, contending with a lion; the Assyrian Venus—a lady of small pretensions to beauty. There are also mythical figures and strange devices, one of the most frequent of which is the Sacred Tree, which always bears the form given in Fig. 1. In the cylinders this form is reduced to great simplicity; but we always find some suggestion of the interlacing side boughs and the independent branch at the top of the stem. The Sacred Tree is a very old and widely spread symbol, and is generally guarded by two figures of strange beasts, or is an adjunct in a scene of religious ceremonial.

Mention has been made of a sacred chamber, a hall set apart in the palace for religious decoration as a votive offering to the gods who had given victory—the "palm-room," as it has been called. The chief worship of the Assyrians seems, however, to have been offered to their kings, to whom—as in Egypt also—a divine quality was ascribed. He stood between man and the unseen powers, and, while offering to the gods, was himself a demi-god.

A portion of a bas-relief representing the chase is given in Fig. 2. Hunting scenes were of very frequent occurrence, as, when not engaged in slaying their enemies, the chief delight of the Assyrian monarchs was in destroying the lower creation. Lion hunts were a favourite pastime with them, and the delineations of the fierce animals and of their hunters in the bas-reliefs are extraordinarily spirited. The Assyrians, like the Egyptians, knew nothing of perspective, and, when drawing a river with trees beside it, gave a bird's-eye view of the water and laid the trees down flat on each side of it, with their trunks facing towards the stream! A device for showing a chariot drawn by four horses was to place the horses on top of one another, showing the whole of each. Troops of men dragging a weight were treated in the same way, as though walking along ledges in a steep rock. The attitudes of their figures, however, were varied and true to life, and their animals were admirable. The methods of conventionalisation of the Assyrians are worthy of study; for, however impossible the grouping and anti-naturalistic the representation of objects, each scene of the bas-reliefs explains itself at a glance, and the history contained in them is nearly as clear as in the written inscriptions which accompany them, and are often written straight over the pictures. Four methods of conventionalising trees are given in Figs. 3, 4, 5, and 6. They are, in their way, as true to nature as Hardy's tree sketches, and are not wanting in a certain beauty—especially the palm-trees with their fan-like and feathery branches. The Sacred Tree is unlike anything in nature—doubtless designedly so, like the monstrous animals with human heads, bulls' bodies, and eagles' wings which stood for sacred animals. The vine was a subject too difficult for Assyrian art, and in its crude ugliness the Assyrian vine resembles the ivy-sprays and rose-branches we are too familiar with in the decoration of cheap tea-trays; but in one of the bas-reliefs now in the British Museum there are two lilies treated with such simplicity and grace that they would be a joy to the nineteenth century æsthete (Fig. 7). The lotus occurs in Assyrian decoration but sparingly; their chief flower-form was that to which Sir H. Layard gives the name of the poppy, and which in Greek art developed into what is called the honeysuckle.

Of actual pattern-drawing the Assyrians did little. The garments of some of the figures in the bas-reliefs are embroidered, but there is nothing striking about the designs. The cone was much used. The star also was a favourite form, probably because astrology had a large part in the Assyrian religion. The king, in the mystic scenes in which he figures, is sometimes surrounded by the sun, moon, and stars.

The most characteristic decorative design of the Assyrians is the guilloche. This border was very extensively used, and from them has come down to us, retaining to this day its popularity. Ruskin contemns the guilloche, chiefly upon the ground that it has no counterpart in nature except in an obscure chemical combination. Surely he has forgotten the wild honeysuckle of our hedges, two or three stems of which often cling together for mutual support, forming in their twisting round and round each other a natural guilloche. What was the origin of the design? Sir Henry Layard thinks it may have had some astrological significance. But among the bas-reliefs in the British Museum there is portrayed the figure of a king pouring a libation from a cup held out in his hand. The stream of water gives the curl round that water is always seen to do in falling in a solid jet from a height, and the curl is represented by a guilloche (Fig. 10). This has suggested to the writer that the guilloche may be one of the many varying conventionalisations of water. The form, when once devised, forms such a natural and simple bordering that it was almost certain to be adopted for decorative purposes. Its value is known to every decorator. It can be worked in wood or metal, and might well be used for embroidery; it is often painted as a border, but where it has been most successfully brought out is in the tessellated pavements of the Roman Empire. The adaptation of such forms belongs to the subject of original design rather than to that of the present series of papers. But the evolution of the guilloche has been of the simplest. Its first inevitable step was the insertion of a small form, such as a star or a blossom, in the space naturally left between the intertwinings of the two strands. This first step was its last, and to this day it remains to us in its naked simplicity, just as it appears on the Assyrian monuments.

The metal bowls and plates, of which mention has been made before, are some of the most beautiful of the Assyrian remains, and those which best represent their purely decorative art, though fragments of earthenware, with designs painted on them, and glazed bricks have also been discovered bearing analogous designs. The handles of the bronze vessels were often formed in the shape of the heads and fore-parts of animals. The subjects of the designs embossed or incised on the surface were animals in conventional pairs, or forming a band, representing such scenes as a lion springing upon a bull, two vultures devouring a hare, or stags feeding gracefully among reeds and trees. Occasionally the scarabæus appears, with other traces of Egyptian influence; guilloches, stars, and tulip-bands are largely used. It is interesting to know that the method employed for the repoussé work was the same as that in vogue nowadays. The copper was laid on a bed of mixed clay and bitumen, and punched with a blunt instrument, a few strokes of which, in the rougher work, served to produce the image of an animal. Fig. 15 is a portion of the design on a bronze bowl from the N.-W. Palace at Nimroud; Fig. 8 from a bronze dish found in the same palace. The curious head-dress worn by the hawk-headed lion like the Egyptian "pshent" had a divine import. We find it on the human-headed bulls and on the kings as represented in their most sacred moments. The mystic animal lays its foot on the head of a worshipper by way of protection and blessing—not, as might appear to the casual observer, as a means of extermination. The winged scarabæus appears on the same bowl, the design of which is exquisitely preserved.

Among the most curious discoveries in the way of Assyrian relics are the cylinders—probably amulets — made of lapis-lazuli, amethyst, agate, onyx, and the like, from a quarter of an inch to two inches in size, and engraved with religious or historical subjects. Fig. 12 is the impression of an Assyrian cylinder of chalcedony. The subject is the Sacred Tree, with two adorers, one on either side—in the air a winged disc, emblematic of the god Assur. Cylinders made by the Phœnicians—those early masters of the arts, the great workers in metal of antiquity—have also been found. Fig. 11 represents part of a quaint cylinder from Cyprus. Babylonian cylinders are also numerous. Of the decorative art of Babylon we have little left in comparison with the vast treasures bequeathed to us by Assyria. The Assyrian bas-reliefs, with which the outside and inside of their palace walls were adorned, were chiefly cut in alabaster, and have thus survived the lapse of centuries; but the Babylonians had no such durable material in any large quantity to their hand, and their sculptures, cut, for the most part, in rock of perishable quality, have long ago crumbled away. What remains shows that great resemblance existed between the arts of the two countries. The wings of the sacred bulls of the Babylonians were shorter, and there were other slight distinguishing peculiarities; but their worship in essential points was very similar, and there are no marked contrasts in their system of decoration. Fig. 18 represents some of the very quaint figures the Babylonians were wont to carve on their boundary stones; Figs. 13 and 14 are from another stone monument — a grant of privileges granted to Ritti Marduk by Nebuchadnezzar about B.C. 1120. The embroideries of Babylon were early famous. It was, doubtless, the beauty of the embroidery on the "goodly Babylonish garment" he had secreted that cost Achan his life. The Babylonians were also great weavers in wool and silk, and the producers of renowned carpets. They buried their dead, and earthenware coffins containing bodies were found covered with decoration, but these perished almost as soon as found.

In my next paper of this series I shall hope to treat of Greek design and ornament, which rose to great perfection in the social life of this great people. Influencing, as it has done, modern ornament, the subject appeals with especial interest to every art worker.

SCIENCE TO DATE.

Electricity in War.—The United States navy has provided one of its ironclads with electric fans to blow away the smoke from the guns.

Good Gum.—Melt at a gentle heat 100 parts of gilders' glue in 200 parts of water, then add 2 parts of lac previously dissolved in 10 parts of alcohol. Next, prepare in the cold a solution of 50 parts of dextrin in an equal quantity of water, and add it to the first liquid with constant stirring. Filter the still liquid solution through linen, and put it in bottles, where it solidifies on cooling and preserves well. To employ this substance, a sufficient quantity is taken, melted, and diluted more or less, according to the use for which it is destined. If it is wished to stick thin paper, the pure dextrin may be advantageously replaced by a solution of the same substance in 5 parts of water, 1 of alcohol, and 1 of acetic acid.

Preservative Fluid for Biological Specimens.—According to Mr. Haly, of Colombo, carbolised oil is an excellent preservative of the natural colours of fish, snakes, or frogs. It is not suitable for marine invertebrates.

Silica in Wheat.—MM. Berthelot and André have determined the amount of silica, soluble as well as insoluble, contained in the various parts and at various stages in the growth of a culture of corn on a soil in which the amount of silica was previously determined. The grain sown contained a minute quantity of soluble silica. At the commencement of growth the stalk contained a notable quantity of insoluble silica, but at the beginning of the flowering the greatest proportion of the total silica appeared in the leaves. Of the total quantity of silica in the plant, the greater part was in the insoluble state; soluble silica exists for the most part in the roots. During the ripening of the grain, the silica accumulates more and more in the leaves; the stalk and roots only contain soluble silica. At the time of desiccation, on the contrary, the roots contain little silica, the stalks more, partly in the insoluble state.

Mistletoe.—It is generally supposed that the mistletoe is injurious to the apple or other tree on which it grows. Dr. Bonnier, of Paris, has recently put forward arguments, based on experiment, to show that this supposition is not correct, but that, in reality, the mistletoe is beneficial to its host. Thus, by observations on the increase in the weight of the dried leaves, he finds that whilst in summer the mistletoe receives the greater part of its nutriment from its host, yet in winter the increase in weight of the mistletoe is less than the amount of carbon which it has obtained from the atmosphere, showing that it has given up to its host a portion of its assimilated material.

New Acid.—A short time ago M. Recoura discovered a remarkable isomeric form of chromium sulphate, a solution of which yielded no precipitate of barium sulphate with barium chloride. When a solution of zinc sulphate is mixed with one of the isomeric chromium sulphates, a substance of the composition $ZnCr_2(So_4)_4$ is formed. This substance gives none of the reactions of sulphuric acid or of chromic acid, but at the same time it exhibits the usual reactions of zinc salts. Hence it must be the zinc salt of a new acid—chromesulphuric acid. The free acid has been obtained as a green powder, very deliquescent in moist air, but permanent in a dry atmosphere. Its solution is bright green in colour when freshly prepared, but gradually changes to blue, and finally to violet, when the solution consists only of ordinary chromium sulphate mixed with free sulphuric acid. Other salts of this interesting acid have been studied.

Nitrojute.—Nitrojute is a new explosive. By treatment of one part by weight of jute fibre with fifteen times its weight of a mixture of nitric and sulphuric acids it is obtained as a brownish-yellow substance, insoluble in water, alcohol, ether, or benzine, but, like other nitrated carbohydrates, soluble in acetic ether and nitrobenzine. It explodes, on percussion, like gun-cotton.

An Electrolytic Method of Preparing Boron.—Fused boric acid becomes a good conductor of electricity when mixed with 20 per cent. of its weight of borax. On passing a current of 35 ampères through such a fused mixture, a little sodium is liberated at the negative pole, while amorphous boron and oxygen are produced at the positive pole. Owing to the high temperature, some of the boron re-combines with the oxygen with brilliant incandescence, but the remainder may be isolated as a chestnut coloured powder.

NOTES FOR WORKERS.

Russia has the longest electric railway in the world, and the government is now considering the construction of a line from St. Petersburg to Archangel, a distance of 500 miles. The longest British line now in operation is between Portrush and Bushmills, in the north of Ireland, and is only 6 miles long.

Methylated spirit is a mixture of 90 per cent. of spirit of wine (alcohol) and 10 per cent. of partially purified wood spirit. The latter is put in to make it undrinkable, and therefore free from the very high duty levied on pure spirit of wine.

Polished surfaces of steel and iron, if varnished with a mixture of lime and oil, will keep their brightness and not rust when exposed to water.

Fifty telephone wires are being erected between Chicago and New York, a distance of 980 miles. This will be the longest line in the world, and as there are two wires in each line, 98,000 miles, or 8,528 tons, of copper wire will be used.

If an alternating current is sent round the laminated field-magnets of an alternator whose armature is stationary, an alternating current is generated in the latter, just as if the field-magnets revolved under the excitation of a steady current.

The effect of revolving the armature as well as exciting the field-magnets with an alternating current is the same as if the field-magnets were revolved at one speed (under steady excitation) and the armature revolved independently at some other speed.

The result of this double rotation is to produce an alternating current whose frequency corresponds with the sum or difference of the speeds according as these are in opposite or the same direction.

WORKERS' QUESTIONS: EIGHT HOURS.

BY ECONOMICUS.

Apart from their own private and individual affairs, there is, perhaps, nothing occupying so large a share of the attention of workmen as the question of limiting the number of hours they shall be permitted to work per day. This question crops up in the workshop, at the dinner-hour, at the meetings of unions—in short, wherever two or three workmen are gathered together, there, it may be said, you will find "eight hours" the subject of conversation, each speculating as to what the effect of the system upon himself and his peculiar trade would be. It is this widespread and living interest in the topic that has forced it into the pages of Work, which has no blind political leanings, and which is, therefore, all the more suitable to offer some general observations to enable workmen to arrive at clear views upon the subject.

In the first place, there should be no difficulty in coming to a conclusion upon the question of a compulsory universal eight-hours day—*i.e.*, an eight-hours day applicable to all employments. In the case of one employed like myself, the closest scrutiny could never discover the number of hours worked, and I am only one among thousands similarly occupied. When Sir Isaac Newton was lying on his back in the orchard and saw the apple drop that led to a revolution in our conceptions of the universe, the Government inspector would have jotted him down as not working then. All the same, he must have been struggling very severely. To everyone's mind will readily occur numerous other sorts of work in which no kind of inspection would avail.

These considerations reduce the applicability of a universal eight-hours law only to those employed in workshops and such places as are known to be places where workmen go for the sole purpose of working. No doubt, if a sufficient number of active inspectors were appointed, breaches of the law in such places might be detected as often as they were made. But the workers employed in these places comprise only a small part of the total population, and it would be obviously unfair that the small part—especially those in it that objected—should be under the operation of a law from which all other workers, from the nature of the conditions under which they worked, were free. Moreover, those workers upon whom the law would operate most precisely are generally paid piece-work wages, and such would be very apt to resent a regulation that resulted in reducing the money they had to draw at the week's end.

These are pointed out as difficulties, apparently insuperable. Let us hope they are not insuperable, however, and that a way may yet be found whereby, to the disadvantage of none, our workmen may enjoy greater leisure than they now do without any reduction of income.

Dismissing, then, as impracticable a compulsory universal eight-hours day, we will now speak of a compulsory eight-hours day for a certain trade or group of trades. The high-water mark in this movement has been reached by the miners, whose case has so far developed as to have become the subject of a Bill brought before Parliament and strongly supported. The reason that the miner has been singled out for special treatment is because his work is very arduous and very dangerous, and because the conditions under which he carries on his work are very disagreeable. All are agreed on these points, and it has consequently been proposed to mitigate the harshness of his lot by forbidding his being employed more than eight hours per day. The miner himself, however, has not made up his mind so clearly upon this point as his friends seem to have done. You see, he is paid so much for every ton of coal he turns out, and he is apprehensive lest, his hours being reduced, the number of tons he turns out will be similarly reduced, and his takings at the week's end affected to his detriment. The advocates of the miners' eight-hours day say to this: "No; the output will not be reduced. The miner with eight hours only will work so much harder during that time than he now does, that he will turn out just as much coal as before." This may be true, and it may not. It may be true of the stronger miners, but what of the weaker? If they are unwilling or unable to live on less wages than they are now earning, it would manifestly be cruel to compel them to do so. Besides, even for the stronger miners, the extra exertion to keep up the output in the shorter hours might be more trying than their present exertion. Many a man can catch his train in five minutes by running all the way from his house to the station. He does it far more easily, however, and is far less tired by allowing himself fifteen minutes. Thus there are many doubts to clear up yet ere an eight-hours day, even for miners, can with certainty be recommended as an amelioration of his lot.

We shall take one step just a little deeper into this question before leaving it. For some it may, perhaps, be a difficult step; for all, however, it will be interesting, as it concerns wages—important, well worth mastering. What really would be the effect of an eight-hours day upon miners' wages, supposing the output of coal to be reduced? If, after the miners worked only eight hours a day, the quantity of coal turned out were not sufficient to meet our requirements, clearly more miners would be employed. Now, if employers found any difficulty in getting these additional miners, the rate of miners' wages would be increased—more would be given per ton turned out. This increased rate would not last long, and the greater the increase, the briefer would be the period it was maintained. The high wages would attract workmen to the pits, and the higher they were the more workmen would they attract. The consequence would be that, instead of employers finding it difficult to get miners—the difficulty that raised wages—miners would find it difficult to get employment—the difficulty that reduces wages. Thus, then, the wages of miners would fall back to their old rates, perhaps below them if the labour attracted by the temporary high wages was much in excess of what was required.

These are points well worth the consideration of all classes of workmen at the present time. The man that has a thorough grasp of the causes that fluctuation in rates of wages is due to is not likely to be led away by delusive hopes. Let every man by all means strive to get the highest return for his labour that he can, but, in so striving, let him be careful not to act so foolishly as the avaricious man who killed the goose that laid him golden eggs.

One other aspect of this question. While a workman is engaged with his tools, he is in no danger of having to spend any money. It is in his leisure that very often the necessity arises, or temptation comes in the way, urging him to seek amusement. Time hangs heavy, and to kill time is frequently costly; and the more time one has to kill, the more costly is the performance liable to be. Many who are not hobbyists will have this difficulty to face. With shorter hours of work, they will have longer hours of play; and as play means expense—in large towns, at any rate—even though wages may be the same and not reduced at all, they will find their power to save in many cases considerably curtailed.

TRADE: PRESENT AND FUTURE.

**** Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

SHIPBUILDING TRADE.—The Aberdeen shipbuilding and engineering trades are dull. One of the largest orders in hand is for a large passenger steamer for the Aberdeen Steam Navigation Company. The *Resolute*—the first of two new battleships—is ready for launching. The second ship—the *Revenge*—is in a forward state, wanting principally such superstructural parts as "conning towers," casemates, etc.

SILVER AND ELECTRO TRADES.—A slight improvement is noted in the Sheffield silver, electro-plate, and Britannia metal trades; in the latter branch orders coming to hand from France.

COTTON TRADE.—In the Lancashire cotton trade there is a feeling of dissatisfaction at the comparative insignificance of the concessions obtained. It is contended that compensation for bad work is an "admitted principle" in Oldham and elsewhere, and the only point which the operatives have gained is the general extension of the arrangement to the other districts. With regard to the employment of non-unionist labour, the position remains practically unaltered. The Stalybridge Company's spinning mill continues to be the centre of a disturbed area.

JEWELLERY TRADE.—The London jewellery trade is still dull, and there is but slight sign of improvement. The case is the same in the country and in Paris.

TIMBER TRADE.—Some twenty or thirty vessels have been unloading a very fine cargo of deals and battens, KAB and NAS mark, in the centre yard of the Surrey Commercial Docks. The cargo also consisted of some 3 × 2 scantling. Piled under the sheds was the first cargo to arrive from Sweden. There was also a fine parcel of BSSC, BC, and BBB 3 × 9 yellow and B—Co. white, Canada sheds—these goods being remarkably bright and clean. There is also unloading a cargo from Freemantle of Jarrah wood.

SHEET METAL TRADES.—In the Wolverhampton district most makers are fairly busy just now in stamped hollow ware and japanned goods. The trade in manufactured iron is dull, some makers being unable to find full employment for their men. In the tin-plate industry, makers in the South Wales and Monmouthshire district are firm.

ENGINEERING TRADE.—There is little change to chronicle in the condition of the Lancashire engineering and iron trades, and it is considered that an exceedingly depressed period may be anticipated, so far as this district is concerned. A few machine tool makers have booked some orders for new work, but otherwise this branch, like that of stationary engine building, is in a very stagnant condition. Locomotive builders are somewhat better circumstanced. Boiler makers are also reporting a decided lull in their business. The shipbuilding and marine engineering trades are exceedingly short of work, except in the Barrow district, where a fair amount of briskness prevails in both branches.

BOOT AND SHOE TRADE.—The West-end London boot and shoe trade has improved, and gives great promise.

BUILDING TRADE.—In Rochdale and district the stonemasons are still out on strike. The demand of the joiners for an advance in July has not yet been conceded, and there is every probability of a strike. The Arbroath joiners have resolved to strike work immediately unless the masters grant an increase of ½d. per hour, making their wages 7½d. an hour. The Sheffield bricklayers' strike still continues. Thirty-four of the masters have signed the men's working rules, but the contractors for the municipal buildings here having refused, no bricklayers are on the works.

IRON TRADE.—In the Middlesbro' iron market No. 3 Cleveland pig was quoted at 40s. per ton for prompt delivery, but few firms are in a position to deliver. Merchants ask 38s. 3d. to 38s. 6d., which is 1s. 6d. less than at the previous close. Warrants have dropped to 38s. cash. The stock of forge pigs is almost exhausted, there being only two or three makers who can supply it. The production and demand for finished iron is somewhat heavier, and prices are stiffer. Steel ship plates are £5 15s.; angles, £5 12s. 6d.; iron ship plates, £5 10s.; angles, £5 7s. 6d.; common iron bars, £5 12s. 6d.; all less 2½ discount and F.O.T. for delivery after close of the strike. Heavy steel rails are £4 net at works. In Sheffield the scarcity of hematite iron threatens to limit the output of steel. Armour plate establishments are still working full time in order to complete the heavy work for the Admiralty programme. The file trade has improved.

PRINTING TRADE.—The printers of Liverpool have been considering the terms offered by the employers, and have accepted them by a very large majority; they are briefly as follows:—Daily papers, night hands, 50 hours per week, £2 5s., with 1s. 2d. per hour overtime; casual hands, 11d. per hour. Day hands, 51 hours per week, at 35s. 6d., and 11d. per hour overtime. Jobbing work and weekly newspaper hands, 51 hours per week, 35s. 6d., and 10d. up to 1s. 1½d. per hour overtime, according to length of time overworked.

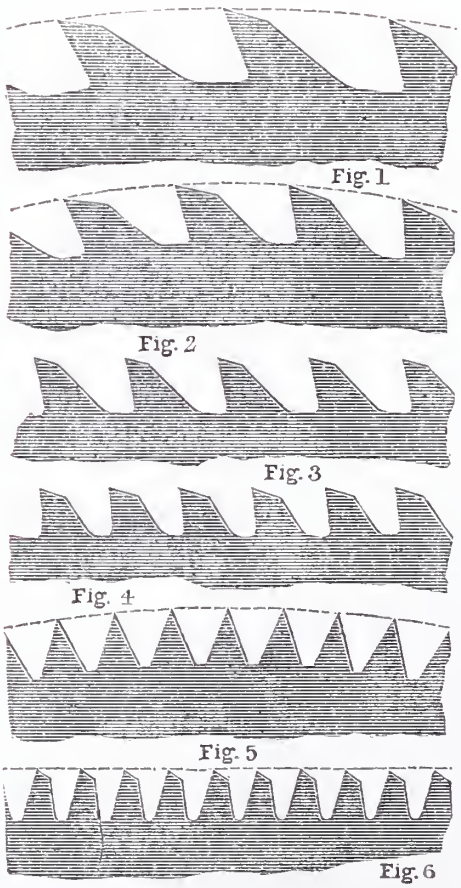
SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of WORK *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given.*

I.—LETTERS FROM CORRESPONDENTS.

Saw Teeth.—A. R. writes:—"Some time ago I promised to write more on saw teeth. The annexed sketches of saw teeth are what I have proved, by long experience in saw sharpening, to be the best form and rake for cutting soft and hard wood generally. Fig. 1 represents circular-saw teeth, for cutting soft wood. The rake of the teeth is at an angle of about 65°, and the top of teeth with the face of teeth at an angle of about 50°. Teeth of this form and rake, from 65° to 70°, will cut soft wood very satisfactorily. Fig. 2 represents circular-saw teeth for cutting hard wood—that is to say, wood that is cut



Saw Teeth Angles.

green or in a wet state, as English-grown timber often is. The rake of these teeth is at an angle of about 75°, and the angle of the top of teeth with the face about 65°. When cutting timber that is dry and hard, the rake should be at an angle of 80°. Fig. 3 represents teeth suitable for a log-frame saw when cutting soft wood. The rake of these teeth is at an angle of about 75°. Fig. 4 represents log-frame saw teeth for hard wood, at an angle of 80°. It will be seen that the angle at the top of these teeth varies, as with the circular-saw teeth. Fig. 5 shows teeth suitable for cutting soft wood in a two-handled cross-cut saw. These teeth should be sharpened to an acute angle, so as to cut across the fibres of the wood easily. Fig. 6 represents teeth not generally used in cross-cutting hard wood, because, I suppose, they are not generally known, and a little more experience is needed to work such a saw tooth. But with a little practice it will be found to cut almost as fast again as does the fleam or peg-tooth (Fig. 5) when cutting hard wood. The teeth of Fig. 6 cut only one way, and instead of there being a rake in the teeth, they lay back. Should these teeth be given rake or lead, the saw could not be worked by the strongest of men, even if such had a deal of experience in cross-cutting timber. A strong man will sometimes force a saw through a piece of timber when a weaker man could not. If the teeth of the last-named saw were upright even, it would be a difficult matter to work it. The teeth of Fig. 6 are parallel, therefore the saw should be shot and pulled perfectly straight. If the arms are moved in an arch, as they may be when cutting with teeth shown in Fig. 5, there also being what is termed a belly in the saw, the saw would not work well, nor do the duty that it would if shot straight, and not forced. It must be understood that when a saw is properly sharpened it is folly to force it."

Workmen's Trains.—T. R. B. (*Newcastle-on-Tyne*) writes:—"With reference to your remarks on workmen's trains (see No. 161, page 72), it may be interesting to your readers in the South to know that workmen in the North have a similar set of trains set apart for them, but certainly at a rather heavy rate of charge. For instance, the rate of charge from Newcastle to Blaydon (4½ miles) comes to 3d. per day return. How would a South-country workman like that? Moreover, a full set of twelve tickets has to be bought; these are supposed to last one week. The trains are not punctual, landing the workers very often fifteen minutes late."

Eight Hours.—W. B. (*Higher Broughton*) writes *à propos* of our remarks in No. 169, as to the Sunderland engineers who tried the Eight Hours system with so much success:—"Five hours a week more play: that is five hours more for reading, walking, house improving—in fact, really and truly living. Five hours more between work and bed; which means better spirits, better health, more comfort for each working man, and by reason of this the same for his wife, and also his family, is, I think, what you would call being better off."

Gravitation.—F. B. C. writes to H. R. (*Colne*):—"*Errata*, p. 29.—In the first column, line 6, for '3·014,159,265 . . . . etc.,' read '3·14,159,265 . . . . etc.' In the second column, line 3, for '$2\pi r \times \pi 2r$' read '$2\pi r \times 2r$'; and line 50, for 'A P,' read 'A B.'"

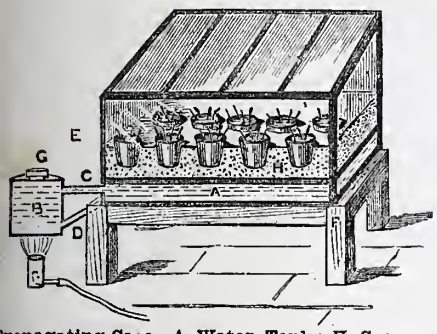
WORK Back Numbers.—R. R. T. (*Frome*) writes:—"I am one of the unfortunate amateurs who did not hear of WORK till it was near the end of its third year, and now cannot get all the back numbers—a great loss to one who looks forward to the arrival of each issue as I do."—[If you were to advertise in our Sale and Exchange column for back numbers, you would probably be successful.—ED.]

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Model Marine Engine and Boiler.—P. B. (*Oldham*).—I think your boiler is not quite large enough, and would make cylinder ⅜ in. bore; then you will drive at a higher pressure and faster speed, and get the same power but with less weight. It is not well to have flat sides to your boiler, they would require to be tied together inside with stays to make it strong; also, though you have plenty of room for water and steam, you have not room enough for the fire, and the chimney is much too small, and would only carry away the burnt air from one of your wicks. Remember it is useless having a number of wicks if they can't burn properly for want of air. I don't like that bend in the flue. I would have it straight, and about 1¼ in. in diameter; then I would make the top of the furnace arched, and have the top of the arch as high as the top of the bend in the flue, or nearly. Take chimney straight up from the middle of the furnace through the top of boiler, which should also be arched. In fact, I would make the boiler saddle shape, and have the furnace open at both ends, using three wicks at each side of the chimney. If you have the top of boiler high enough, it will not need a dome, which saves expense and trouble. I would not have those eight water tubes. You might round the bottom of lamp to suit the boat. Fly-wheel is all right; make it as big as you can, as also the screw propeller. Methylated spirit is the right thing for the lamp, which should be kept as cool as possible, or the spirit will boil and the wicks flare up. Why have the lamp under the boiler at all when you can lead the wicks where you want them by tubes, and interpose a little cock in the tube to regulate the spirit burnt? Spirit will boil away about four times its weight of water; if, therefore, you wish to know how much to put in the lamp, fill boiler up to cover the furnace; then weigh how much it takes to fill it full enough for starting, and put quarter of that weight of spirit in the lamp. Thus you may be sure the lamp will go out before the water is low enough to allow the boiler to be unsoldered. You can let air into the lamp by partly unscrewing the filler, or by boring a little air-hole through it.—F. A. M.

Liquefying Horn.—PROBYN.—So far as I am aware, the only known solvents for horn are concentrated alkali solutions, as caustic potash or soda.—S. W.

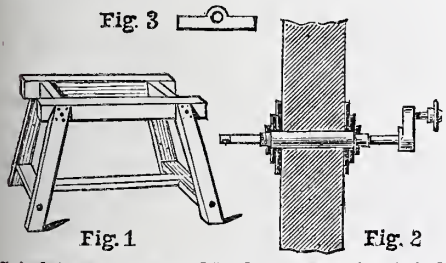
Plant Propagator.—E. H. M. (*Bideford*).—For a propagator 3 ft. × 2 ft., such as you desire, it would be necessary to have a water-heater, as a flue only would make some parts of the frame inside very hot, and inefficiently warm the others; whereas, with ever so small a circulating water-heater covering the bottom, the heat would be uniform. The annexed sketch shows a very successful arrangement of the kind, which acted admirably with very little attention. The frame may be made of any material—preferably bar zinc. At the bottom a tank about 2 in. deep is fixed; this should be made of copper if it is intended to last many years; the next best material is tin-plate; but on no account use zinc, as with heat it rapidly deteriorates, and soon becomes useless. B shows the



Propagating Case—A, Water Tank; H, Cocoanut Fibre.

heater proper, which is connected to the tank by a flow-pipe, C, and a return pipe, D, the former leading to the top of the tank, the latter, or D, leading from the bottom of the tank. A filling-plug, G, is provided on top of heater; the heat of the lamp or gas flame causes the water to completely circulate in the tank, and the whole surface gets a uniform heat. Above this tank a bed of cocoanut fibre is placed, into which the pots with seeds or plants are placed. A very short experience will enable you to maintain a fairly uniform degree of heat with either a paraffin lamp or gas—a very small flame suffices. Of course, an ornamental case can be made upon similar lines, but the above is intended as a practical hothouse on a small scale.—C. M. W.

Grindstone.—Young Joiner.—You don't say the size of the stone, but if about 3 ft. diameter, make the frame of 4½ in. by 3 in., or 6½ in. by 2½ in. stuff. The frame will be about 9 in. wide inside, depending on the thickness of the stone. The cross-pieces are notched ½ in. into the sides. The legs are notched at the top, and splayed end and sideways. The stays between the legs are mortised, and a long bolt, with nut and washer, put through, and screwed up tight; also put similar bolts through the top of the legs and across the frame. The top of legs should be cut to a templet, and nailed (see Fig. 1). The axle and crank are shown in Fig. 2. Make the centre 1½ in. diameter, or the size of the hole in the stone. Reduce this at each end to 1¼ in. to the inside of the bearings, and make the outer end 1 in. diameter, leaving a shoulder to work



Grindstone. Fig. 1.—Wooden Frame for Grindstone. Fig. 2.—Section of Grindstone with Axle and Crank. Fig. 3.—Cast-iron Bearing.

against the inside of the bearings. A collar is welded on at one end, and two plates, 4 in. diameter and ⅜ in. thick, are fitted on. The other end is screwed, and has a nut fitted to it. Also make two discs of willow or plane tree, 7 in. diameter and ⅜ in. thick. Put a plate and wooden disc on, then the stone and a disc and plate, and screw up tight, or you may make the centre of the axle square. Lay the stone on a level bed of sand. Put the axle in and run with lead, but this is not such a good plan as the other. Sometimes wood and iron wedges are used, but these are very liable to break the stone. Make the crank of cast or wrought iron. Cut a keyway and key it on the axle, making it 2 in. or 2½ in. throw. The bearings are cast-iron, as shown in Fig. 3. If you put a core point in, the hole can be cast in, and will only need riming out. Fix the bearings on the frame with screws; also drill a hole in the top of each for lubrication. The crank pin is keyed in, and has a pin and washer on the end. The treadle may be fixed to one of the legs; it may be iron 1 in. by ⅜ in., set edgeways. The outer end is flattened for the foot to rest on. The connecting-rod will have a double end, fixed to the treadle by a pin or bolt. The top end has an eye to fit the crank-pin, and is fixed by the pin and washer. The treadle will work at one side of the frame, or the end may be cranked and come out at the middle of the frame. Fix the treadle so as to clear the floor, and don't give it too much rise.—M.

Draught Screen.—D. C. (*Kinross*).—The difficulty caused by your pictures being 18 in. too short for the panels we should overcome by making up the deficiency with Japanese leather-paper—one with as much gold as could be introduced without "killing" your pictures: there should be a 6 in. border at top and a 12 in. at bottom. The best place to get Japanese pictures, leather-paper, etc., for screens would, we imagine, be Rothmann, Strome & Co., St. Mary Axe, London, E.C.—that is, if you are buying wholesale for trade purposes; but, perhaps, for mere retail purchases you would do better to go to Liberty's, Regent Street, London, W. Prices would, of course, vary widely. For proper brass hinges try Jas. Cartland & Sons, Constitution Hill, Birmingham; you can order through any good ironmonger. Prices will depend on size and weight of metal.—S. W.

Exhibition Stand for Cut Flowers.—D. C. (*Kinross*).—You ask for an idea for a stand to hold, say, six cut roses or other flowers. We should suggest a hexagonal wooden box, large enough to hold one of the shallow round Australian meat tins (for water); this will be mounted on a turn-table. It would have a lid fitting so far into the box as would allow the sides to rise nearly 1 in. above it. Through the lid, and opposite to the middles of the sides, holes would be pierced to admit the stalks of flowers, and in the middle might be a hole for some tall ornamental grasses. The sides of the box would be ornamented with rustic work or cork. The lid would be covered with green moss, which should be kept in place by the rim formed by the sides; or a pretty effect might be gained by making the lid of looking-glass, and drilling the holes through it. A great point in connection with such a case as this would be that, at a touch, it would move round and bring any required specimen to the front.—S. W.

Book-keeping.—A. C. (*Leeds*).—We fear that to attempt to sketch out for you a system of book-keeping in "Shop" would scarcely be practicable. Your really best plan would be to get the evening services of a clerk to set your books going, and to put you into the way of carrying them on; in large business towns like yours there are always numbers of men who would be glad of such an engagement for a trifling consideration. Or get a work which treats of the subject—say "Cassell's Popular Educator." This will give all you want to know; and, if we remember rightly, Cassell's have published a "Guide to Book-keeping," taken from, or based on, the Educator lessons. Write for their catalogue. Or, again, W. & R. Chambers, Edinburgh, publish exercise books in book-keeping for schools; you might get them, and fill them up according to the sample page given in each.—S. W.

Wood-Carver's Strops.—T. W. (*Kendal*).—Melt a tallow dip in a saucepan over a fire, then spread it on to a strip of buff leather about 4 in. wide and 9 in. long, and before the tallow cools, sprinkle the emery-powder on to it; then mix together well. Put as much emery as will make the tallow a dark puce colour, and until you get a firm paste like butter. Spread the paste equally all over the leather to the depth of about $\frac{1}{32}$ of an inch. Care must be taken to keep the leather flat during the process, as if the tallow is very hot it sometimes makes it curl up. Do not melt the tallow on to the leather instead of in the saucepan first, as that is a fatal mistake. The strop is improved by use as the paste in time gets well beaten into the leather.—M. E. R.

Medical Electric Belts.—Perpetuum Mobile.—Directions for making a medical electric belt were given in "Shop," on page 827, Vol. II., and further instructions on the same subject were given on pp. 174, 203, 251, 315, 396, and 427, Vol. III., in reply to correspondents. It would take up too much space here to give fully illustrated descriptions of electric belts.—G. E. B.

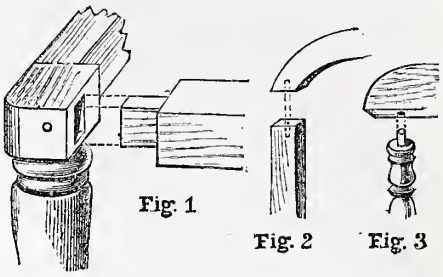
Books on Painting.—W. H. (*Hastings*).—Messrs. Brodie & Middleton, Long Acre, London, W., publish a cheap and useful handbook, dealing with all kinds of work. It is, however, more suited to amateur requirements. I cannot refer you to a "best book," dealing *collectively* with painting, house decorating, and sign writing. Vol. I. of Work contains very useful series on House Painting and Sign Writing. Vol. II. contains a good series on Graining. With these you get practical lessons by reputed workers and writers at the "lowest possible cost." If you want the best modern works, irrespective of *cheapness*, write for particulars to the Decorative Art Journals Company, Mosley Street, Manchester.—F. P.

Moulding in Plaster.—Amateur Modeller.—Yes, there are other substances in which moulds for plaster casts can be made, such as wax and gelatine, but plaster is most in use, and is, for general purposes, by far the best. You will find such articles as you ask for in Vol. II. of Work, and these will give you full information on the points in question: on Clay Modelling, pp. 3, 50, 123, 189, 255, 303 (Nos. 53, 56, 60, 64, 68, 71); and on Plaster Casting, pp. 319, 398, 500, 578, 659 (Nos. 74, 77, 83, 88, 93).—M. M.

Rearer.—P. S. (*London*).—Winchcombe's address is Leonard Stanley, Gloucestershire. These rearers can be obtained of Mr. Stevens, who advertises in Work.—Leghorn.

Work (Cover for).—A. H. (*Cork*).—Thanks for your suggestion.

Mahogany Chair.—C. H. B. (*Jewin Street, E.C.*).—I think the best way to make the chair is to let the back legs run up to form the back rest, instead of having them separate, as it makes a stronger job than the latter. You can get the front legs at a turner's, and, having shaped the backs to taste, tenon together as shown in Fig. 1. This could be made more secure by driving in oak dowels right through the leg and the tenons. The top rail of the back can be dowelled to the upright as in Fig. 2, but a better method is to have a round tenon on the upright, and glue it into the socket in the back



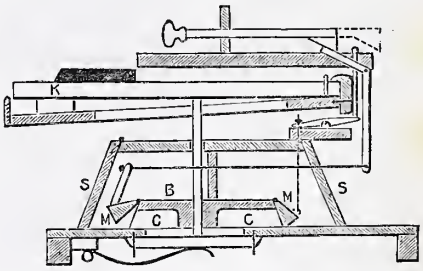
Mahogany Chair. Fig. 1.—Tenoning of Frame into Legs of Chair. Fig. 2.—Dowelling of Back Rail. Fig. 3.—Tenon to Back Rail.

rail (see Fig. 3). The rail below this is also tenoned into the standards. I suppose by an "ordinary wooden chair," you mean one suitable for rough usage in the kitchen, etc. The construction in such a case would be much more simple than that just described, and the different parts are more easily put together by an amateur. All the rails and the frame can be balanced into the legs instead of being tenoned in. Stiffening rails would most likely be needed between the legs. A plain wood seat screwed to the frame is sufficient. I am afraid I have no space here to give a list of tools, as most of the ordinary cabinet-maker's tools would be necessary to make a good job.—F. J.

Plumbing and Gas-fitting.—W. J. D. (*Montgomery*).—These subjects have not been dealt with in Work. When a thoroughly competent writer and practical worker can be found, arrangements will be made for papers on both subjects.

Work and Contents.—J. H. S. (*London, S.E.*).—Thanks for your letter. Some more ornamental wood turning shall be given as soon as convenient.

American Organ.—C. W. T. (*Leytonstone*).—(1) The stops are not "fixed to the reeds," but a piece of well-seasoned wood, of suitable size to cover the ends of the cavities in which the reeds are placed, is hinged to the top of the cavity-board, so that when the piece of wood rests on the edge of the cavity-board, no wind can enter the cells containing the reeds. In order to make the contrivance effective and silent, a spring to close it, and cloth or leather to prevent noise and secure an air-tight fit,



American Organ Stop Action—C B, Cavity-Board; C, Reed Chambers; M, Mutes; K, Keys; S, Swell-Shades.

are added. The draw-stops are connected with these so as to open them at pleasure. There are many ways to unite the draw-stops with the "mutes" just described. Probably C. W. T. can arrange a wire to each, so that the drawing of the wire will open the mute, and relaxing the tension will allow the spring to close it again. (2) The swell is managed in a similar manner to the stop action; but the swell may enclose several sets of reeds, and is generally arranged so that the swell-cover may be lifted by the player's knee. There may, of course, be a stop knob, marked *forte*, to open swell-cover, in which case the knee action is, for the time, superseded. By an arrangement of levers the mutes may be raised by the player's knee, when the stops not in use because the draw-stop is pushed in become available as long as the knee pressure continues; as soon as the knee is withdrawn the stops, drawn again, govern the reeds as usual. The sketch sent is a suggestion.—B. A. B.

Motor.—First Start.—I am sorry to hear that the little motor you have made from the paper in Work, Vol. III., No. 154, p. 785, will not go. In the first place, you have put far too much power into it. I should not like to put a battery of twelve cells on to the one I made to write the paper upon; two or three single-fluid bichromate cells are quite enough to make it go well. Are you sure you have got it connected up properly? Try it with two cells independently—that is, one cell on to the binding screws from the magnet, and the other cell on to the binding screws from the armature; then see that your brushes are in the right place: you will find you will have to bend and adjust them; don't let them press too hard, but see that they make contact all round. If the armature touches the magnet, it will be held tight; to prevent this, unscrew the button on top of the magnet and set it back a little, then screw it up tight again; I think it ought to go then. If you think your winding is faulty, you can test it with a galvanometer; I should not do it with a bell. If you have not got a galvanometer, look in the index to Vol. III. of Work, and you will find how to make one that will do very well for testing purposes of any kind.—J. B.

Motor.—R. W. Wright, Jr.—If you use about 30 yards of wire on the magnet for the model in Work, Vol. III., No. 154, p. 785, and about 20 yards on the armature, you will find it will work properly. There is a paper already in hand as to making your own batteries, carbons, etc., which doubtless will appear in due course.—J. B.

Staining and Matching.—J. M. (*Manchester*).—A similar query to yours is answered under the same initials and address in our issue of December 26th, p. 652, No. 145, Vol. III., which, if you will read, will give you the information you require without fully repeating it here, except that I may further add that the desired result may also be gained by wiping over with a solution of common washing soda; or by wiping over with a weak brown stain, made by mixing a little vandyke brown into a thin paste with liquid ammonia or a solution of pearlash, then thinned down with water till the required shade is obtained, and using a little coloured polish.—Lifeboat.

Ebony Stain.—Vulcan.—The French black stain is sold by most veneer merchants, including Mr. Kingston, veneer merchant, Pershore Street, Birmingham, and most druggists and gum merchants at 1s. per pint. Stephens and S. Jackson & Sons can supply you with ebony stain either in liquid or powder. I am sorry I cannot recommend you to any place nearer home, unless you try the Yorkshire Varnish Co., Limited, Ripon, and Mr. H. O. Milnes, Bradford. The ebony stains in general use are suitable for most woods, including yellow pine. Should you prefer to make your own, you will find full particulars in "Shop," under Ebony Stains, p. 332, No. 125, Vol. III., August 8th, 1891 issue.—Lifeboat.

Heating Greenhouse.—Novice.—The water will not circulate if you carry the pipes below the level of the boiler, and I do not see how you can avoid doing so without carrying the pipes round the kitchen; in which case the loss of heat from radiation in the kitchen would prevent the greenhouse from getting warm. It is far better to have an independent boiler for the greenhouse, as the kitchen fire is generally out, and the pipes cold, at the time when warmth is most required—*i.e.*, the early hours of the morning. Any ironmonger will supply you with a gas heating boiler for small greenhouse, which you can connect for yourself. You do not give the size of greenhouse, but, judging from the sketch, I should say the size of pipes you propose would do very well.—T. W.

Incubator.—H. S. (*Dalston Lane, N.E.*).—Articles on "How to make an Incubator" appeared in Work, Nos. 89 and 143.

Induction Coils.—Anti-Procrastination.—These articles are appearing in the fourth volume of Work.

Designing for Furnishers.—E. C. M. (*Portadown*).—Your designs indicate no talent whatever. You have evidently never learnt drawing. Work hard at this in your spare time, and you may some day be able to submit good original designs.—Ed.

Cottage Specifications.—Theo d'Olite.—(1) "Is it usual to use pressed bricks for cutting and rubbing?" No, it is not usual; but it is better for pressed bricks to be used, as the bricks generally used for rubbing and cutting are usually composed of about 75 per cent. of sand, which makes the bricks absorb more water, and when they come in contact with frost—which they cannot help doing—the frost, when it thaws, enters the pores of the bricks, and thus splits or, rather, cracks them, rendering them utterly useless for their work. I have seen myself where they have been used for arches, and within twelve months after they have had to be removed, and pressed bricks inserted in their place. Pressed bricks have an advantage in being hard and durable, and they can resist more pressure or strain upon them than "rubbers." (2) If Theo d'Olite will kindly look at the drawings, he will see plainly that I have shown in my design all that he mentions in his letter. What I have not mentioned in the specification is plainly described in the drawings. If I had to write a full specification of works required in their erection, it would occupy at least two numbers of Work. As a rule, architects never mention every little detail in their specification; they say, as shown in drawing No. so-and-so. When Bills of Quantities are taken out, then every item is entered in detail, mentioning their length, height, and width. (3) "Is water required to mix the mortar, and who is to provide it?" Of course, water is used to make proper mortar; and as regards who is to provide it is a question of detail. As a rule, the contractor has to, and it is charged along with wear and tear of tools and scaffolding. (4) "Would a 9 in. wall be absolutely damp-proof?" If you will kindly note, I have mentioned, "Lay a damp course of pitch and tar, well boiled, or a layer of roofing-felt well soaked in pitch and tar, throughout the length and thickness of the walls." A 9 in. wall, faced with pressed bricks and a damp course, as above, is perfectly damp-proof. (5) "Could two contractors be fairly expected to tender from the specification in the matter of joiners' work?" Yes, if they had the same drawings and specification, and knew their business.—W. B.

Gold and Stone Tests.—Learner.—The articles on ear-rings appeared in Nos. 106, 111, 115, in Vol. III. of Work. Look out for an article on Gold Tests. Your other query as to testing precious stones and pearls will be answered in a future number.—H. S. G.

Electricity.—A. M. (*Glasgow*).—Messrs. Cathcart Peto's address is Hatton Garden, London.

Working Drawings for Violin Making.—E. E. W. (*Abergavenny*).—The writer of instructions for violin making will furnish you with a set of full-sized working drawings for 2s. 6d. The address is in the advertisement columns of Work.—B.

III.—Questions Submitted to Readers.

**** The attention and co-operation of readers of* Work *are invited for this section of "Shop."*

Lathe Attachment.—Learner writes:—"Can any reader kindly give instructions for making a fret-saw attachment to a 4½ in. centre lathe?"

Oil.—Learner writes:—"What is the best way to cleanse a bottle which has contained oil?"

Ice Safe.—Butcher writes:—"Will some reader kindly advise as to the filling of the interstices, 4 in. wide, of an ice safe that my carpenter is building for me, 6 ft. by 4 ft. by 7 ft. high. Sawdust is objectionable, it gets damp, then smells badly, and charcoal is too expensive. Also which is the best method of placing the ice to produce the coldest and driest air?"

"Woodite."—C. (*Londonderry*) writes:—"This substance is used upon or behind armour plates, and by its expansive properties closes shot-holes automatically. What is its composition? How is it applied and kept *in situ?* Where can it be obtained?"

Camp Cot.—F. K. (*Staveley*) writes:—"Would any kind reader of Work give me instructions how to make a camp cot—one to fold up? I want to make it of wood, to rest on legs."

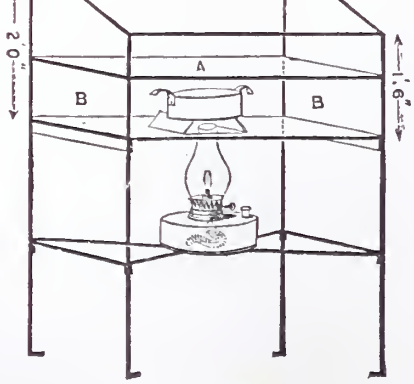
Razors.—J. P. (*Claydon*) writes:—"Can any reader tell me the stone to use, and the best method of setting a German hollow-ground razor, and whether oil or water should be used?"

Lubricating Oil.—Spot writes:—"Will any reader say what is the best oil for lubricating with, or how to make a lubricating oil that will not corrode?"

Puzzle Money-Box.—R. S. H. W. (*High Wycombe*) writes:—"Would some kind reader of Work give me a design for the above in fretwork? Also for a monogram for R. S. in the same."

IV.—Questions Answered by Correspondents.

Plant Propagator.—Cawd Hud writes to Barra (see No. 161, page 78):—"Construct an ordinary box frame of 1 in. boards, say 3 ft. 6 in. by 2 ft. Let it be 2 ft. deep at the back and 18 in. in front. Nail strips of 1 in. wood all round the inside about 9 in. from the bottom, and fix two cross-bearers, 2½ in. in width, on a level with the strips. The bearers must be placed edgewise for strength. On these fit accurately a piece of galvanised sheet iron, which must be thoroughly perforated with fine holes. Now nail boards closely all over the bottom of the frame, and cut a circular hole 3 in. in diameter in the centre of the bottom. The lower board at the back must be made movable, by sliding or otherwise, to afford access to the lower chamber, wherein is placed a shallow metal vessel about 18 in. square, which must be kept nearly full of water, supported on two bricks, laid flat. Lay three inches of cocoa-fibre or sphagnum moss on the false bottom of galvanised iron, and place the whole on four stout legs. Take a paraffin oil lamp, having a 3 in. wick—to be used for obtaining heat—and stand it so that the lamp chimney protrudes through the circular hole, and within two inches of the metal vessel. Have your seeds, etc., in boxes, and place them on the fibre or moss, which must always be kept moist. Put on your sash, and having lighted your lamp, you should have no difficulty in maintaining a heat of 70° or 80°. If your propagator is to stand outside, you will require to nail boards round the legs to screen the lamp, or it will be blown out by the wind. Mind the ventilation."



Plant Propagator—A, False Bottom; B B, Vapour Chamber.

Photo. Frame.—A. S. (*London, W.*) writes:—"Seeing W. W. (*Wokingham*) inquiring for a photo. frame that appeared in No. 152 of Work, he may like to know that I got E. W. Wise, of Chiswick, to make one for me. He enlarged the design."

V.—Letters Received.

Questions have been received from the following correspondents, and answers only await space in Shop, upon which there is great pressure:—S. & Co. (*Blackpool*); H. F. M. (*Ramsbury*); L. M. (*Roscrea*); C. C. (*Norwich*); L. W. (*Kettering*); F. C. B. (*Blandford*); W. P. (*Dartford, Kent*); A Kerry Lad; M. E. (*Renfrew*); R. A. de P. (*South Kensington*); Corescrew; W. J. P. (*Lines*); J. W. H. (*London*); H. W. H. (*Heathfield*); D. W. (*King's Cross*); R. B. P. (*Dartmouth Park Road*); W. B. (*Wirksworth*); Faraday; Dynamo; A. B. D. (*South Shields*); In Duplis; A. T. (*Bollington*); Walnut; H. T. W. (*Cardiff*); A. L. (*Dewsbury*); F. C. B. (*Deptford*); H. (*Sunningdale*); S. W. (*Glasgow*); S. W. (*Cardiff*); Saint Mungo; W. N. (*Lincoln*); E. D. (*London, W.*); Mechanic; Amateur Screws; H. J. (*Liverpool*); G. H. (*Sheffield*); Drill; Royal College; Horologist; H. B. (*St. Peter's Park*); Padiham; An Old Subscriber; Donovan; D. A. L. (*Bacup*); W. S. (*Havant*); D. J. E. (*Bryhmaur*); J. G. S. (*Barbados*); D. W. H. (*Tredegar*); A. G. (*Sheffield*); D. J. C. (*Ipswich*); Bookcase; W. S. P. (*Bilston*); B. B. (*Hillsborough*); A. P. M. A. (*Stretton*); J. T. M. (*Burnley*); Jules; J. E. (*Deptford*); J. B. (*Moss Side*); A. B. (*Middlesborough*); A. J. H. (*Brixton*); F. H. W. (*Southampton*); G. S. L. (*Strangeways*); T. C. (*Dewsbury*); S. T. (*Londonderry*); P. B. (*Bolton*); Constant Current; Stager; Dynamo; J. R. (*New Brompton*); E. F. B. (*Darlington*); Barnet; J. P. (*Chester-le-Street*); D. McD. (*Glasgow*); D. B. (*Glasgow*); W. T. (*Houghton-le-Spring*); O. B. (*Hanley*); One in a Fix; A Reader.

"WORK" PRIZE SCHEME.

Next Week's Work (*No.* 168) *will contain full particulars, rules, etc., of the* First of a Series of Competitions *in connection with the* Work Prize Competition Scheme. *The Editor will be obliged if his Readers will assist in making these Competitions known amongst their friends, with a view to their becoming permanent.*

SALE AND EXCHANGE.

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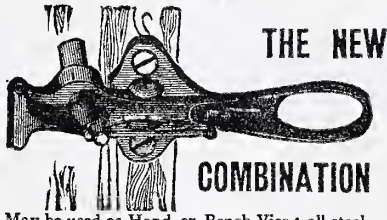

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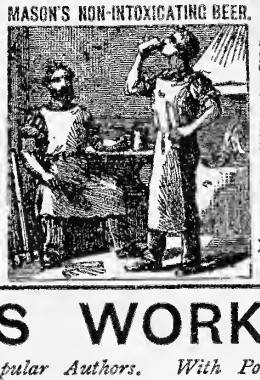

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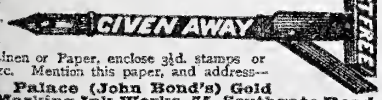

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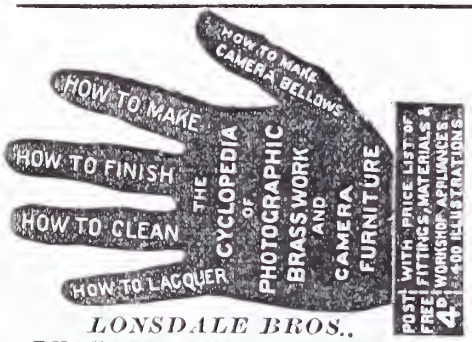

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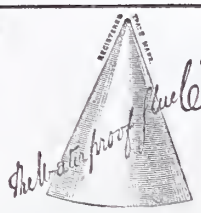

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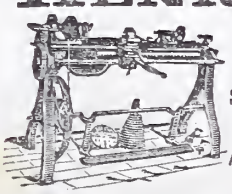

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Castings, Forgings, and Fittings supplied for the ½-h.p. Horizontal Steam Engine described in WORK by F. A. M.

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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VOL. IV.—No. 168.] SATURDAY, JUNE 4, 1892. [PRICE ONE PENNY.

WORK WORLD.

A CIRCULAR saw of an original design has just been brought out. It will cut and plane simultaneously any kind of wood by the same action as an ordinary circular saw, the result being a very smooth surface.

* *

Fire escapes are welcome. A new one consists of a light iron balcony which is affixed to a French or other window. On the floor of the balcony is a trap-door, which, on being raised, causes a telescopic ladder to slide down to the ground, thus affording a simple and novel means of escape.

* *

A considerable number of voting machines have been patented both in this country and America, and in the latter one has now been brought into use. The voter presses a knob labelled with the name of the candidate he supports; the registering is automatic. The votes given for sixty-four candidates were counted in ten minutes at the close of the poll.

* *

A novel method for connecting metal pipes to earthenware sanitary goods consists of lead union sockets or joints. They are cast with a thread, and a corresponding thread is made on the closet traps and other fittings; a thin coat of paint is stated to be all that is required to make a perfectly sound joint. We await with interest the result of more extended use of these fittings.

* *

An Aberdeen engineering firm has effected a curious alteration in its working hours. Previously the hours, all over the trade, were from 6 a.m. till 5.30 p.m., but till 1.30 p.m. on Saturday, thus making a 9½ hours' day and a 54 hours' week. These hours have been altered to from 6 a.m. until 6 p.m., and until 10 a.m. on Saturday, thus giving the workmen nearly a whole Saturday, and still keeping the number of working hours in the week at 54.

* *

One of the greatest railway engineering feats of modern times was the alteration in the gauge of the Great Western Railway from Exeter to Plymouth. Two days only—Saturday and Sunday—were allowed for the alteration from broad to narrow gauge of 160 miles of line, and 5,000 experienced men were engaged in the work, which was carried out during the night as well as the day. Hundreds of tents for sleeping in were pitched alongside the line, and the traffic was suspended during the two days, arrangements being made for carrying the mails by post coaches.

* *

The Worshipful Company of Saddlers of the City of London has arranged for an important exhibition, to commence June 10, of old and historic saddles from various parts of Europe and this country. We shall see the sort of saddles cavaliers of old used and maintained their seats, with a half or three-quarters of a hundredweight of iron cased over them. Our hunting men may, perhaps, be able to compare the modern saddlers' saddles with them, and find out how so many expert riders, on the best horses, at little fences, are killed or disabled for life.

* *

A new wheel of an enduring stamp for heavy work or extra hard wear is now being made. The ordinary wood naves and spokes are fitted with T-shaped girder tires that need no wooden felloes. The spoke ends are fitted with flanged sockets, the flanges being riveted through the mid-rib of the tire. The hardest wear cannot expand these tires, so the cost of contracting the tires and rejointing felloes, so frequently necessary with ordinary wheels, is obviated. Special steel is used, and the welding done by electricity, which makes an economy in first cost as well as in the double or treble durability of the wheel.

* *

Old amber beads are often of a very beautiful colour, almost like gems in fact. This colour is produced by age, and is an alteration of the surface of the amber—it does not penetrate into its substance. If the surface is removed by being polished, then the colour goes too, and with the colour much of the beauty and value. Since the surface cannot be interfered with without removing a property it may have taken fifty years to produce, it follows that scratches or breaks are better left in, and they should be unless the owner gives explicit orders to repolish, after he has been warned of the change that will take place. It is rare that repolishing spoils an article, but it would do harm in this one case, however it might improve the other nine hundred and ninety-nine articles out of a thousand.

* *

If proof were wanting of the usefulness of, or the enterprise in connection with, telegraphic resource, the last Oxford and Cambridge boat-race would afford an instance. The boat conveying the representatives of the press, which followed after the rival crews, carried on it a telegraphic instrument and a few miles of coiled cable. The one end of the latter was fastened to the instrument on board, the other to an instrument at the nearest telegraph office on land. Then, as the boat steamed after the crews, the cable was paid out, and all the time messages describing the race at various points were cabled to the Press Association offices, in each case within a minute after the crews actually passed them. The result was, many of the London clubs had almost continuous information about the race while it was going on; and newspapers with full accounts of it were being sold six minutes after Oxford passed the winning post.

* *

Many engineers having to drill and tap a hole, employ a drill just the size of the tap at the bottom of the thread. This is altogether a bad practice. The hole, say, that a ⅞ in. stud has to go into should be ·77 in., or $\frac{1}{25}$ of an inch larger than the tap at the bottom of the thread. In the operation of tapping, the tap does not cut at the extreme bottom of the thread, but other parts of the tap force the material—whether forged steel, wrought iron, soft brass, or copper—into form. Thus, after the tap comes out of the hole the diameter at the bottom of the thread is ·73 in., or smaller than it was before the tap went in. In the case of cast iron this rule should be strictly observed, so that the thread can be *cut* and not pressed into shape. If the hole is drilled the exact size of bottom of thread, the material being forced up will likely weaken the thread and cause it to break away. The best form for the thread in metal poles is for the bottom of the thread to be slightly flat

The Severn navigation improvement now affords means of carrying iron from Staffordshire to Bristol in barges taking over 100 tons of cargo, and drawing 6 ft. 3 in. of water. Iron is also being taken down the canal to Worcester.

* *

The supply of water from Lake Vyrnwy to Liverpool will commence about the middle of this month. It has been a really gigantic undertaking, and is now on the eve of completion. That Liverpool has taken a step in the right direction is shown by the action of Manchester, Birmingham, and London, who are all thirsting for a little of the dew off the mountains. The undertaking to supply Manchester with water from Thirlmere is already progressing.

* *

Datchet possesses veritable apostles of art in the Misses Palmer. Those who remember the first beginning of the embroidery class they started among the village girls, and the simple cotton smock sent to the Home Arts and Industries Exhibition—the first time they sent specimens of their work, was it four or five years ago?—and have watched the gradual progress from season to season up to the production of the exquisite Greek lace, needlework of various kinds, delicate smocking and embroidery, of which large quantities are now exhibited and sold every year, have a splendid proof of what, under able and artistic instruction, our village people may show themselves capable. The recent Industrial and Art Exhibition, consisting of exhibits confined to the work of the villagers of the place, was exceedingly creditable.

SEWING MACHINES: HOW TO BUY AND USE THEM.

BY CYCLOPS.

Introduction.—The history of machinery, from the very earliest period down to the present day, has been a history of rapid advancement. In whatever branch of science we study, we find that there have been inventions and discoveries which have been at once the stepping-stones and landmarks of its rise and progress.

Of all mechanical inventions we are bound to give to the steam engine the foremost place; for in it we see the laws of nature subjected and applied to the requirements of man in the most important direction—the concentration of energy into motive force; and what the steam engine is in our workshops, the sewing machine has become in our homes.

Over all domestic machinery and appliances the sewing machine stands pre-eminent. In its present perfect form it is the outcome of years of careful study and experiment, and as a piece of mechanism swift, sure, and yet delicate in its action, it is without a rival.

While the immortal Howe was spending the best years of his life in the invention and construction of a "machine to sew," the "Song of the Shirt" was being sung over the wretched employment of the seamstress, accomplishing, by sheer manual yet sedentary work, what was destined, through the labours of that great inventor, to be in the future accomplished swiftly and surely by the application of machinery. The first sewing machine of Howe, when looked at by the side of the present perfected form of machine, falls into insignificance. Its complicated details of construction—details far more complicated than are to be found in the best machines of to-day—accomplish very little more than was accomplished by the old method of hand-sewing; yet in it we see the first application of mechanical laws to do the work which was formerly done by what had become the almost instinctive action of the human hand.

The ice was broken, and inventors were not slow to follow up the scent, and contrive improvements on Howe's system, which gradually brought the sewing machine into the position in which we see it to-day.

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Sewing Machines. Fig. 1.—Wilcox and Gibbs' Chain-Stitch: Section through Sewing. Fig. 2.—Ditto, ditto: Top View of Stitch. Fig. 3.—Ditto, ditto: Under View of Stitch. Fig. 4.—Lock-Stitch: Section through Sewing. Fig. 5.—Top and Under View of Lock-Stitch.

Object of these Papers.—The sewing machine has become such an indispensable piece of furniture in every house, that a series of articles giving some information on its various principles and construction will, no doubt, be of interest to the many readers of WORK; and in bringing before your notice the following remarks on sewing machines and their maintenance, the writer hopes that they will be useful to readers at least in two ways. First, to those who have anything at all to do with sewing machines they will give some insight into the working, adjusting, and repairing; and secondly, to those who may not have anything to do with these interesting machines, but who may be wishful to make themselves acquainted with the principles which govern their action, they will, no doubt, be of service.

Two Leading Principles.—The great principle of all sewing machines is the binding together of two or more textile fabrics, or parts of textile fabrics, by means of a thread or threads; and in the consideration of the principles in which sewing machines work, they are naturally divided into classes by the manner in which the cotton or thread is manipulated to obtain the desired result. So that we can at once set out by dividing machines into two classes: those producing work by what is called the chain-stitch, and those producing it by what is known as the lock-stitch.

Chain-Stitch.—Chain-stitch is distinguished from lock-stitch by its necessitating the use of only one thread, which, by the action of the mechanism of the machine, twists itself into the material to be operated upon in such a manner as to give on one side the impression of a chain. Fig. 1 shows the formation of the stitch through the material, Fig. 2 shows the top view of stitch, and Fig. 3 shows the bottom view.

It will not be necessary for us to go any further into a description of the formation of this stitch here; it will be fully described in our second paper on the Wilcox and Gibbs' machine, which is really the only well-known chain-stitch.

Lock-Stitch.—In this principle there are two threads employed, the top contained on a bobbin and running through the needle, and the bottom contained in a shuttle, which runs through loops formed by the top thread, or in a spool round which the top thread is directed by the hook-holder which carries the spool. These two threads lock each other in the centre of the material, hence the name "lock-stitch."

Of these machines there are an innumerable variety on different principles. Some have reciprocating shuttles carrying the bottom thread, some have rotary shuttles, and some have stationary shuttles or spools. These will be treated under their different headings further on.

The formation of stitches on the lock principle is illustrated in Figs. 4 and 5. Fig. 4 shows the formation through the material, and Fig. 5 the appearance of the stitch on the top and under side, which are, when properly adjusted, both alike.

In our next paper we shall deal exclusively with the Wilcox and Gibbs' chain-stitch sewing machine, which, in its construction and arrangement, is a really beautiful sewing machine.

AN ORNAMENTAL SHELF BRACKET.

BY J. LUKIN.

THE present design is introduced to call the amateur's attention to a system of decoration in which the lathe as usual bears an important part, not in respect to pilasters and similar cylindrical work, but in the preparation of mouldings and surface or plankwise turning. This is, perhaps, as easy as the other method, but not unless a judicious selection is made of the material to be used. Deal, for instance, although it may be pressed into service, is of too loose and open grain to allow fine mouldings to be cut clearly and sharply plankwise. Soft woods may be used, but only those of close grain can be moulded, even with sharp tools, without having recourse to that bane of good turning—sand-paper.

Of course, one may be frequently obliged to use unsuitable stuff, but if any fair quantity of turnery is proposed, it will always pay an amateur to buy what he really needs for his work, especially as none of the soft woods are expensive. Horse chestnut is a capital wood for many such works as that under consideration. It cuts clean, is not brittle, it will serve for screws to be cut in a screw box or in the lathe with a V tool, and it can be bought without difficulty at the saw mill.

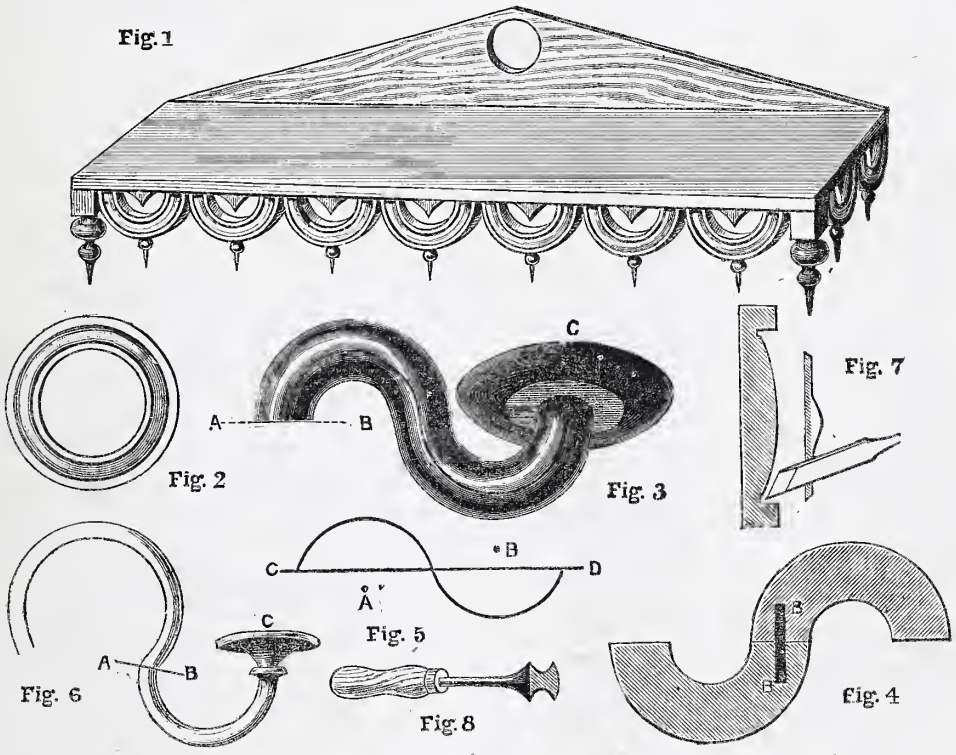
Then there is sycamore, largely used for making bread platters—silvery white or darker creamy white, according to age. It cuts well either plankwise or on the cylinder. There is little need in this cricketing age to declare the merits or to describe the peculiarities of the willow, of which the cricket bat has long been manufactured. It turns well, and is soft and easy to cut, while the grain is close and even—and in these qualities it is closely allied to the lime. Either of the above is preferable to deal for face work, and all are largely used by the soft wood turner. Just now it is the fashion to ebonise furniture of various kinds, brackets and shelves included, and it is for this reason that those woods should be selected which show but little of their fibrous nature; ebony being of that uniformly black and even surface which cannot be imitated by coating with a black stain wood which has a figured or conspicuous grain.

I might have included in the list of suitable woods both beech and birch, the latter being the softer of the two; but these have more conspicuous grain, and are better suited for work that it is not proposed to ebonise.

These are very valuable woods, and for general purposes can hardly be surpassed. There is, therefore, ample choice of material, obtainable at low cost, either in London or in the country; nor is there any great difficulty in obtaining it dry and well seasoned. So now let us get to work.

The bracket shelf entire is shown in Fig. 1. The size is unimportant, as it is made, generally speaking, to fit into a space designed for it. I may state here, however, that if designed for a study, and intended to be something more substantial and useful than a mere bracket, it should be entirely of oak, polished or otherwise, and the actual shelf ¾ in. thick to 1 in., according to length and width proposed. No oak furniture will look well if of thin stuff—oak suggesting massiveness and solidity.

We are, however, supposed just now to be dealing with material less substantial, and which may, therefore, be thinner. Deal will answer well for shelf and back, and one of the other woods for the semicircular pieces of the hanging border. It is of the latter that I wish to treat in detail, as they open up a field of special design. To form them as drawn here, a piece of board is to be taken and a square of it cut off, from which the corners had also better be removed or they may strike the lathe bed. As to size, the height of lathe centres will set a limit in one direction, and with regard to thickness it should be that of the shelf, so as to admit of somewhat deep cutting to produce bold and handsome-looking mouldings. Mount the piece on the taper screw chuck, taking care that it beds down truly against the face, and level the wood with a gouge. If it is a bit of planed stuff a light cut all over should suffice for this. Now determine the outside measurement, and at the point thus decided apply a parting tool held horizontally upon the rest, and cut a circular groove. Shift the tool its own width from time to time, to give it ample room, sideways, that it may not jam itself and get broken; and, thus deepening the cut, the outside part will soon be severed in one piece, leaving a circular disc for the formation of the necessary ring, shown in a finished state in Fig. 2. In the remainder of the work I must premise the possession of very keen tools—gouge and chisel. It is of no use to try and turn face work unless the bevels are long and flat. A short bevel to either gouge or chisel will answer perfectly for hard wood but not for soft, and a rounded bevel cannot be made to produce a keen edge by application to the oilstone. To proceed, turn the edge of the disc, where it was left somewhat irregular by the parting tool, quite smooth and level. Gauge the size with the callipers or a band of paper or tape, and keep an exact record of it as a guide to the size of all the other pieces required. Decide also upon the width you wish to give the moulding, hold a pencil against the face of the piece, and mark the width as it revolves in the lathe. At this mark apply the parting tool and cut a fairly deep groove, but not so as to obliterate the pencil mark, nor so deep as to endanger cutting through the wood. Now with the same useful tool mark the outer and inner fillets between which a rounded part appears in the drawing. A carver's V tool or a *soft* wood parting tool will do this even better; but that used for hard wood will do almost equally well, especially as these grooves are made merely to define the position of the mouldings, and to form a guide for the gouge and chisel. Let the fillets in this case remain flat and of square section, and round the central part only. Lay the chisel quite flat upon the rest, just touching, at first, the highest part of the curved surface, and from this position carry its keenest angle gradually down on one side of the curve, so that this edge may clean out the angle following the groove cut by the parting tool (see Fig. 7). Then turn over the tool and work into the other angle. Let there be no undue hurry, and let the cuts be light; and for the final ones, after the rounded part has become nicely formed, *begin* at the lower part with the keen angle, as before, in the groove, and work with a steady traverse *up* to and just beyond the summit; then turn the chisel over and begin in the same way in the other angle, and proceed till the cut made beyond the centre is just met and passed. This should make a good surface of the rounded part, but if not take another or more cuts either way till the contour is an even curve with no flat at the top or side, and then turn your attention to the outer fillet, of which the inner edge will want a touch of the chisel to finish it. This can be done in an instant if the chisel is set on its edge upon the rest, but I may warn the reader of danger of a "catch in," and rather advise that the tool be still laid flat upon its side so as to use the acute angle of it only. If needed it must now be papered, which will be of no hurt to a rounded surface like the present, and if a bit of the finest No. 00 is used, and folded sharply, it can be also made to enter and clean up the deeper part. But sand-paper, remember, will not render even a badly cut surface, and if flats were left flats will become visible in certain lights, therefore, let due care be taken not to produce them by an unskilful use of the chisel. Speaking of this tool leads me to observe that if the original piece of wood is unduly rough, or a larger moulding needed, such as in the decoration of substantial oak shelves, it will be necessary to commence with the gouge, which must be upon its side with its hollow towards that part which it is approaching, so if cutting, as in Fig. 7, down the left side of the rounded part the hollow will also be towards the left. But care must be taken when it gets down into the angle not to let its edges catch and tear the face of the adjacent fillet. This will to a certainty happen if they come into contact with it. The entire ring has now to be separated by deepening the cut first made by the parting tool. The inside disc or core may, of course, be sacrificed, and therefore



An Ornamental Shelf Bracket. Fig. 1.—Ornamental Shelf Bracket. Fig. 2.—Turned Ring ready for cutting. Fig. 3.—Ring cut and re-united. Fig. 4.—Section of same. Fig. 5.—Rings cut on a Diameter. Fig. 6.—Rings cut beyond Diameter. Fig. 7.—Position of Chisel. Fig. 8.—Ring Tool.

the groove may be widened towards the centre as the cut proceeds, so as to allow the cut to be made clean and true on the ring part. If carefully done, matters may be so managed that when at last the ring falls off it will need no more to be done to it, otherwise it will have to be again mounted in a hollow or cup chuck of wood or metal in order to still further finish the inside edges. If it is so intended, the best plan is to use a wooden barrel stave chuck with outside rings, which will securely hold all the rings in succession. A self-centring iron chuck of sufficient size is too heavy for a good lathe, and should not be used if it can be avoided.

The ring thus finished, as many copies of it are to be made as required, *i.e.*, half the number of the semicircular pendants which form the border of the bracket, and these are to be sawn across the diametrical line quite squarely into halves, so that all shall be exactly alike. There is no difficulty in doing this accurately, but it may be facilitated by marking out upon a sheet of paper a circle of the same size as the ring, drawing a diametrical line through its centre, and then, standing the ring upon it, pricking upon each side the ends of this line, and by the help of a set-square marking on both faces and edges of the ring the guide line for the saw cut. Such line may be marked, if preferred, while the work is in the lathe, before the final cut is taken, the T of the rest raised to height of centre serving to rule such mark across its face. In any case use a square to carry the line down and across the edges, that the cut may be accurately square to the face of the work, otherwise the semicircular pieces, when glued on, will not lie in the same plane, but will lean this way and that and spoil the appearance of the shelf. There is little that need be said about the corner pendants, which are turned in the usual way, as are also the smaller ones depending from the semicircular pieces; but the latter should have short lengths of wire or needle points inserted to secure them while the glue is drying by which they are attached. The corner ones will have a good square base and will need no such pins, especially as the shelf will be laid bottom upwards on the bench while these ornaments are being fixed in place. The small triangular pieces may be of ½ in. wood. They greatly add to the effect by reason of their sharp angles and straight sides contrasting with the rounded forms of the adjacent mouldings. They are, of course, glued on, but it will be better to leave them till the rest are dry and incapable of displacement.

Such are the details of the shelf bracket, which will well repay the care and trouble needed to execute it in a satisfactory manner; but I have added a suggestion or two of other work requiring similar treatment so far as the lathe is concerned, such pieces forming the basis of a great number of designs in ornamental woodwork. They have, moreover, this advantage over the more elaborate ornamental turning, that they need no expensive chucks, tools, or other apparatus, but can be made by means of any plain and cheap lathe. Fig. 3 might represent the curved arm of a circular shelf to support a candlestick or vase of flowers, or might be the arm of a candelabrum, represented again in a lighter form in Fig. 6. This is turned in a manner similar to the ornaments of the bracket shelf, but entirely rounded like a large wooden curtain ring (which is similarly made). It may, however, if preferred, take the form of Fig. 2, but with precisely similar mouldings on both faces, the piece being reversed for this purpose in the chuck so as to bring the second face under the action of the turning tools. If, however, the form of Fig. 3 is to be followed, it will be necessary, after working both faces, to place the ring upon a wood mandrel or outside a chuck in order to finish more neatly the outside part of the curved surface. It may even need to be mounted, finally, inside a barrel stave or cup chuck so as to get at the inside of it. These rings, however, if made of hard wood, are formed by what is called a ring tool. This is a double bead tool like Fig. 8, one edge cutting the outside and the other the inside of the ring each to a true semicircular section. For stouter work and soft wood this tool is unsuitable, and the chisel and gouge are often followed by the rasp and file after the work has been removed from the lathe, sawn in half and glued together. To secure the parts glue alone is not sufficient, but a pin must be inserted, as seen in the section Fig. 4. The hole for this must be very carefully made at right angles to the sawn faces, which will not otherwise get truly together. Made thus, the whole serpentine arm is as strong as if it consisted of one solid piece. Fig. 5 is drawn to show the effect upon the entire curve of sawing off a part of each after dividing the ring into two pieces; A and B are here the centres, but only the part above and below the line C D is used. This makes a nicer curve than that formed by two entire semicircles. In Fig. 6 another effect is produced by making use of two different sized rings and taking of each more than the semicircle. The arches being thus of a horseshoe form, there is an angle or elbow at the line A B. Sometimes at the part where the pieces join there is inserted a round disc of wood, and at other times a round ball is bored so as to slip on and conceal the joint. It must, of course, be placed in position at the time the pieces are being glued up. Many devices are used to lend variety to this class of work, and there is ample room for the exercise of taste and skill; but in all cases it is of paramount importance to ensure good and close contact between the ends of the semicircular parts, as no more than a faint line should be visible at the junction. For this reason, too, the glue must be good and somewhat thin, not daubed on as a sticky mass, which does but keep surfaces apart, but laid on neatly with a small brush while it is boiling hot, and all that runs out of the joint is to be at once wiped off with a bit of sponge dipped in hot water. Such curved work cannot be clamped together but may be pushed up close by hand, and if it is well fitted the peg or pin will hold it securely till dry.

BOOT AND SHOE MAKING.

BY WILLIAM GREENFIELD.

Buying the Tops (or Uppers)—Selection of Leather for the Bottoms—The Way to Wet, Flesh, Dry, Buff, and Hammer it—To Fit Inner Soles, Stiffeners, and Side Linings—Explanation of Terms and Tools.

Buying the Tops (or Uppers).—Fig. 1 is a gent's lace (or Balmoral) boot. No. 3, for light work, is cut from calf-kid, levant, seal, memel, calf, etc., and 4, 5, and 6 are cut from French calf, krup, patent, etc. For stouter work, we use English calf, porpoise, etc.; and for very heavy best work, memel, cowhide, stout porpoise, neat's, etc. For rough working kip is employed. I only illustrate this kind of boot, but there are many others, such as button, elastic, bluchers, Derby bals., etc.

Lace shoes (Fig. 2) are termed Oxford shoes. Then there are button shoes, elastic shoes, tie shoes, etc. The following list indicates the prices of a few of the most generally used uppers:—

	s.	d.	s.	d.
Gent's bals., kid leg, calf (French), gol. and cap	5	6 to	7	6
Gent's bals., kid leg, calf (French), pieced gol.	from		3	6
Gent's calf Derby bals. ... ... from	3	6 to	5	6
Navvy water-tights, kip			5	6
Gent's elastic, goloshed	3	0 ,,	5	6
,, ,, military, French calf ...	6	0 ,,	7	0
,, ,, ,, kip	3	6 ,,	5	6
,, kid button, French calf, gol., etc.	5	0 ,,	8	0
,, calf Oxfords (caps 6d. extra) ...	3	0 ,,	4	3
,, kip ,, ...			2	6
Women's all calf kid button, worked holes, 7 buttons			4	6
Women's all calf kid button, worked holes, 9 buttons			5	6
Women's all calf kid button, worked holes, 11 buttons	6	6 ,,	7	6
Women's lace, same height, about 4d. and 6d. less than button				
Women's Oxford shoes, lace and button	2	6 ,,	4	6

Selection of Leather for the Bottoms.—The stuff for the bottoms (of a pair of boots or shoes, called a set of stuff, consists of insoles, outward soles, welts, stiffeners, lifting—according to height of heel*—top pieces, shank pieces, side linings, and felt.

The cost of a medium-sized gent's "set" should be somewhat as follows:—The insoles, cut from shoulder, 5d.; outer soles—a pair of long soles—1s. 6d. These should be cut from English butt leather, and should not be either very yellow or red, but a pale nut brown—the two former coloured leathers being foreign, the latter English. The English leather should have a very fine epidermis, or grain, it being a thin layer only, while the fibrous tissues of the dermis (the true skin) should be very firm, close, fine, and of a nut brown colour. If gent's soles are cut in one piece they are called squares; whereas ladies' soles are always cut in one piece, and are named springs. Welts consist of a long strip of oil-dressed leather about ¾in. wide, and cost—women's, 1d.; gent's, 1½d. and 2d. Other parts are stiffeners, cut from shoulder or middle—3d.; lifting, from first cut of butt leather, three pair, about 6d.; top pieces, which must be the same good and solid butt leather as soles, cost 4d. per pair. Gent's soles are not cut long enough to go right through the heel. We therefore need a piece of sole leather to splice on to them; it need not be very good, and with the side-linings will cost about 3d. The prices quoted must serve only as a guide, for much will depend upon the class of boot or shoe you intend to produce.

The Way to Wet, Flesh, Dry, Buff, and Hammer it.—Get a pan of clean water, and put the insoles, outer soles, stiffeners, lifts, and top pieces in it, letting the water cover them. Cut the welts straight down the centre, first making a mark with a pair of compasses to see that both sides are the same width; tie them up in a knot, and put them in the water. When these are perfectly wet through, they, with the exception of the welts, which have to be used wet, should be laid in a draught—not near a fire—to dry. The insoles require to be dried on the last. They must be marked out to the shape of the last with the sewing-awl (Fig. 3), cut in two, and the grain side buffed or scraped† while wet, and tacked on to the

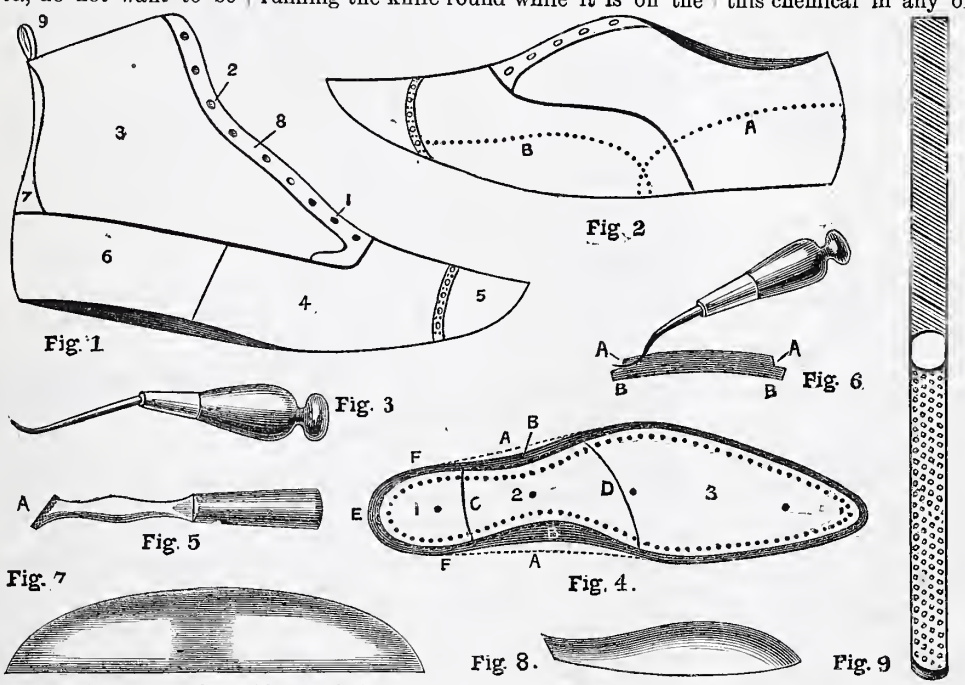
* The sole, split-lift, 3 lifts, and top piece will make about an inch heel; add one whole lift more for each ¼ in. required.

† The buff knife. How to make this will be explained when we have more need for it. A sharp knife held perpendicularly will suffice, or even a piece of broken window-glass.

bottom of the last with four tacks, as A, A, A, and A, Fig. 2 (see No. 165, page 130), and then the sides should be stretched all round with a pair of pincers, and tacked here and there to keep the leather tight to the bottom of the last till it is nearly dry; this is called blocking the insoles. Let the outer soles dry till they are only just mellow, lightly buff off the grain, and skive the thin layer of flesh or superfluous dressing off the back, and the same with the lifts and top-pieces. Then a lap-iron, or old flat iron without its handle, is wanted, and a shoemaker's hammer. Place the lap-iron on the thighs just above the knees, while seated on a low seat,* with its face upwards; hold the leather on it, grain side downwards, and hammer it all over, commencing from the centre, taking care to let each stroke be even, straight, and firm, and striking with the head of the hammer, so as not to bruise the leather. The lifts, etc., do not want to be hammered so hard as the soles and top pieces. Leather is hammered to make the fibrous tissues more dense, and thus more impervious to damp or water, and to offer more resistance to waste in wear.

To Fit Insoles, Stiffeners, and Side Linings. — When the insoles are nearly dry, carefully take out the tacks from the edge, and with a knife round each up to the shape of the last, save at the waist, where it must be made narrower than the last, as shown at B B, Fig. 4, where we suppose the dotted lines, A A, to be the last; then rub a little soap all over. This is to make the awl work better in making the holes. With a pair of compasses draw a line the whole way round from A, ¼ in. to ⅓ in. wide, and divide the sole into three sections by drawing the two lines C and D. This gives (1) the heel, (2) the waist, and (3) the fore part. This margin you have made should be a little wider at the waist; more so at B B than at the ends, and more particularly on the inside. The smartness of the waist depends upon this sweeping curve.

A boot, like a house, depends upon the foundation, for which reason the leather should be good of its class, and every care exercised to fit it properly. The line referred to should also be wider at E. This is done according to the range and pitch of the last. The more dead the last is in the waist, the more the heel will want under-seating—that is, it will want to be feathered wide and sewn under at E, and feathered narrow and sewn full at F and F, to prevent the heel, when built, from pitching on the breast. This line in its proper shape must be cut through to about one-third of the thickness of the leather, the knife being held perpendicularly. This must be opened with a prick-stitch tool (Fig. 5).* Cut the whole of this narrow strip of leather away: this leaves the feather—which must be of even substance all round the fore part—about two-thirds its original thickness. The waist can be thinner, and tapered towards the edge. The way to hole it is to make a second line from the feather in the same way as from the edge for the feather; then put the sewing-awl (Fig. 3) in at this line, and bring the point of it out on the edge of the feather, as at A A, Fig. 6. This is the transverse section of the insole, and shows the feather, B B. After the insole is fitted carefully, take it off the last, and notice that the edge all round on the grain side is quite sharp; this has to be taken off with a knife, but not too much, or we shall destroy the feather. Sometimes it is sufficient to scrape it, and it can be done by running the knife round while it is on the last. This needs more practice. If this is not done, and the foot is at all hot, it will curl up in wear and hurt the foot.



Boot and Shoe Making. Fig. 1.—A Gent's Lace Boot: (1) Eyelet, (2) Hooks, (3) Quarters, (4) Vamps, (5) Toe-cap, (6) Golosh, (7) Back-straps, (8) Facings, (9) Loop. Fig. 2.—Lace Oxford Shoe, showing position of Stiffener and Side Linings. Fig. 3.—Sewing-awl. Fig. 4.—Inner Sole, fitted and holed. Fig. 5.—Prick-stitch. Fig. 6.—Transverse Section of Inner Sole with Awl in position for holing. Fig. 7.—Stiffener fitted. Fig. 8.—Side Lining fitted. Fig. 9.—Shoemaker's Rasp.

Fig. 7 shows the shape of the stiffeners. They should be good, and used wet, that they may dry hard. For gent's they should be 1¾ in. high at the back: ladies', 1½ in. The length can be decided by measuring the tops. The dotted lines at A, Fig. 2, show about where they should come to. They must be skived all round on both sides, but not much on the grain side, or the stiffness of the leather will be lost. The leather should be skived or tapered to nil right round the top, but the bottom only to half its own substance; the dark parts of Fig. 7 show where and how it should be skived. The side linings (Fig. 8) can be of almost any kind of upper leather, though calf is best, as it is an oil-dressed leather. The dotted line in Fig. 2 indicates its position in the boot or shoe; the dark parts in Fig. 8—as in the stiffeners and fittings—show where they are to be skived.

* A stool can be made by cutting four or five inches off the four legs of an old chair.

* This tool is generally made from the handle and shank of an old iron table-fork, and sharpened to a blunt edge only, as at A.

PRINTING ON BROMIDE PAPER.

BY G. P.

Developing Solution—Development—Fixing—Blisters: How to Cure—Printing Clouds in Bromides—Mounting—Conclusion.

Readers interested in photography may remember that in Work, No. 164, I commenced a description of a process of photographic printing under the above heading. I had got as far as "Exposing the Paper," when our "Speaker" called for an adjournment, and I had perforce to obey. Before picking up the connection, I ask my readers to again read my former communication (see Work, No. 164, p.114), so that this continuation may be better understood.

Developing Solution. — Bromide paper may be developed with either ferrous oxalate, eikonogen, or hydroquinone, but never with pyro.; indeed, the slightest trace of this chemical in any of the solutions will stain the prints; so be careful. Ferrous oxalate is generally used, although eikonogen is now coming into favour, it being recognised by the highest authorities to be superior to ferrous oxalate. Even Mr. Lyonel Clark admits that "it is most suitable for this class of work, and, in fact, entirely replaces, and is much superior to, either ferrous oxalate or quinol [hydroquinone], the two developers which have hitherto held this place in the dark room." I give here formulæ for both ferrous oxalate and eikonogen developers, so that the reader may choose for himself. My reason for not giving formulæ for a hydroquinone developer is: most of the workers with bromide paper opine that hydroquinone is somewhat inferior to either ferrous oxalate or eikonogen for development of bromide papers.

Ferrous Oxalate Developer.

Oxalate Solution.

Potassium oxalate (neutral) ...	16 ozs.
Hot water...	48 ozs.
Acetic acid	3 drams.

Iron Solution.

Iron protosulphate	16 ozs.
Hot water	32 ozs.
Citric acid	¼ oz.

Bromide Solution.

Potassium bromide	1 oz.
Water...	40 ozs.

These solutions to be mixed as follows: For long exposures and light tones: oxalate solution, 12 drams; iron solution, 1 dram; bromide solution, 1 drop. For short exposures and black tones: Oxalate solution, 12 drams; iron solution, 3 drams; bromide solution, 30 drops.

EIKONOGEN DEVELOPER.

Eikonogen Solution.

Eikonogen	100 grs.
Sodium sulphite*	400 grs.
Citric acid	30 grs.
Boiling water (distilled)	10 ozs.

N.B.—Dissolve the sodium sulphite and citric acid in the water, then add the eikonogen. Be sure the sulphite is dissolved before adding the eikonogen.

Alkali Solution.

Sodium carbonate	400 grs.
Water (distilled) up to	10 ozs.

For ordinary use, take eikonogen solution, 1 oz.; alkali solution, ½ oz.; bromide of potassium, 10 per cent. solution, 1 drop. This may be modified by using more of the "eiko." or more of the alkali, to suit exposure or tones required. Old developer—either eikonogen or ferrous oxalate—renovated just before use with a portion freshly mixed, is considered by some to work more evenly than new, and to give more brilliant prints.

CLEARING SOLUTION.

Acetic acid	2½ drams.
Alum	2½ ozs.
Water	80 ozs.

FIXING SOLUTION.

Sodium hyposulphite ...	15 ozs.
Water	80 ozs.

Development.—After exposure, soak the paper in clean water, and then make up the developer—in the event of ferrous oxalate being used, adding the iron to the oxalate, and not *vice versâ*, or you will come utterly to grief, for a precipitate will be formed. Pour off the water and pour on the developer, rocking the dish steadily. If the paper has been correctly exposed, the image ought to begin to make its appearance in exactly the same number of seconds as the paper was given of exposure. When it appears, and its quality can be judged of, the developer can be modified, if necessary. When nearly far enough out, pour off the developer, and keep a jug of cold water in one hand ready. The moment you see all detail well out, pour a lot of cold water on the print to stop development; a little practice will soon teach you the moment at which to do this. If the picture should flash out too rapidly, pour off the developer at once, and flood the print with water; then add more bromide to the developer, pour off the water, and apply the modified solution. It must be remembered that the *finished print will be darker* than it looks when in the developer; allowance must therefore be made, and the development not carried too far.

Fixing.—After development, and *without washing*, immerse the prints for about two minutes in the clearing solution; pour off this, and repeat. The clearing solution should be prepared freshly for each batch of prints, and should not be stinted in quantity. Now wash the prints thoroughly for about ten minutes in several changes of water, for if all the acid is not removed fading of the prints will result. Now transfer to the fixing bath, which should also be mixed freshly for each batch of prints. Allow fifteen minutes for thorough fixation, then wash thoroughly—say, for two hours in running water or in frequent changes. Place the prints between the leaves of one of "Wheeler's blotting-books" to dry. These books are filled with chemically pure blotting-paper, free from fluff, and are much superior to commercial blotting-paper, which always contains hypo.

Blisters: How to Cure.—Blisters sometimes appear after fixing; they may be avoided by immersing the prints after fixing, and without washing, in a 10 per cent. solution of common salt. If, after fixing and thorough washing, yellow stains should show, immerse the print in chrome alum, 2 ozs.; hydrochloric acid, 1 oz.; water, 30 ozs.; or in a strong solution of tartaric acid, until the stains have disappeared.

Printing Clouds in Bromides. — It is strange that so few photographers, amateur and professional, will take the trouble to print clouds in their landscapes, when these small additions cost so little extra labour and heighten the artistic effect so much. Mr. Ruskin says: "White paper is not the least like air"; and yet more than fifty per cent. of the landscape photographs which we see daily have their skies pure white. Not only is white paper unlike air, but, in the words of Mr. J. Constable, R.A.: "The landscape artist who does not make his skies a very material part in his composition neglects to avail himself of his greatest aids." Let all photographers, then, amateur and professional, resolve now to call no landscape photograph finished until suitable clouds have been printed thereon. To help them to carry out their good intentions, I give here the method for printing clouds in bromide prints. Take a piece of ordinary note-paper, and cut it to the size of the outside opening of your printing frame. Then put the negative into the frame, and press it into one corner; hold the frame up to the light, supporting the negative at the back with the finger, and, having put the note-paper over the front of it, trace the outline of the landscape in pencil on the paper, taking no heed of trifling projections above the sky-line. Now cut out this mask, and snip the edges very finely, in the way vignetters are done. Mark the corner of the printing frame into which the landscape negative was jambed, and, taking it into the "dark room," insert a suitable cloud negative, pushing it into the marked corner, and place on it a bromide paper; close the frame, put the mask on the front, and then expose to the printing lamp for about one-eighth or one-tenth the normal exposure. Return to the "dark room," remove the cloud negative and mask, insert the landscape negative, and again jamb it into the marked corner; place over it the bromide paper, close the frame, and give full normal exposure. Clouds are best printed in subdued light; therefore, increase the distance between your printing frame and lamp, and remember the rule that the time of exposure is quadrupled when the distance is doubled.

Mounting.—The following is the best and cleanest material for mounting bromide or silver prints; and, moreover, it has the advantage of not cockling the mounts, as starch does: Take 4 ozs. of best glue, and break it into small pieces; put into an old jam-pot, and fill up the pot with cold water. Leave the glue to soak until it swells to double its former size and becomes quite flexible, then put the pot into a saucepan with hot water. Boil gently until all the glue is melted, then pour in gradually 4 fluid ozs. of methylated spirits, stirring all the time. Mix well, and strain through muslin into a large bottle for use. When cold, it sets hard, but may be liquefied by placing the bottle containing it in hot water. Shake the bottle. This preparation will keep a long time.

Conclusion.—I sincerely hope that the foregoing may be of use to photographic readers of WORK who have not before tried bromide printing, and also to those who have tried and failed. Difficulties will no doubt be encountered, but no amount of written instruction will make a person proficient in photography without careful practice; therefore, let the reader take trouble to surmount these difficulties, for a certain amount of opposition is a great help to a man. Kites rise against, and not with, the wind: no man ever worked his passage anywhere in a dead calm. Let no reader of WORK give people an opportunity of placing him in the category of "dabblers," but let all remember the words of Mr. T. Delft: "The dabbler, lacking perseverance, patience, and intelligence, flies from one process to another, and, failing in each, is always eager for something new, every new thing sharing the fate of its predecessor. The devotee holds fast to that which is good, and adopts no change but such as leads him a step onward."

Although I have tried to give all the necessary information regarding bromide printing, it is probable that I "in proving foresight may be vain," and there may be one or two points I have not touched on; one or two remedies for failures I have not given; for, as Burns says,

> "The best-laid schemes o' mice an' men
> Gang aft a-gley,"

but I shall be pleased to help anyone who may apply for information through "Shop."

HAND-WORKING OF SPECULA FOR THE NEWTONIAN TELESCOPE.

BY EDWARD A. FRANCIS.

GLASS—EDGING THE GLASS DISCS—THE CURVE-GAUGE—SAND AND COARSE EMERY—FLOUR-EMERY—THE PROCESS OF ELUTRIATION—ROUGE AND PITCH.

THE following material must be provided before work can be commenced:—

(*a*) Two discs of polished plate glass.

(*b*) A curve-gauge to indicate when the glass has been made sufficiently concave.

(*c*) Sand or grain-emery for rough grinding.

(*d*) Flour-emery of various grades for fine grinding.

(*e*) Rouge (peroxide of iron).

(*f*) Pitch.

These shall be separately considered.

(*a*) *Glass.*—The definite instructions in these notes will apply to the making of a speculum 5½ in. in diameter, and 5 ft. in focal length. The principle of construction, however, applies to specula either larger or smaller, and there is no reason why either the diameter or the focal length mentioned should be adopted. Anyone who is prepared to face extra difficulty may reduce the focal length, even to 3 ft., and thus save trouble in mounting. A speculum of large diameter is scarcely to be recommended for a first experiment.

Two discs of polished plate glass, each 5½ in. in diameter and 1 in. in thickness, should be obtained. The discs will be supplied by the glass merchant with the edges either rough or ground smooth, as may be ordered. The price with rough edges should not exceed 1s. 6d. for each disc, and the further charge for smoothing the edges would probably be a like amount.

If the glass be purchased with the edges rough, they may be smoothed on a large grindstone, using much water and more patience, or they may be mounted in the

* The largest crystals are the best. Keep it in a tightly-stoppered bottle, for if kept long in contact with air it will turn into sul*phate*—an inert, if not a deleterious, compound in the developer.

lathe and cut true with emery. The last method is, of course, more workmanlike. A disc of wood is cemented to each face of the glass, which is thus mounted. A strip of soft sheet iron, bent as in Fig. 9, is secured to the slide-rest so as to spring against the revolving glass. The lathe is then driven at slow speed, and grain-emery (or quartzose sand) and water is fed down in the direction of the arrows, until, by abrasion, the glass is reduced to shape. Flour-emery is then used for a short time, until a suitably smooth surface appears. The coarse emery may be received in a saucer placed on the bed of the lathe, and so used again and again. The time necessary to edge a 5½ in. disc is about three hours. The bearings and exposed parts of the lathe must, of course, be shielded from any emery which may be thrown off by the rotation of the glass. It is desirable, in order to avoid the risk of grains of coarse emery lodging in the interstices of the jagged edge of the disc intended for the tool, that this also should have its edge smoothed.

(*b*) *The Curve-Gauge.*—The focal length of a concave speculum for parallel light rays (as in a telescope) is one-half the radius of its curvature. At present we shall simply act on this rule: the reason of it will be afterwards considered.

As the speculum with which we are dealing is to be of 5 ft. focal length, the radius of its curvature must be 10 ft. Take a lath of more than 10 ft. in length, and so fix it by one end that the other end may swing free (as in Fig. 10). Ten feet distant from the pivot, A, insert a sharp-pointed tool, capable of cutting through the plate of sheet zinc or copper, C C. The cutting will be performed by repeatedly moving the rod to and fro. When the sheet of metal is cut through it will form two templates or curve-gauges, the one convex, the other concave, the curved edges of which should be smoothed to fit perfectly, and the straight edge turned back, as in Fig. 11, to secure rigidity. If it be inconvenient to swing the radius bar on a wall, the curves may be cut on a level floor.

(*c*) *Sand and Grain-Emery.*—Either of these agents may be used for the first roughing out. Sand (ordinary silver sand) is less expensive than emery, and it may be obtained from any good-natured marble or granite worker. But it loses its cutting power more quickly than emery.

The coarse emery is sold, and is named, according to the number of meshes in each square inch of the sieve through which it has passed in manufacture. Forty, sixty, and ninety hole emeries are suitable for the rough grinding and the first smoothing of the glass.

(*d*) *Flour-Emery* (elutriated).—For the fine grinding, a much more exact process, flour-emery is used after it has been separated into several grades by the process of elutriation now to be described.

Into a vessel containing about two gallons of water is poured a pound or more of good flour-emery, and the mixture is well stirred. The coarser grains at once sink to the bottom, but a quantity of finer powder remains in suspension. At the end of ten seconds, if the mixture be left entirely undisturbed, all the grains above a certain size will have settled to the bottom. At the end of twenty seconds all the grains of a certain smaller size will have settled down, and so on, until, when half an hour has passed, the greater mass of the emery will have fallen, and only the finest particles of the mineral will remain in suspension, visible as a slight discoloration in the water.

This discoloured water is carefully poured or syphoned into a clean, shallow vessel, and allowed to stand aside, carefully screened from dust, until the impalpable powder which it contains has been precipitated. The quite clean water is then drawn or syphoned off, and the powder which is left adhering to the shallow vessel is dried and collected.

The original mixture being again stirred, and again allowed to subside, the water, charged with powder, is once more drawn off at the end of fifteen minutes, and the powder collected as before, the process being five or six times repeated in some such order as that indicated in the following table:—

Grade *a*	collected after	30 minutes' suspension		(finest grade)
b	,,	,,	15	,,
c	,,	,,	6	,,
d	,,	,,	2	,,
e	,,	,,	1	,,
f	,,	,,	15 seconds	(coarsest grade)

The residue, which will not remain in suspension for fifteen minutes, should be used only for preliminary smoothing.

The table of times, and consequently the degrees of gradation, vary with different opticians. Each intelligent workman formulates a scale of his own. That cited above was used by Tully, of Islington, a famous lens-maker.

Other tables of eminent workmen are:—

Ross,	*a* (finest)	60	minutes' suspension	
	b ,,	20	,,	,,
	c ,,	10	,,	,,
	d ,,	2	,,	,,
	e ,,	30	seconds'	,,
	f (co'rs'st)	10	,,	,,
Draper,	*a* (finest)	30	minutes' suspension	
	b ,,	10	,,	,,
	c ,,	3	,,	,,
	d ,,	1	,,	,,
	e ,,	20	seconds'	,,
	f (co'rs'st)	3	,,	,,

It will be observed that the finest powder is necessarily drawn away first, and the coarsest last. In the successive drawings of water the greatest care is needed to prevent any disturbance of the coarser sediment. Of the finer grades a very small quantity will be obtainable (from a pound of flour-emery), and but a very small quantity is required. To complete a 5½ in. speculum, not more of the finest grade will be necessary than could be contained on a sixpenny piece. It is best to use for the elutriation earthenware or glass vessels. The powder adheres to the enamelled surface, and, after drying, can be rubbed with the finger tip into a little heap and collected with ease. Each grade of the washed emery should be kept in a separate labelled bottle or box.

Good flour-emery is of a bright chocolate colour. Powder of a slaty hue is probably adulterated, and should be avoided, as possessing insufficient cutting power. Care bestowed on the process of elutriation is likely to be amply rewarded.

(*e*) *Rouge.*—This is *not* the rouge sold by perfumers, but the peroxide of iron specially prepared, and known commercially (I believe) as "jeweller's rouge." It is of a colour varying from deep red to red with a decided purple tinge, and the latter is the best quality. It needs no preparation, being sent out by the manufacturer ready for use. It should cost from 6s. to 8s. a pound, and an ounce will be sufficient to polish several specula.

(*f*) *Pitch.*—Pitch, which is used as a cement, and to form the polisher, can be purchased, of suitable quality, from the chemist. A box containing a pound or two costs a few pence. When cementing glass to wood, or glass to glass, the surfaces should be always first slightly warmed, that the hot pitch may not be chilled by contact. A question through "Shop" would no doubt be productive of a suitable pitch recipe.

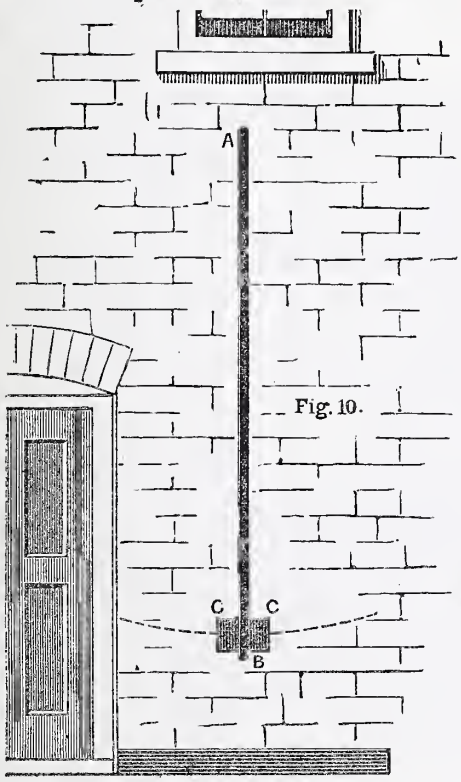


Fig. 10.

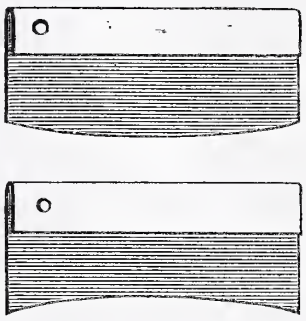


Fig 11.

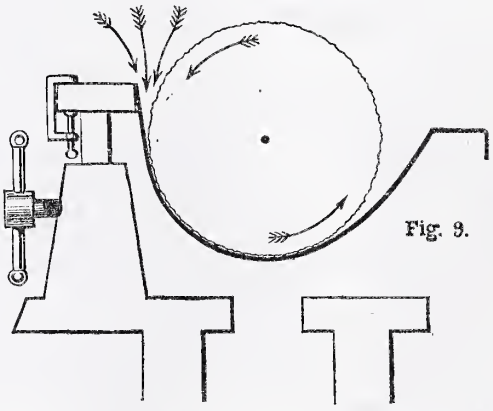


Fig. 9.

Hand-Working of Specula for the Newtonian Telescope. Fig. 9.—Edging a Glass Disc in the Lathe. Fig. 10.—Radius Bar on Wall. Fig. 11.—Metal Curve-Gauges.

NOTICE.

"WORK" COMPETITION COUPON

will be found at the foot of page 191.

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BROAD GAUGE.—This is now a matter of history. In the evolution of gauges it must be classed among the unfit. Many elderly men will be able to recall the battle of the gauges that was waged so furiously in the forties. Brunel was the leading railway authority of that period. But time has dealt unkindly with some of the bolder creations of his massive genius. The *Great Eastern* has been broken up after a long record of disaster and financial failure, the Thames Tunnel has lapsed into decent obscurity, and now the gauge for which he fought so many pitched battles before Parliamentary Committees is no more. In this connection it is interesting to note how little *primâ facie* reasons weigh against the slow developments of experience and utility. The 4 ft. 8½ in. gauge, now triumphant, had its origin in the humblest manner possible. It was settled by no conclave of eminent engineers, but, like Topsy, "it growed." It was simply made after that of the first railways in the North of England, whose gauge was that of the old wooden tramways, which they superseded. These tramways had been made to suit the distance between the wheels of the country carts. Brunel could not be otherwise than original and massive in his conceptions, and enjoying the entire confidence of the Great Western Company, he carried his point in the matter of the broad gauge in 1836. He anticipated greater boiler power in the wide engines, with more room for the machinery. He thought that the greater width of base would give increased steadiness and smoothness of motion at high speeds. He also thought that wheels of larger diameter might be used, and the centre of gravity kept low, by placing the bodies of the carriages between the wheels. This latter consideration alone settled the precise width of 7 ft. The running powers of other lines had no weight in early railway days; in fact, the separate gauge was thought an advantage as a means of securing the whole trade of the West of England, South Wales, and the South of Ireland. To show that there was no idea then, in the infancy of the railways, of the growth of traffic, and consequent necessity of uniformity of gauge, the Eastern Counties Railway, it may be noted, was first constructed and opened in 1839 with a gauge of 5 ft. To-day the 4 ft. 8½ in. gauge is employed in Canada, New South Wales, France, North Germany, Holland, Belgium, Austria, Hungary, Turkey, Switzerland, Italy, Sweden, Denmark, Spain, and Peru. During the last year or two, out of over 2,500 miles of English railways, only about 426 have been broad gauge, and of this all but 163 miles have been available also for narrow gauge traffic. Out of 100 trains that have left Paddington and its adjacent goods yards every day, only ten have been broad gauge. Twenty years ago there were more than 700 broad gauge engines running. Recently there have been less than 200. And on May 20, the 10.15 train from Paddington closed the record of over half a century, whose history commenced with the famous "North Star" locomotive in 1839. The change will cost over half a million of money. Fifteen miles of sidings have been laid down at Swindon for the accommodation and conversion of the rolling stock, and 5,000 workmen have been engaged on the alteration of the metals. The Great Western Railway deserves much credit for the thorough manner in which they have effected the change.

"WORK" PRIZE SCHEME.—The present age is essentially a competitive one—so much so, that many minds well able to weigh the matter incline to the conclusion that we are getting altogether too fine an edge upon the national character in this direction. This may or may not be the case. We will not now discuss either the merits or demerits of the question. Taking things as they are, we find that while the great race of life becomes more competitive every week and every day, those concerned do not seem to get tired of it, but go on hourly adding their mite to the great element in motion. Perhaps it is only man's insatiable craving for work which is answerable for this condition of things. If this be so, a comfortable feeling should arise from the contemplation of the superior animal—capable of so much or so little—contentedly and industriously employing himself. Among the directions in which this making of work has been stimulated, none exceeds that arising out of journalistic enterprise, which has been carried to a pitch which almost precludes the most ingenious mind from possibly discovering any new competitive world to conquer. At least, this is how this latter aspect of the matter dawns upon us when, in order to be "up to date," we find ourselves called upon by our readers to afford some sequel to the late WORK Exhibition, which afforded such excellent opportunities for our readers to engage in friendly rivalry. Full particulars of the WORK Prize Scheme will be found set forth in page 190 of this issue. The subject decided upon for the initial competition is an essay upon "The Cycle: Its Worth to the Nation." As there may be two opinions in connection with this text, the competition should elicit some valuable ideas and suggestions, which will be certain to interest the general public. It only remains to add that before the first competition falls out, due notice will be given of the one to follow it. Should the results of these competitions prove satisfactory there is no reason why they should not become permanent. With this view our readers will, no doubt, exert themselves to make the competitions known—especially in cases like the present, when the subject is one surrounded with no restrictions, and open to young and old alike.

A RUSTIC FLOWER-BASKET OR CENTRE-PIECE FOR LAWN.

BY ARTHUR YORKE.

THE BASKET AND ITS USES—MATERIALS—CONSTRUCTION—FIXING.

The Basket and its Uses.—This rustic receptacle for flowering plants is, as will be seen by the illustrations, a plain octagon in its main portion, but for variety and effect it is so designed that on each of its eight sides a shallower triangular box projects, thus bringing its shape more nearly to that of an eight-pointed star. In size it may be varied to suit any particular lawn, but as here drawn, on a scale of ¾ of an inch to the foot, its dimensions are: height, 5 ft. 6 in., and breadth, 4 ft. 6 in. The internal measurements of the large octagonal box (which stands with its top 3 ft. from the ground) are, from side to side 3 ft., and depth 1 ft. 6 in. This portion is more especially intended for climbing plants, for the support of which a square trellis rises from its centre, and from this there are also flying chains to all the angles. The eight smaller boxes, shaped as right-angled triangles, measure internally 1 ft. at base and 7 in. perpendicular; their depth is 1 ft. They are intended for small, low-growing plants, such as will afford masses of colour.

Materials.—For the bottom of the boxes 1 in. board will be required, and for the sides ¾ in. Elm is considered to endure best for such purposes as this. The four supports may be of any rough and lasting wood that comes most readily to hand; I have drawn them as of larch. The upright sticks which carry the trellis, as well as those at the angles, will perhaps look best in maple or wych-elm, on account of the rough, ornamental bark worn by the saplings of those trees, but larch or other fir will look very well. The rustic mosaic covering the boxes is partly white, made of the halves of peeled withy rods, and partly dark, made of those of hazel, and wearing their natural covering.

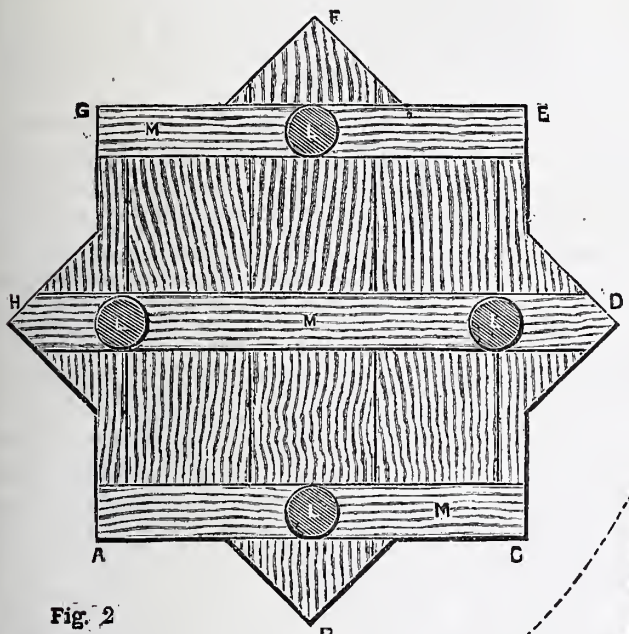


Fig. 2

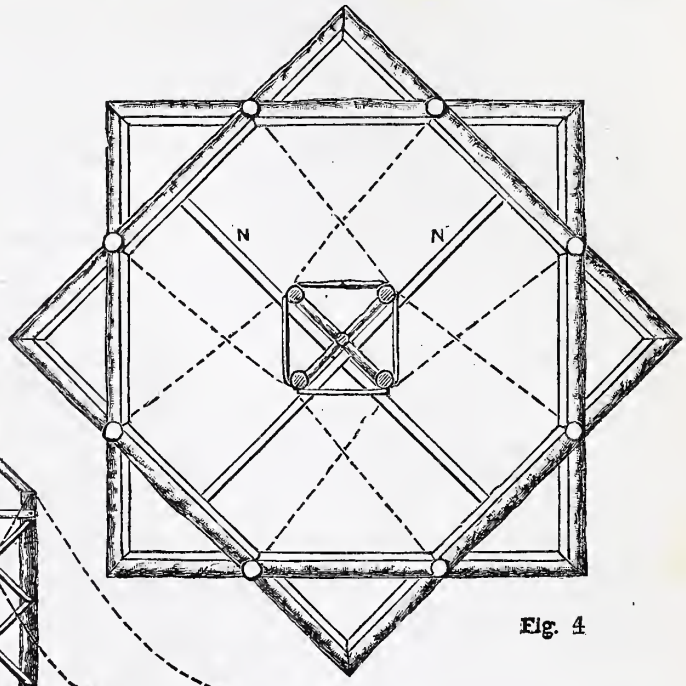


Fig. 4

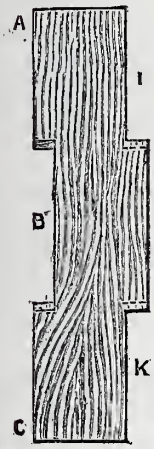


Fig. 3.

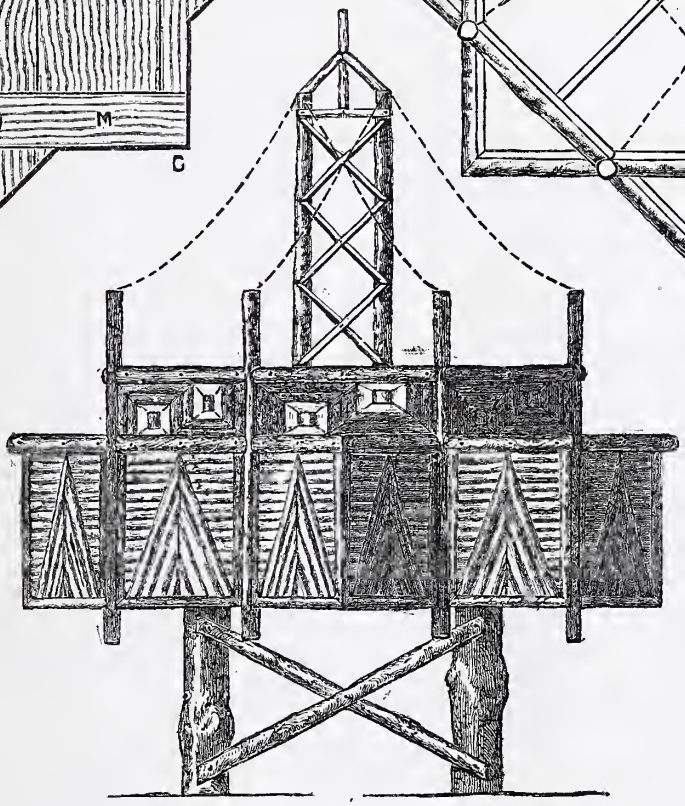


Fig. 1.

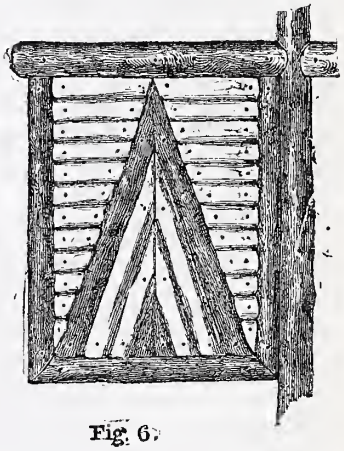


Fig. 6.

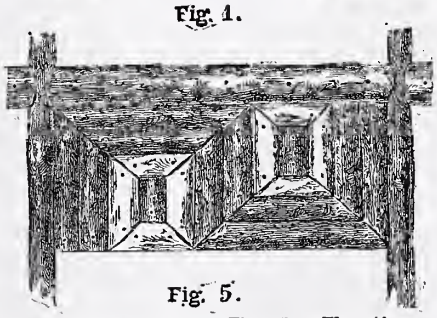


Fig. 5.

Rustic Flower-Basket. Fig. 1.—Elevation of Basket. Fig. 2.—Bottom of Basket, Lower Side. Fig. 3.—Board of Side. Fig. 4.—Plan of Basket, showing its Upper Part. Fig. 5.—Mosaic Border on Octagon. Fig. 6.—Mosaic on Panel.

Construction.—Whether our basket is to be a fixture or removable at pleasure must depend partly on its size and partly on the individual views of its owner. To be sheltered through the winter will doubtless tend to its preservation, but it may suffer damage from careless moving, and it will stand far more firmly as a fixture. Without attempting to decide the question for others, I will for the present presume that it is to be fixed.

Such being the case, the four supports will have to be let into the ground like so many posts. Their position is shown in Fig. 2, where they are marked L, L, L, L. They form a square 18 in. apart; in diameter they should be as much as 4 in. They stand 16 in. above ground, and should go down a foot below.

The bottom of the boxes, made, as before stated, of inch board, is drawn in Fig. 2. It is the underside which there appears,

and it is nailed together by three ledgers of the same thickness, M, M, M. These ledgers will lie on the supports, and the box will rest on them when in position. In the sides, which are of ¾ in. stuff, it will be obvious that in order to secure the full amount of strength, it will be desirable to make the boards cross each other at the angles. It will be remembered that the sides of the large box have to be boarded to a height of 20 in., and those of the smaller ones to 14 in. We will, for the sake of explanation, say that we begin at bottom with a 9 in. width like that drawn at Fig. 3; it is 3 ft. long, and it has to be nailed to the side A C (Fig. 2). The opening B is cut slanting as shown, to admit the angle B in the same figure. Strips 2 in. wide are also cut from its upper edge as shown at I K. The board for the side G E is precisely the same, and those for G A and E C differ only in being ¾ in. longer at each end. Having placed these, we can board up the intermediate angle boxes, B, D, F, H, with short boards (11 in. long) to the same height as their fellows—viz., 7 in.

If for our second course we again take 9 in. widths, we can cut them the same as for the first course, except that the opening at B will not be required. In this course we nail our first board on the side H B, and so on round the box, thus making the boards cross those already on, and we nail them to the parts of those boards which rise 2 in. above the general level. When this course of boards is nailed on, the angle boxes B, D, F, H, will be boarded up to their required height—viz., 14 in.—and we have to board up the intermediate ones, A, C, E, G, with short lengths of 7 in. wide to make their outer sides also complete.

What now remains to be done is to complete the deeper octagon box, of which the sides A, C, E, G, are at present 16 in. high, whilst the intermediate ones, B, D, F, H, are only 9 in. high. On these last-named we fix another 9 in. width, nailing to the rising corners as before, the pieces being 14 in. long. Next we complete the sides A, C, E, G, with pieces of similar length, 4 in. wide. Lastly, 2 in. strips, filling up the sides B, D, F, H, will complete the box. The short 2 in. strips, of which we have cut a number from the lower boards, we shall utilise as ledgers, nailing them vertically up the inner sides of the boxes.

All this explanation must appear tedious, but I fear that without it many amateur carpenters would be puzzled in dealing with so complex a figure as that before us.

The four uprights which support the trellis are kept in place by strips crossing the box near its top as shown at N N (Fig. 4). The standards are 4 ft. 11 in. long.

Those other uprights which run up the angles of the octagon should be neatly trimmed with the chisel where they come in contact with the boards. Their tops are connected with those of the trellis by what I have called flying chains. These may be real metal chains, or, what will look more in character, we may twist a couple of thin nut rods together, and instead, place them for the climbers to cling to. The arrangement of these things is shown by dotted lines in Fig. 4.

The boarding of the boxes is covered with rustic mosaic—a kind of decoration about which abundant particulars are given in the previous articles on rustic carpentry. The patterns are formed by lengths of split rods bradded to the boards. Of the fret running round the octagon, one of the sides, drawn to double scale (1½ in. to foot), appears in Fig. 5; whilst in Fig. 6, on the same scale, we have one of the panels on the line of the shallower boxes. These sixteen panels are all of like dimensions.

Fixing.—If the basket is to be an absolute fixture, nothing more will be needed than to nail it to the supports, but some may prefer to have the supports fixed and the basket otherwise movable. To do this, iron pins would have to be driven into the supports, and holes for them to fit into bored in the bottom. If the whole thing is to be movable, the supports need only be cut 16 in. long, and they will be nailed to the bottom, but the solidity of the previous plans will not be gained by this.

PHOTOGRAPHIC EXPERIMENTS.

CURIOUS, AMUSING, AND INSTRUCTIVE.

BY WALTER E. WOODBURY.

MAGIC PHOTOGRAPHS—PICTURES PRODUCED BY SMOKE—PHOTOGRAPHING LIGHTNING—REDUCING DARK PRINTS—MAKING A PLASTER CAST FROM A NEGATIVE—ARTIFICIAL SNOW SCENES—DOUBLE PORTRAITS—A TEST FOR HYPO—MAKING A POSITIVE FROM A NEGATIVE.

Magic Photographs.—Take an ordinary silver print, preferably one made upon plain un-albumenised paper. The latter can be made by soaking a piece of plain well-sized paper in a two-per-cent. solution of common salt dissolved in water, and hanging it up to dry. It is then floated on a ten-per-cent. solution of silver nitrate and allowed to dry once again, only this time in the dark. The print should be fixed without toning, and afterwards well washed to remove all traces of hypo. After washing, immerse in a saturated solution of bichloride of mercury, when the image will entirely disappear. Next soak some strong bibulous paper in a saturated solution of sodium sulphite, and, when dry, paste a piece to the back of the print with a little starch paste at the edges only. All that is necessary is to soak the print in water, which dissolves the sulphite and causes it to attack the print and make the image perfectly visible as a brown picture. Of course, the image can also be made to appear by soaking the invisible print, without the bibulous paper attached, in a solution of sodium sulphite, hypo or water with a little ammonia added.

Pictures produced by Smoke.—Magic pictures made in the manner above described can also be developed by smoke. A novelty introduced in Paris some time ago consisted of a cigarette or cigar holder containing in its stem a little chamber for the insertion of small pieces of apparently plain paper, but in reality magic photographs. The smoke passing through the chamber attacked the print and developed the image. By blowing smoke on to the invisible image it may be made to appear, but the operation is rather tedious, and anyone with a little ingenuity can easily construct a cigarette holder with an arrangement to hold tiny prints, and allowing the smoke to pass through it.

Photographing Lightning.—The camera should be focussed on some distant object during the daytime, and a mark made, so that it can be quickly adjusted on a stormy night. A rapid rectilinear working at full aperture is the best for the purpose. Direct the camera to that part of the sky where the lightning most frequently occurs, if possible, so that a portion of the landscape is included on the bottom of the plate. Place a plate in the camera and draw out the slide, uncap the lens, and wait for a flash. If preferred, the cap can be left off, and the images of a number of flashes made; but, of course, the image of one flash is more interesting.

Reducing Dark Prints.—In making a lot of silver prints, it often happens that we find some of them have been printed too darkly. To reduce these to the required depth of colour, adopt the following method. Place the faulty print in a bath made up of six grains of potassium bromide, six grains of mercuric chloride, and one ounce of water, until they are sufficiently reduced in density, when they must be taken out, well washed, and dried.

Making a Plaster Cast from a Negative.—After the negative has been washed, remove it from the water and remove all superfluous moisture with some pieces of blotting-paper. Then gently heat the plate over a lamp or fire, care being taken that it is not made too hot, otherwise the gelatine will melt and run. The effect of a gentle heat is to cause the dark parts of the plate to swell up in high relief, so much so, in fact, that a cast in plaster-of-Paris can easily be made.

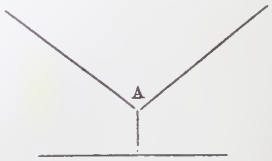
Artificial Snow Scenes.—There are several different ways of producing snowstorm effects with an ordinary landscape negative. The usual plan is to sprinkle a little red colour over the negative by means of a hard brush charged with the colouring matter. But, as a writer points out, the only drawback to this method is that the flakes all appear to have tails. He recommends the following as a better plan. The negative is coated with a thin sticky layer of one part of gum dammar and five parts of ordinary turpentine. A dry colour, like lampblack, for instance, is then placed in a hair sieve, and the latter held at some distance from the negative and shaken until sufficient of the colour has fallen flake-like down upon the negative. When dry, the plate is placed in a printing frame, and a proof made. If satisfactory, the colour is fixed to it by a coating of varnish; if not, the whole can be washed off with turpentine, and the operation repeated.

A hard under-exposed negative gives a good effect, and with a little red colouring matter it can be further improved by touching up parts to represent the fallen snow.

Double Portraits.—These are very effective if made skilfully, there being a number of curious effects that can be produced—for instance, a man playing chess, etc.

A black or red background is required, so that it gives no effect upon the sensitive plate. Place a table in the centre, and let the sitter place himself on a chair on one side. Expose the plate, and then let the sitter take his chair and again seat himself on the other side of the table; another exposure is then made. The slide must be left open the whole time, as any movement of the camera will ruin the picture. If the feet are to be included, it will be necessary to have another red blanket on the ground.

In making a picture of a man shaking hands with himself, a little care must be taken in posing the hands carefully. An invisible rest must be employed. This can be made by a piece of strong black thread tied across the room and fastened in the centre to the floor in this manner—



The hand can then be supported at A.

A Test for Hypo.—Permanent prints are nly possible if every trace of hypo be horoughly eliminated. To test, take a mall quantity of the last water the prints ıave been washed in, and add a drop of the ollowing solution :—Potassium permanganate, 2 grains; carbonate of potash, 20 rains; distilled water, 40 ounces. If any ıypo be present this test solution will turn rown.

Making a Positive from a Negative.—Take an under-exposed negative, one that s, in fact, so under-exposed as to be useless s a negative will answer the purpose well. Thoroughly well wash it, to entirely remove ıny trace of hypo, and then soak it in a saturated solution of mercuric chloride. This urns the image quite white, and it is then vell washed in several changes of water and lried. Afterwards it can be mounted in a rame with a piece of black velvet or cloth behind it, forming a most delicate positive picture resembling a picture on ivory or opal.

CHINESE LACQUER WORK.

The red gold and pale yellow effects seen in Chinese lacquered cabinets, etc., are produced by the aid of tinfoil laid upon a perfectly smooth surface, and varnished with various gums.

Very effective panels may be made upon this principle, useful for decorative purposes, such as screens, cabinets, etc.

In case sheet metal is used, it should be perfectly free from marks of any kind, and highly polished to begin with. If wood is employed it must be planed very flat and smoothed with fine glass-paper, sized, and primed with white lead and yellow ochre, mixed with drying oil, and a small proportion of oil size; give two coats, rubbing each down with a flat pad, using powdered pumice and water. Next give the work a coat of *flat black*, and rub down, first with finest sand-paper, then with a dry cloth, and finally with the palm of the hand. See that no particle of dust remains, and give an even coat of a mixture of black japan two parts, gold size one part.

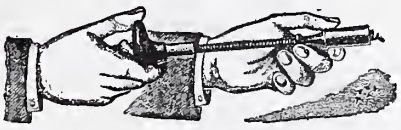
When dry rub down, as above, with pad and pumice, and the panel is ready for the silver leaf.

The portions to be treated with the foil are then given an even coat of gold size, with a small proportion of linseed oil, and when at the proper stage of "tackiness" the leaf or foil is laid on, as in gilding—*e.g.*, if water in a landscape is to be represented, the leaf should be laid on that part exactly; figures, the sun, etc., are treated similarly. When dry, and the surplus leaf removed, the subjects are toned, shaded, and tinted; the darker shades with dragon's blood mixed with turpentine, thinly or thickly as required, the lighter shades with gamboge.

All the *transparent* oil colours, as used by artists, may also be used for various effects upon the foil. The other portions of the landscape, etc., may be executed in oils, and should be more suggestive than in detail. When dry, wash with water and a suspicion of soda, and varnish.

SOME GOOD THINGS.

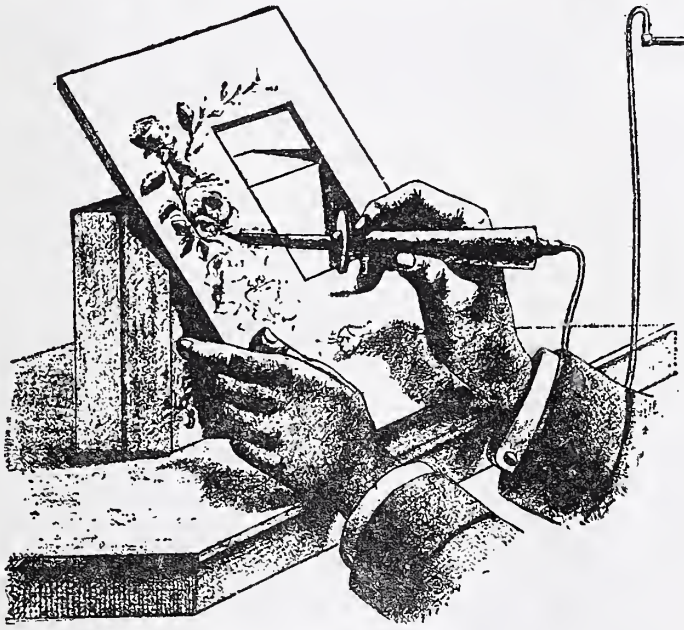
Tin Tack Driver.—So many of our readers have to do with tinned tacks that we have much pleasure in adding our testimony to the worth of Mr. W. Henry Thompson's "Eureka" Magnetic Tinned Tack Driver, an illustration of which is given here. It is simple, strong, and effective; and by its means tacks can be driven in noiselessly and quickly. The Magnetic Tack Driver requires no hammer, and it can be carried in the pocket. It is used by pushing the knob until the magnetised end of the plunger has



Tin Tack Driver.

reached the tack. The pressure is then released, and allows the spring to draw the tack into the brass socket. To drive the tack, the worker places and holds firmly the socket on the wood, hitting the knob with the palm of the hand sharply, when the tack will be found to be properly driven in.

Poker Gas-Etcher.—*À propos* of our articles on Poker Work in Nos. 158 and 163, we present to our readers a design of the Patent Gas-Etcher made by Messrs. Hallam & Scott. The illustration shows how to hold and use the etcher, which may be helpful to workers. The advantages claimed by the present over other machines are as follow:—The left hand is free; there is no further expense after the machine is bought; no danger, no smell, nor dirt; and the pointer is kept at a nice heat, so that very delicate shading can be done; and it is cheap. These advantages should bring it within the reach of amateur workers who wish to decorate woodwork.



Poker Work Gas-Etcher.

"**Electric Toy Making.**" By T. O'Conor Sloane. (E. & F. Spon.)—This little book of 138 pages has a short chapter on primary batteries, and other short chapters on magnetic and electric toys. About 14 pages are devoted to induction coils, 7 pages to dynamos, 13 pages to electro-motors, 5 pages to electric bells, and 11 pages to miscellaneous receipts. The book is well printed and illustrated, but some of the cuts have been borrowed from English journals, although their source is unacknowledged.

SCIENCE TO DATE.

Phosphorescence of Diamonds.—Boyle discovered that diamonds are sometimes phosphorescent. Recently Mr. Kunz, of New York, has stated that all diamonds are susceptible of emitting luminous rays when they are rubbed in the dark with cloth, wood, or metal, after having been exposed to the sun's rays or to the electric light, and that this property may be made use of to distinguish true stones from paste, which does not produce this phenomenon to any degree.

Photographing Rifle Bullets.—Professor Boys has designed an ingenious and simple apparatus for photographing rifle bullets. The bullet is fired through a dark chamber, in which a photographic plate is exposed. In its passage it strikes against two upright wires, thus completing a circuit and producing a brilliant electric spark from a condenser specially arranged so that the spark lasts so short a time that the bullet, although travelling with great velocity, is practically stationary during its existence, and thus a photograph is obtained. Many photographs have thus been taken, and show a wonderful system of air-waves accompanying the bullet in its flight, as well as peculiar eddies of the air in its track.

"Supplementary" Colours.—As white light can be split up into two "complementary" colours, so can coloured light, as Professor Sylvanus Thompson has recently shown, be split up by suitable means into a spectrum tint and a shade of grey. These latter he proposes to call "supplementary" colours. This result agrees with that of Captain Abney, who found that any tint could be matched by mixing grey with a spectrum tint.

Steel Manufacture.—A recent process claims to produce a steel of greater strength by passing an electric current through it whilst in a molten state. It is expected that this will cause the molecules to group themselves in such a manner that, when cold, the steel is more compact and thus strengthened.

Ozone.—Professor Dewar, who in December last discovered that liquid oxygen gas is magnetic, has since proved that liquid ozone is also strongly magnetic.

Action of Nitric Acid on Coal.—If bituminous coal in fine powder be covered with rather more than double its weight of 49 per cent. nitric acid, the mass rapidly becomes warm, and dense red fumes are given off. In this way nearly the whole of the coal is dissolved, and from the product of the reaction a black acid, fairly soluble in distilled water, can be obtained. Its composition is at present unknown, but it seems to be a nitro compound. If this black acid be further treated with nitric acid, a brown acid is formed. Further research may afford valuable information as to the composition of coal.

NOTES FOR WORKERS.

An exhibition in commemoration of the discovery of America by Columbus is to be held at Genoa, in Italy.

The carriages to be used on the Liverpool Overhead Railway will be 45 ft. long and 8 ft. 6 in. wide, will run on bogey wheels, and be provided with a gangway from end to end. The weight of a carriage, including the motor, is 14 tons.

At the Chicago Exhibition there will be about 127,000 electric lamps, of which 7,000 will be arc, of 2,000 candle-power each, and 120,000 incandescent, of 16 candle-power each. To run the plant 22,000 horse-power will be required. In the great manufacturing building alone there will be 33,000 lights.

A pneumatic inner sole for boots has been invented for people with tender feet. It is made of hollow indiarubber, and inflated with air.

A committee has been formed, consisting of engineers and electricians, to explain and demonstrate the use of the chief exhibits at the St. Petersburg Electrical Exhibition to the Russian public.

TRADE: PRESENT AND FUTURE.

**** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

COTTON TRADE.—All is now going on satisfactorily, trade being good and the mills working full time. Thus both spinners and weavers are doing well. The woollen trade also keeps in a fairly good condition.

CUTLERY AND FILE TRADES.—There is a considerable falling-off in the file trade now that the orders for Spain are completed. Cutlery ware is not in great request, although some individual firms are well employed.

JUTE TRADE.—The depression has now reached Aberdeen, and the Aberdeen Jute Company has been compelled to reduce wages 5 per cent., and to run the mill only four days per week.

CYCLE TRADE.—The cycle trade is growing apace in the Midlands. Coventry, formerly foremost in watch making and silk ribbon weaving, now claims cycle making as its staple trade. Redditch, the centre of the needle industry, is also taking up cycle making. Many of the large engineering firms of Birmingham and other towns are forming a cycle department, workmen being advertised for on all sides. Our Glasgow correspondent writes:—The season is now in full swing, and agents in most places have a splendid run of trade.

TIMBER TRADE.—The deliveries from the London docks still show a decrease. The hardwood and mahogany trade seems to be rather brisk, although there is little or nothing doing in teak. The last of the mahogany cargoes have arrived, and most have been disposed of. At Grimsby, Hull, Hartlepool, and Cardiff the cry is "Prices dull and demand moderate." Floorings and matchings showed a falling-off in prices at the London sales, and other goods went little better—in fact, some must have been sold at under cost price. At Liverpool there have been large auction sales of logs, etc., including pitch pine, pencil cedar, mahogany, American hardwood, oak, black walnut, and hickory. Ebony: 10 tons from Elobey sold at £6, and 30 tons Gaboon at £6 7s. 6d., per ton ex-quay.

CABINET TRADE.—Cabinet makers and French polishers are fully employed in Birmingham.

ENGINEERING TRADE.—Although no very material improvement can be reported in the condition of the engineering and iron industries of the Manchester district, some of the local establishments are booking a few orders; but, generally speaking, there is a conspicuous absence of new work, especially in the machine tool and stationary engine branches. The business of the boiler makers has taken a turn for the better, and many firms have now enough work in hand to keep them fairly busy for some weeks to come. Locomotive builders and the various machinists report no change in the aspect of trade, and generally the tendency is still towards increasing slackness. Barrow is the only centre where trade continues in a flourishing condition. Here both engineers and shipbuilders are exceedingly busy, and, from the orders lately secured, it would seem that this activity will continue at least to the end of the year. The condition of the shipbuilding and marine engineering trades on the Mersey is becoming, if anything, more serious than ever. No new work of any kind has been booked for some time, and, except for an occasional renewal of boilers and other repairs, the shops are virtually at a standstill, while the yards are only employed in finishing vessels now on the stocks. No appreciable improvement takes place in the state of the iron market, buyers being disposed to pursue the hand-to-mouth policy which has been observed of late. In the metal market quietness is still reported, buyers—who are, for the most part, short of work—holding back in anticipation of lower rates prevailing in manufactured materials, but at present there is little prospect of a lowering of prices taking place.

METAL AND CHEMICAL TRADES.—Our Liverpool correspondent writes:—Reports are to hand that there is an improvement both in the metal and chemical markets. Most of the metals are dearer, and chemicals are scarcer. There is an increasing demand for bleaching powder.

MASONRY TRADE.—It has been decided by the arbitrator for the Liverpool stone-masons that the wages be 9d. instead of 8½d. per hour, which the men demanded; also that payment of wages commence not later than 12·15 on Saturdays.

RUBBER TRADE.—A considerable quantity of rubber has lately been sold by auction in Liverpool (60 tons, besides 261 casks and packages of no stated weight). The present prices are: Para, 2s. 10d. per lb.; Cape Coast and Accra, 1s. 2d.; Gambier niggars, 1s. 5½d. to 1s. 10½d.; Grand Bassam, 1s. 4d.; Sierra Leone, 1s. 2d. to 1s. 6½d.; ordinary South Coast Flake, 11d. per lb.

SILVER AND ELECTRO TRADES.—There is a further improvement in the Sheffield silver, electroplated, and Britannia metal trades, orders coming in freely for trophies for summer sports.

COAL TRADE.—In the West Yorkshire coal trade business does not compare favourably with the volume of trade in 1891. Best Haigh Moor, 13s.; seconds, 12s.; Silkstone hards, 12s.; house coal and cobs, 11s. 6d.; Stanley Main seconds, 8s. 9d.; steam coal, 8s. 9d.; coke, 8s. 6d.; slack, 5s. to 6s.; smudge, 2s. 6d. to 5s.—all per ton.

EDGE TOOL TRADE.—In consequence of the brisk skate trade last winter, the edge tool stocks have got extremely low, therefore the workmen in this trade are busily employed. These two trades go together, as a rule, forming a winter and summer trade; and in the case of a severe winter when skating may be practised, it proves one of the steadiest trades in Sheffield.

HATTERS' TRADE.—Orders in hand are unprecedented; but a strike has occurred at Stockport in consequence of the refusal of the employers to increase the rates of payment and to formally recognise the men's union.

STEEL TRADE.—The Durham strike is still interfering with the manufacture of Bessemer steel. There is a continued scarcity of hematite iron, and prices of Bessemer steel have further advanced; but railway companies are giving out their average amount of railway work, although their traffic returns have of late shown a falling-off.

BUILDING TRADE.—The masons and wallers of Nelson and district have struck work for an advance of wages from 8d. to 8½d. per hour. In Rochdale and district the joiners, bricklayers, plumbers, painters, and all kindred trades are busy. The stone-masons are still on strike, though a good many are employed by the smaller builders at the wages they are standing out for—9d. per hour. In the Elgin district building operations are good. There is some difficulty in finding masons to do the work. So many from the district emigrate to the States that few are left for the work at home. Several important contracts will be let, which will keep builders busy during the summer months.

SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of WORK *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given.*

I.—LETTERS FROM CORRESPONDENTS.

Russian Larch.—A. R. (*Scorrier*) writes:—"It may interest our readers to know that Russian larch timber is superior to teak or oak to a great extent for ship-building. Many of our war ships and other iron ships are lined with teak, which is reputed not to decay; but the fact is it does decay. It is subject to destruction by a species of worms. Larch timber answers much better for ship-building purposes. It does not become worm eaten, nor, on account of its resinous properties, does it so easily decay. If exposed to the air or to water it becomes almost as hard as iron. Ships have been built almost exclusively of larch, oak only being used in the curved parts of the vessel. The iron bolts have been found to rust more rapidly in the oak owing to the tannic acid it contains."

Machinery Photos.—T. R. B. (*Newcastle-on-Tyne*) writes:—"Many are in the habit of photographing machinery for the purpose of sending the photograph to a possible buyer. To such the following hint may not be lost: Say, for example, a full front view of a drilling machine is to be taken. Lay a piece of board 2 ft. long by 3 in. in width on the ground in front of the machine, and close up to it; then take the photo. Now we have a photo. of the machine, and to *scale*. Mention the size of the wood to the customer, and he will be able to make all necessary measurements to ascertain whether the machine will suit him or not."

A Teacher's Guild.—H.B.S.(*Liverpool*) writes:—"I noticed a leaderette the other week in WORK about 'Workmen's Holidays'; could we not inaugurate something like a teacher's guild for the purpose of having excursions to places of interest, and to urge upon the railway companies the desirability of cheap rates for workmen who are wanting a holiday, and who cannot, at the present rates, afford one? The institution might be called the 'Workmen's Guild.' It would require the workm to go into it heart and soul to make it succeed.' [We give insertion to this suggestion. It is for o readers themselves to determine the value of t idea and to follow it up.—ED.]

Needed Inventions.—E. B. (*Manchest* writes:—"You said a few weeks ago that y would be pleased for any suggestions for need inventions. Well, an invention is badly needed a machine for peeling potatoes and apples with cutting to waste. There have been several m chines, but they do not do the work satisfactor as by hand. Any new machine must adapt itself irregular shapes."

Testing Accuracy of Framework.—G. (*Elgin*) writes, in reply to J. C. K. (*London, N.*) (see WORK, No. 161, page 76):—"With curious p sistency which I am unable to account for, J. C. notwithstanding my former remarks, repea 'Assuming true square of angles and lengths of si of frame, where and why the necessity for testin I reply, None whatever. It is simply because *cannot* assume true square of angles that we quire to test; but I hold that if the opposite side the frame be equal, and if the diagonals be eq (I say nothing whatever about angles), *then* angles are bound to be right angles; and I sh continue to hold that opinion until J. C. K. pro that we who hold it are wrong. A case is cited the test clumsily applied, but if the simple meas ing and comparing two short distances be too m for a man, one may imagine his confusion when to test the accuracy of a framework (say the carc of a dresser) by means of a square. When learn geometry, the definition of a trapezoid given was: 'A trapezoid is a quadrilateral having two its sides parallel and the other two not parall Now I can easily imagine such a figure, indeed have one before me, in which one of the n parallel sides is perpendicular to each of the para sides, while the other non-parallel side makes obtuse angle with one parallel side and an ac angle with the other; and I cannot, try how I w make the figure such that the opposite sides sl be equal. I congratulate J. C. K. on the clos sentence of his communication, and I heartily ciprocate his sentiment."

II.—QUESTIONS ANSWERED BY EDITOR AND STA

Copal Varnish.—J. R. E. (*Congo Balolo M sion, Upper Congo*).—I much regret that I unable to give you any reliable formulæ or metl by which you can convert the copal gum in y midst into a serviceable varnish. Copal varn making is for the expert and experienced only. is not, as so many readers of WORK appear fancy, merely a question of mixing by heat cert articles in a vessel for a certain time. I should you would do far better to import the varnish want, and to export the copal gum—which latte a valuable commodity. I have replied to so m queries in "Shop" upon this subject that I almost ashamed to send this to the Editor. I h an illustrated description of the works and p cesses used in varnish-making by a very emin London firm; but it is useless to think any part the whole of such, would aid the raw noviec in c cocting small quantities. There are no recipes any book yet published that I could recommend to try; and I have it direct from one of the f English manufacturing firms that all the inforr tion yet printed on copal varnish-making is "trash."—F. P.

Bevelling Tires.—G. W. (*Bournemouth*).—I not know of any machine for bevelling wheel tir 4½ in. and 6 in. tyres bevelled have gone out of d altogether. The outside of a 4½ in. or 6 in. is n made convex. Light cart and carriage tires bent out of straight flat bars in the bendi machine. There is also a jumping-machine to as in piecing tires and axles.—W. P.

Fireproof Safes.—A CONSTANT READER (*M End*).—Our correspondent has evidently got hold one of the "sheet metal boxes" (Brummag duffer"), sold as, and miscalled, "Fireproof Saf with which the market is flooded. We have s dozens of this kind of ware, and found the "f proofing composition," as a rule, to be of the char ter named. The object of placing a material tween the inner and outer cases was to cause heat to melt and vaporise the same, so as to p duce moisture in the interior, and thus reduce damage caused by the fire and heat to the pap therein contained. Each maker of *safes*—we m the respectable ones—has a composition of own, which is generally looked upon as a tra secret. Our correspondent should refer, in Patent Office Library, to the Abridgments "Safes and Strong Rooms," where he will f specified the various materials used by most of makers of safes. From these he will be able select that best suited to his purpose.—C. E.

Lenses.—W. H. (*Chorley*).—Achromatic len were, and are, sometimes made triple. That wh you have is probably of old manufacture, but is likely to be the worse therefore. Your Huyghen eye-piece is apparently properly made. To asc tain its magnifying power, take half the fo length of the larger lens of the eye-piece, and div it into the focal length of the object-glass, thus:

Focal length of field lens of eye-piece = ¾ in.
" " " object-glass .. .. = 24
∴ magnifying power = $\frac{24}{\frac{3}{8}\text{ of }\frac{3}{4}}$ = 64

—E. A. F

Fountain.—W. J. (*King's Cross*).—So many readers of WORK have made up the fountain described in No. 69, and find it work successfully, that it is clear you have not quite carried out every detail. The height to which the jet will play is determined first by the *distance between* the upper and lower vessels (compared with which it must always be less), and by the friction of the outlet and also its shape; and the highest jet is produced with a pipe and jet formed of one continuous tapering passage, without a tap. The reason the water does not rise instantly is because some air gets in the way of the water in the down-pipe and temporarily checks the pressure—a small trouble. Do not mind how many pints of water go down the pipe, but be sure the basin is about half full or more, so that you get the maximum pressure.—C. M. W.

Beehive.—G. W. C. (*West Butterwick*).—You know, I suppose, that the standard frame is 14 in. long by 8½ in. deep. The breadth of a hive in which standard frames are used is 14½ in., thus allowing ⅛ of an inch at each end of the frames; and the depth is 8½ in., thus allowing the frame to be from the floor the thickness of the top bar, usually ⅜ in. or ½ in. The frames are $1\frac{3}{16}$ in. apart, and if we multiply this by 12, which is about 17½ in., we have the inside length of a hive capable of holding twelve frames. Therefore, the internal dimensions of your hive will be 14½ in. × 8½ in. × 17½ in. For the rest, make a box this size, with double walls, roof, and floor-board, and you have a good hive. Read my papers on Hives, etc., which run through the second volume of WORK.—APIS.

Reversing Gear for ¼-Horse Engine.—ERIC.—Are you sure you really wish to go in for this? It would be impossible to give you "lucid" instruction in "Shop." Link motion has more in it than you think, perhaps; besides, engines of this sort rarely have link motion. A locomotive must have it, and so must a crab-winch, but an engine to drive an amateur's shop does not require it. If he wants his lathe to reverse, he uses two loose pulleys and an open and crossed belt; he can't well leave his lathe and run to the engine when he wants to stop, start, or reverse. If you require to reverse *occasionally* for a short time, that would not hurt the guide-bars, and you could use a slip eccentric, which would turn half-way round on the shaft.—F. A. M.

Procuring Papier-Mâché. — S. B. C. (*Liverpool*).—Try McCallum & Hodson, Summer Row, Birmingham. To procure an equal strength, you will certainly require a greater thickness in papier-mâché than in tin-plate.—S. W.

WORK Subjects.—H. P. (*Langley*).—All the subjects you indicate shall be duly considered.

Boys' Golf Balls.—J. W. H. (*Edinburgh*).—For golf tools, apply to Slazenger, 56, Cannon Street, London, or McEwan & Son, Chingford.—J. W. H.

Boxwood Modelling Tools.—J. A. (*Birmingham*).—Lecbertier Barbe, Regent Street, London, supply boxwood modelling tools at moderate prices; also G. Philip & Sons, Fleet Street, London, sell them.—W. E. R.

Cylinder.—INNEK.—No; not without making a new portion, and soldering or screwing on. Better to have a fresh casting.—J.

Temper Bits.—R. F. (*Norwich*).—See my articles, entitled "Practical Papers for Smiths," in Vol. III. of WORK.—J.

To Strain, Mount, and Varnish Prints, etc.—A. C. C. (*Rochford*).—The linen or calico must first be stretched on a plain strainer (either skeleton or panelled). This should be done by tacking it tightly; then it must be thoroughly coated with strong size, and left till nearly dry. The sheet of paper or print to be mounted must be well covered with carefully made paste—*i.e.*, well stirred paste about as thick as porridge, with a pinch of alum boiled with it, then squeezed and strained through coarse canvas. It is best to paste it twice, leaving the first coat about ten minutes to soak into the paper. After applying the second coat, place the paper on the strained linen, and dab all over with a clean cloth. When thoroughly dry, which process must not be hurried, give two coats of thin size (a piece the size of a small nut in a small cupful of hot water will be strong enough); or if the engraving be anything very choice, size of the same strength as above, but made of gelatine, is better; when dry, varnish with white hard varnish. A plan I have adopted for ornamenting such rooms as nurseries, bedrooms, and "snuggeries," is to take some of those excellent colour reproductions, and sponge the backs with clean water; when half dry, paste *round the edges only* about ¾ of an inch, and lay on the wall, dabbing all round. You will find them dry quite tight and strained. You can then size and varnish them as before directed. They will then last fresh for years, and can be washed at any time with freedom.—F. B.

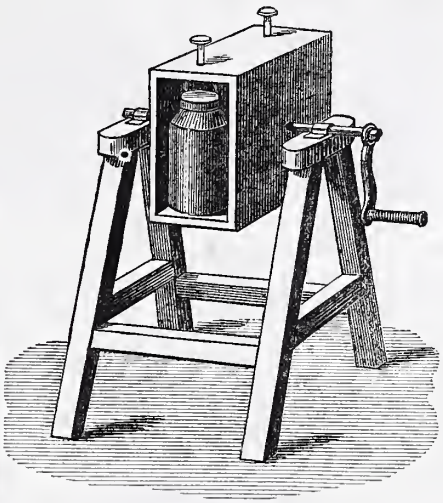
Pigeon Trap.—E. W. (*Chirk Green*).—You had better consult a local man.

Upholstery.—L. (*Pontefract*).—I must frankly confess that I am unable (and I believe no other contributor is able) to give better advice to L. than is given on page 807, Vol. II. I may add that to cover a scroll you had better tack here and there, not driving the tacks home, but altering and regulating as found necessary.—B. A. B.

"Great Eastern" Models and Catalogues.—Our numerous readers who have written as to these, in reply to MODEL S. L.'s query (see page 814, Vol. III.), should advertise in our "Sale and Exchange" column.

Self-Acting Fountain.—A. W. (*Canning Town*).—You should advertise in the "Sale and Exchange" column of WORK.

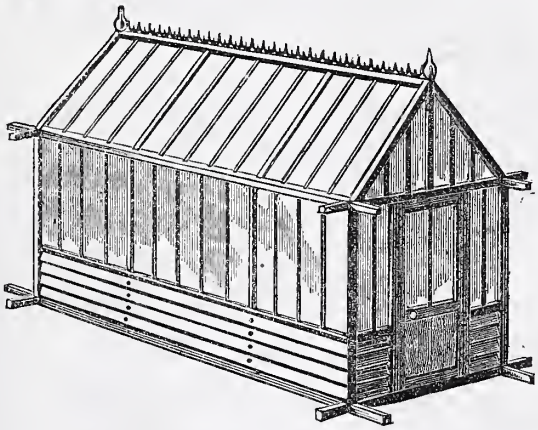
Churn.—W. J. B. (*Deptford*).—If I were going to attempt to make a churn, I should obtain a couple of glass jars as large as possible, with as large necks as can be had. I have seen such jars for French



A Domestic Churn.

plums and confectionery. Also a grindstone spindle, which, with roller bearings, can be had for 3s. in malleable cast iron. A frame must be made to contain the jars, having a screw adjustment to fix them. This fixture must also assist in keeping the cover on the jars. I think, however, that it will be better to buy a churn ready for use. One capable of making 1½ lb. of butter at a churning may be had for a small sum of Kent & Co. I fear the proper jars can only be had by buyers of complete churns.—B. A. B.

Conservatory.—H. B. (*Finsbury Park*).—The probable cost of a greenhouse for tomatoes, 9 ft. × 6 ft. × 6 ft., would be about £2, plus labour, varying, of course, according to materials used. As you require it to be easily removable, I should recommend you to make the base-frame like a large "Oxford frame"—a form which is capable of bearing a great strain. The ends of the cross-pieces



A Portable Greenhouse.

should project about three inches; the same remark also applies to the top frame. The uprights should be tenoned into the centres of the cross-corners, and into the side lengths where required, say 3 ft. apart on the 9 ft. side, using also two uprights at each end for doorposts; 2 in. deal would be a suitable strength for the entire frame except the ridge board, which should be about 4 in. wide by ¾ in., fixed edgewise. Do not use any other form, as this is the best to avoid sagging in the ridge. The joints must be tenoned true and neatly; and if this part of the work is well done, you will avoid the creaky, ready-to-tumble-down effect which is often the accompaniment of a portable glasshouse. You can buy sash-bars ready moulded at any timber yard; these should be partially let into the framework and fastened with screws. The lower part of the sides may be conveniently fitted with match-boarding, also fastened with screws. For the purpose of growing tomatoes, it will not be necessary to fix the glass with putty, but let each overlapping square of glass be held with a strip of sheet zinc, the whole being held in position by a narrow strip or lath of wood on each sash; this will facilitate removal while not materially injuring the efficiency of the house. As you say you can use a few tools, I have confined my remarks to a general outline only; you can set out your quantities from the drawing herewith.—C. M. W.

Fretwork Tool.—A. E. G. (*Leicester*).—The "best tool" for rebating fret frames—such as carte-de-visite photo frames—would, in my opinion, be a lathe with a small stout circular-saw, which would cut the rebate at one operation; but as it may be that the questioner has no lathe, he can cut the rebates with a cutting-gauge, having a short stiff cutter sharpened well, or he may use a gauge such as that used for inlaying lines in furniture, the tooth of which is a scraper, and removes wood in the form of dust-like shavings equal to its thickness. Either of these tools, used on the back and inner edge, will cut out the rebate almost to the corners, which can afterwards be cut out with a sharp chisel.—B. A. B.

Liquid Glue.—ANON.—There is no way of keeping any liquid glue in an open vessel to be ready for use at any time. Still less will "ordinary carpenters' glue," by any addition, remain liquid and equally useful. The usual solvent for liquid glue is very dilute nitric acid or acetic acid, but I should not use or recommend it for ordinary work. Bichromate of potash is sometimes added to glue: it is said to render glue insoluble after exposure to light. There are some fish glues and other special cements in liquid form, but all are expensive, and some have the acid to which the querist objects.—B. A. B.

American Organ.—J. H. (*Westleigh*).—Octave couplers can be bought or made, so can the fan for the vox-humana. If I had to fit both to an American organ, I should buy the octave coupler, but make the vox-humana. The octave coupler will cost 7s. 6d., one half up, and the other (bass) half down. Ask for Wilcox's patent wire coupler. The vox-humana consists of a fan, part of which revolves by the passage of air into the suction bellows, the rest of which passes along the back of the tube-board, having a cardboard sail affixed through the axis. The fan can be had for 2s. 3d. The casing of the actuating part and the valve will have to be made by the querist; but if he buys the fan, it will suggest at once how it is to be fitted. Dealers in fittings would do well to advertise prices in WORK.—B. A. B.

Enamel for Pony-trap.—T. E. B. (*Sidbury*).—Do you not mean varnish? A pony-trap is mostly of two or more colours—black and fancy colour—besides relief lines. One colour will not serve, unless all black; then carriage japan is used. If another colour as well is wanted, Whittingham & Wilkins, Long Acre, W.C., would match your colour, if such be desired, and send what you require, with suitable brushes. Even then the boot, nose-hoops, and parts of ironwork should be japanned. This they would supply, with colour for relief lines and pencils for use, if you could not get them elsewhere. Of course, the old varnish must be partially rubbed off with pumice-stone and water—solid and in fine dust—with woollen cloth pads. All rusty parts must be filed and touched in with priming or lead-colour before the rubbing down commences; that keeps the water from the iron and bare wood. The whole is then primed over with very thin lead-colour, and then a second time; then the fancy colour; then the relief lines; and, finally, copal varnish. Every coat of paint has to be flatted with pumice-stone and water, and washed very clean, and to be dry before another coat is put on. Be particular to take all you can apart to paint, and to put together again when all varnished and black parts are japanned. Avoid oil from axle and boxes of wheels touching any painted parts, by cleaning and washing with turpentine before beginning the job. Relief colours are sometimes only given to the fronts of spokes in the naves, and by a different coloured stripe being painted round mouldings and broad surfaces; these are laid on thin with suitable pencils. Varnish follows. This will be a ten or twelve days' job, and should look and wear well. But possibly touching up and varnishing might serve the purpose; this will only take three or four days to dry ready for use. You proceed as if you were about to repaint, by touching in rusty and bare places, first with lead-colour, then pumice-stone; dust off all surfaces, and touch up with match colour where wanted. Then varnish all over, and japan black the parts. Keep all brushes swung by the handles in colour or varnish, and a card cover or a floorcloth one over the paint pots. Let all coats be well brushed in, and only the varnish a full coat.—J. C. K.

Dye for Branding Cattle.—J. H. M. (*County Meath*).—A preparation, of which an "aniline" dye is the basis, will be the thing for your purpose. Whether anything of the kind has hitherto been used for cattle we do not know, but this is what is used, in what are called "Homing Societies," for marking carrier pigeons, and what will do for the one will, of course, do for the other. You want a dye which will "last for a reasonable length of time." This will answer that requirement; indeed, you will not find it easy of removal. It is applied with a rubber stamp, which you can have made to

any device or size. You see the advertisements of the makers of such stamps everywhere. You can get the prepared "ink" in either small or large quantities from Thornton, Redditch.—S. W.

Reviving Kid.—BASHER.—There are plenty of "kid revivers," sold as such, which will give the gloss you want. White of egg (albumen) will also do it. French polish—that is, shellac dissolved in alcohol—is also good to give a gloss to leather, but if used for your purpose, it would have to be very thin, and rubbed very lightly over the surface with a soft rag; if saturated with it, the kid would be rendered hard.—S. W.

Weather Glass.—H. McG. (*Cork*).—This correspondent asks how to construct a weather glass on the American system—*i.e.*, a liquid enclosed in a tube which, by the position and appearance of a crystalline deposit, indicates the "coming" weather. These glasses are really not weather indicators at all, except that they indicate to a certain extent the weather which *we are having*. They are made in two ways: either with a brass cap with a very minute hole in the top or hermetically sealed glass tubes. To make one, take a glass tube about 12 in. long and ¾ in. diameter. In this place the following composition: Camphor, 2 drachms; potassium nitrate (nitre), 1½ drachms; ammonium chloride (sal-ammoniac), 1 drachm; methylated spirit, 2½ fluid ozs. Dissolve the camphor in the spirit, and the nitre and sal-ammoniac in as *little* water as possible. Add the two solutions together, and place in the tube. Draw out the end of the tube and seal up before the blowpipe. The action of these so-called weather glasses is really one of the variation of the amount of solid which can dissolve in a given liquid at variable temperatures.—J. G. L.

Machine for Grinding Edges of Glass. — I am sorry to say I cannot give you the address of a firm supplying these at present. I expect you mean the same kind as are used to prepare the glass for microscopic slides. Perhaps some of our readers, seeing this, may be able to help you; if not, I will bear it in mind, and hope to be able to let you know through "Shop" before very long.—W. E. D., JR.

Wiped Joint.—S. D. (*Harmondsworth*). — To make a joint similar to that termed a plumber's or wiped joint is not very difficult in some cases, such as when the pipes are easy of access and lying horizontally, but when the pipes are in awkward positions, then it is that considerable skill and practice are needed. In the case you mention, such as a burst pipe that you want to repair without cutting, proceed as follows: Close up the crack with a hammer; see that the water is all out of the pipe, or some distance below the flaw; scrape the pipe clean with a shave-hook or knife a little farther than the crack extends, and coat the pipes each side of the scraped part with "soil"—this is a technical term for a mixture of lampblack and glue-water, used on parts of the work where the metal is not wanted to stick. You must also be provided with some "wipes" or wiping cloths—they are usually made of fustian, two or three or more thicknesses stitched or folded together, and of various sizes, according to the work to be done. To make the joint, melt a quantity of plumbers' solder (two parts lead, one part tin) in a metal pot or large ladle; rub the part to be soldered with some tallow, and either pour or splash on to it with a flat stick the hot metal; it is usual to pour a little metal on to the joint to get the heat up (of course, with something underneath to catch it) before commencing to splash on the metal that is to make the joint. When sufficient metal is on the pipe, take a cloth in the hand and, bending it into a hollow shape, draw it round the joint. The metal should be sufficiently plastic to be wiped into the proper shape, which is something like a long egg—no doubt you know that. Two or three trials in the workshop after these hints will soon show you whether you can manage it or not. If the metal gets cold before you have properly shaped the joint, you must warm it up again with an iron.—R. A.

III.—QUESTIONS SUBMITTED TO READERS.

*** *The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Fretwork.—J. McC. (*North Brixton*) writes:—"Would any reader kindly inform me where to procure a cheap and simple book of instructions to beginners in fretwork?"

Fernery.—E. H. (*No Address*) writes:—"I shall feel obliged if a brother reader will give me a design for a fernery for a window, with advice as to about putting in the ferns."

Bagatelle.—W. E. (*Battersea, S.W.*) writes:—"I am anxious to make a French bagatelle table, but not knowing the different bells, holes, etc., perhaps some reader would kindly give me information on the subject."

Address. — LABOURER asks for the address of Adams & Bishop, Publishers, New York, U.S.A.

Carriage Monograms. — COACH PAINTER writes:—"Will some reader please give me two designs of monograms, 'M.W.C.' and 'P.L.G.,' suitable for coach painting?"

Match Making.—T. M. (*Wakefield*) writes:—"Will someone tell me how to mix match brimstone, how many kinds of materials there are, and how mixed up together?"

Tin—Geometry. — YOUNG READER writes:—"Will any reader tell me whether large quantities of good tin canisters could be sold or turned to any account? Also, I want a good book on geometry for beginners."

Steel Blue.—A. B. (*Sheffield*) writes:—"I should be pleased if any reader would tell me how to get blue off steel after stiffening."

Fire Lighters.—W. B. (*Queensbury*) will thank any reader to state the best way of making fire lighters.

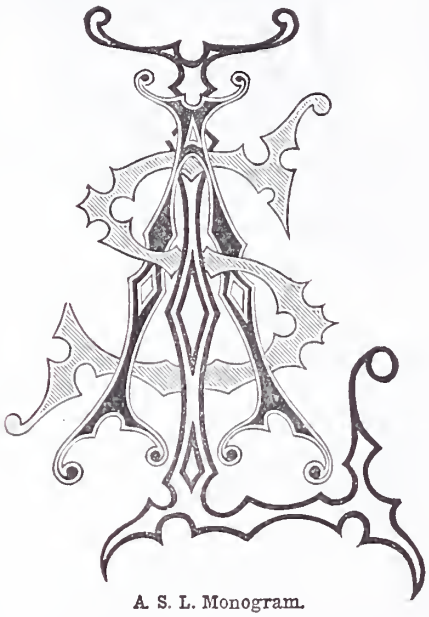
Label Damper. — W. C. (*Banbury*) writes:—"Will any reader kindly furnish, through 'Shop,' the name and address of firm manufacturing label dampers similar to those supplied to Hudson's?"

W. H. R. Monogram.—W. H. R. (*Commercial Road*) will thank a brother reader for a monogram for W. H. R. for carving in a circle 2½ in.

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Leather Work.—A READER writes, in reply to J. B. M. (*Blairgowrie*) (see No. 156, page 830):—"Walter Strachan, Novelty Leather Worker, Bervie, N.B., will undoubtedly furnish you with the necessary information."

A. S. L. Monogram.—J. B. writes, in answer to R. R. (*Greenock*) (see No. 156, page 830):—"I hope the monogram design below will be of use to you for the top of workbox."



A. S. L. Monogram.

Syrups.—J. H. (*Newton Moor*) writes, in answer to W. W. (*Glasgow*) (see No. 159, page 46):—"A book published by E. Skuse, Praed Street, London, W., on 'Syrups and Aerated Waters,' will meet all requirements."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—J. B. (*New Cross*); LITTLE JIM; AMATEUR BALLOONIST; T. H. D. (*Wood Green*); NOVICE; C. W. D. (*Hammersmith, W.*); W. H. (*Peterborough*); PAINO; C. H. D. (*Shepherd's Bush, W.*); HYDRAULIC DRIVER; A NEW READER; J. A. (*Thirsk*); T. B. (*Great Orton*); G. G. (*Farnworth*); TOM; E. H. (*Bethnal Green*); HYSTERESUS; S. W. (*Ashton-under-Lyne*); A. S. B. (*Loughborough*); TAXIDERMIST; H. A. H. (*Leeds*); F. W. R. (*Sunderland*); R. T. (*Hounslow*); DOUBLE GEAR; D. B. (*New Mills*); G. E. W. (*Swanley Junction*); J. G. (*Bala, N. Wales*); W. H. S. B. (*Derby*); D. B. D. (*Penryn, Cornwall*); ONE WHO WISHES TO KNOW; W. G. G. (*Hornsey Road*); W. J. B. (*Londonderry*); A. T. (*Macclesfield*); S. J. (*Failsworth*); E. C. (*Leyton*); A. F. (*Ovenden*); F. H. W. (*Liverpool*); NEMO; R. A. K. E. (*Peckham*); AMATEUR; R. T. (*Glasgow*); E. K. (*Smethwick*); W. W. (*Aylesbury*); J. R. B. (*Accrington*); G. C. (*Stratford-on-Avon*).

"WORK" PRIZE COMPETITIONS.

THE Editor of WORK has the pleasure of calling the attention of his readers to the following scheme for Prize Competitions, which he will feel obliged by their bringing under the notice of friends and others interested in any of those departments of work, or employment, which the prize scheme is intended to stimulate.

Fully sensible of the interest which many thousands of the readers of WORK take in matters of a competitive nature, this prize scheme has been deemed a suitable sequel to the WORK Exhibition, in which so many readers obtained honours.

It is manifest that a prize scheme to appeal to the varied constituencies of WORK readers could not be covered by one competition. Therefore our plan must necessarily be given in separate instalments. We shall, however, endeavour to arrange that all our readers—professional and amateur, craftsmen, apprentices, and hobbyists—shall be cared for in turn.

A general subject has been considered best with which to commence; and as most of the readers of WORK and thousands of the outside public know something of bicycles and tricycles, competition is invited for the best essay upon

"The Cycle: Its Worth to the Nation."

For the three best essays the following prizes will be awarded—

First Prize, £3;
Second Prize, £2;
Third Prize, £1.

CONDITIONS AND RULES OF THE CYCLE ESSAY COMPETITION.

ALL Essays to bear the WORK Prize Coupon, cut from one of the numbers of WORK in which the prize scheme is announced.

Each Essay to be signed with an original *nom de plume*, and to have the writer's real name and address securely attached to the manuscript in a sealed envelope.

No Essay to exceed more than two pages of WORK in extent, including any diagrams that may be necessary to elucidate the text.

In the work of judging regard will be had to original suggestions of value affecting the improvement of bicycles and tricycles, especially where such improvements are shown by diagrams.

All Prize Essays and Drawings to be published, if desired by the Editor, in WORK, the copyright thereof to remain with the authors.

Copies of MSS. and Drawings to be retained by the competitors, as in no case can the return of MSS. be undertaken.

The Editor of WORK will supervise the judging of the Essays, and the selection as determined upon is to be final.

All manuscripts intended for the Cycle Essay Competition must be addressed to the Editor of WORK, c/o Cassell & Co., Ld., Ludgate Hill, London, E.C. They must reach him not later than Saturday, June 25, and should be legibly endorsed on the envelope or wrapper, "WORK Cycle Essay Competition."

SALE AND EXCHANGE.

Victor Supply Co., Grimsby, sell Mail-cart Wheels & Parts. [

Beit's Patent Enamelled Adhesive Waterproof Advertising Paper Letters and Figures in all colours and sizes. Best and cheapest. Liberal terms to agents. Sample sheets, gratis.—Factory, 17, Arthur Street, W.C., London. Sole Agents for the United States of America and Canada: The Flash Light Advertising Signs Company, 862, Broadway, New York. H. I. WILLIAMS, Wellington, New Zealand; Melbourne and Sydney, Australia.

Caplatzi's Matchless Technical Collection embrace most things electrical, optical, mechanical, chemical, photographic, models, materials. Catalogues, 2d. Chenies Street, Bedford Square. [

Lettering and Sign-Writing made Easy. Also full-size diagrams for marking out eight alphabets, only 1s.—F. COULTHARD, Darlington Street, Bath. Decorators' Stencils (60 large sheets), 2s. 6d.

100 Fretwork Designs (new), 100 Carving, 100 Repoussé, 30 Fret Brackets, 100 Sign Writer's Stencils (full size), 300 Turning, 400 Small Stencils. Each pack 1s.; postage free.—F. COULTHARD, Darlington Street, Bath. [

Fretwork Designs.—40, 7d.; 12 brackets, 1s. Catalogue 300 miniatures, 6d. Lists free.—TAYLOR'S Fretworkeries, Blackpool. [1

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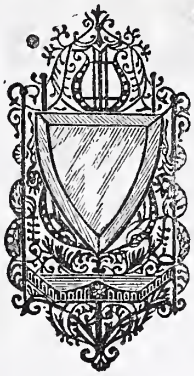

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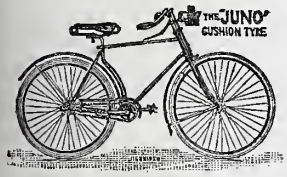

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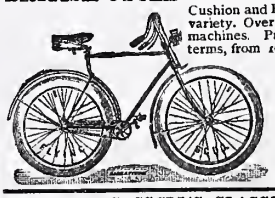

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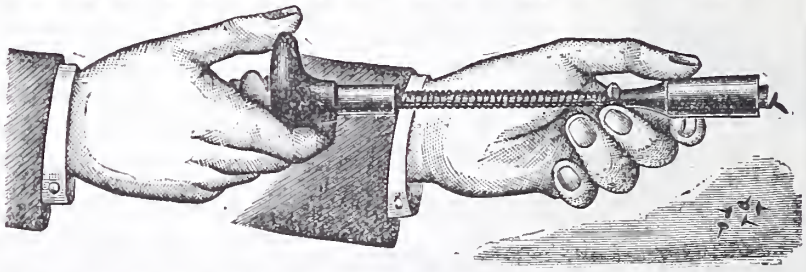

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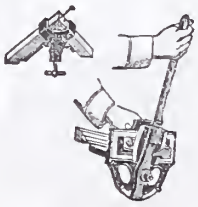

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WORK

An Illustrated Journal of Practice and Theory

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VOL. IV.—No. 169.] SATURDAY, JUNE 11, 1892. [PRICE ONE PENNY.

WORK WORLD.

ELECTRIC boats are already in use on the Manchester Ship Canal between Eastham and the Weaver. The boats are a success, and a fleet of them will shortly be afloat.

* *

An instrument has been designed for drawing parabolas of short focus, such as are required for reflectors. Its construction is based on the property that every point in the curve is equidistant from the focus and the directrix.

* *

Cement is wanted in Russia. Vice-Consul Robinson represents that there is a demand for cement, of which a dearth exists in Russia. There are only 800,000 tons of cement made in Russia—in England 8,300,000 tons annually. A large trade awaits the enterprising British merchant.

* *

A chance for cycle makers presents itself in Belgium. The Belgian Minister of War has announced that a series of cycle trials will be held between June and November this year at Wavre to decide upon the type, pattern, and make of machines to be ultimately adopted by the Belgian army. English manufacturers should go in—and win.

* *

Large glass tanks for chemical manufacturing processes have long been a desideratum. The largest tanks have hitherto been produced by blowing, and never exceeded a length of 2 ft. The Armstrong Glass Company have now succeeded in making large tanks by a process of building up the tank with plates or sheets of glass, and then fusing the edges together.

* *

An important find of coal has been made at Bredbury, near Stockport. After two years' labour a good coal seam 5 ft. thick has been reached. The mining engineers had considerable difficulties to encounter in sinking the pit, the red sandstone giving off much water. This has been shut out of the pits by about eighty yards of cast-iron lining.

Workmen have begun raising trusses to support the roof of the Manufactures Building of the Chicago Exhibition. These trusses—twenty-two in number—will be the largest in the world, each covering a span of 688 ft. Over the centre of the roof, inside, to the ground floor, will be a distance of 206 ft. Each truss weighs 200 tons, and a total of 6,000 tons of steel will be used in the roof of the building.

* *

A steel wire railway carriage seating is taking the place of padded, and volute spring seats. The new seat consists of minute steel wire rings compactly knitted together, with a thin layer of hair or felt padding over them. The London & North Western and Great Eastern Railways are adopting them. Something now needs to be done, especially by the underground railway companies, to guarantee us from infectious diseases which can be so readily taken in much frequented and indiscriminately used railway seatings.

* *

Considerable interest has been excited in engineering circles concerning a process which has been discovered for enamelling the interior of boilers, with a view to the prevention of corrosion and incrustation. Experiments have been proceeding with the process for the last three years, and the results are certified to be of a most surprising and successful character. More tests are being applied, and if what is claimed for the process be definitely attained, the gain to engineering generally will be great.

* *

In the Brin process of production, oxygen is absorbed by baryta heated to a temperature of about 1,100° Fahr. The baryta is subsequently heated to 1,600°, when it gives off the oxygen previously absorbed. A producer capable of yielding 10,000 cubic ft. of oxygen in twenty-four hours consists of twenty-four cast-iron retorts, 13 ft. long, 6½ in. internal diameter, and 1 in. thick, laid at an angle of 30° to the horizon. These are charged with 2,100 lbs. of baryta; air is forced in at 10 lbs. pressure above the atmosphere, and the oxygen is exhausted at a vacuum of 13 lbs. Before entering the retorts the air is passed through lime and soda purifiers to remove carbonic acid and moisture. The retorts are heated by a carbonic oxide generator.

Plate-glass bricks are being made from the sand formed in the grinding of the glass. The glass is ground by a reciprocating movement of damp quartz sand over its surface, the sand resting upon iron plates having an oscillating motion. The quartz cuts into the glass and iron, and becomes mixed with both, and when sharp edges and particles of sand were worn away, such was heaped up as worthless, but is now made into bricks. After being dried, it is forced into a mould under a pressure of several thousand pounds per square inch. The bricks thus formed are then baked at a temperature of 2,732° Fahr. These bricks are perfectly white, will withstand frost, are not attacked by acids, and will resist a crushing force of from 800 lbs. to nearly 1,000 lbs. on 0·155 square inch. We can imagine a variety of directions in which a glass brick might be employed with especial advantage to those who build houses, and still more so to those who have to live and work in them.

* *

A new hand camera will shortly be in the market. It is light and compact, with a new method for change of plates. The camera for ¼-plate size measures 11½ in. long, 5 in. wide, and 4 in. high. It is divided into four compartments: the first contains the lens and shutter, and is in front; behind is the second, which is the exposing chamber; and behind this are two chambers one above the other. The upper chamber contains the stock of plates lying horizontally, and the lower chamber receives the plates after exposure. In these chambers is a cage, which, as a plate leaves the upper chamber, falls, and receives the same on being returned from the exposure chamber, and so on for every plate in succession, so that all the plates from the upper chamber are finally placed in the lower one. Between the two chambers and the exposing chamber is a narrow slit with a shutter, which opens and closes automatically, through which the plates pass and repass. In the exposure chamber is a tumbler balanced on its centre, and moved from a vertical to a horizontal position by a milled head from the outside. This movement changes the plates, which can be returned from the exposure chamber to the upper chamber. The plates are used in sheaths, and there are no springs, grooves, or rods, and no chance of the plates being jammed. Photographers will watch it.

ABOUT WORK AND POWER.

BY W. C. CARTER, M.I.MECH.E.

An interesting case suggests itself, which might have been discussed at an earlier stage, but it is too instructive to be omitted. Suppose that a house has at one side a lean-to greenhouse, and one day a man working on the roof dislodges a small pebble accidentally, which, falling upon the glass-house, shatters one of the panes to atoms. We pick up the pebble and look at it, and think, "Well, that is a very small pebble and looks very harmless," and we lay it upon an unbroken pane of glass without its making any visible effect upon it. If asked what change has taken place that the pebble has now no destructive powers, and from what those powers were derived, we should probably answer that its power was derived from the fall, and the velocity it attained in its descent. Of course, such a reply is quite correct as far as it goes, but we shall find it very instructive to look still more closely at the first cause.

The pebble, in breaking the glass, used up work in doing it which must have been given to it at some time. It may have been years ago, but the pebble was at some time or other carried up from the ground-level, where it was harmless, to the height at which, though lying apparently quiescent, it possessed the powers for mischief shown in the damage done; and the fact is—and it might be shown by the laws of gravitation—that the amount of work given out by the pebble when falling was *exactly* equal to its weight multiplied by the height of the house.

We see, then, that this work was originally put into the pebble by the agency which carried it up, and we recognise, therefore, in this simple case that the pebble was a machine having work put into it, to be afterwards given out exactly the same in amount, except the inappreciable loss due to the friction of the air in the fall. This case is, probably, as nearly that of a perfect machine with a modulus of 1 as could be found.

The Switchback Railway.—We have in this modern amusement a very interesting illustration of the all-pervading principle that we are studying. We have here a carriage starting from an elevated position, and depending for its motive power upon the weights of the passengers, which cause it to descend the railway at a great velocity, and then we find the car ascends the opposite inclines, and *very nearly* reaches a position on a level with the one it started from. But, having come to a standstill, the passengers are asked to alight, and the attendants pull the car up to the starting-point for the return journey, which is on a level with the original starting-point, but a few feet above the point where the passengers are discharged. Now, let us see what has occurred, in scientific language. Each passenger, in walking up the steps to reach the starting platform, raises his weight through a certain distance and performs a certain amount of work. It would not be necessary to call attention to this if, on alighting, he descended an equal distance, and thus received back the work done; but, as we know, the passenger does not descend when coming off the railway an equal distance, and thus he has given some work to the car equal to the height ascended and that descended. What, then, has become of the work which he gives up? It has gone to overcome the friction of the machine, and the efficiency of the car as a machine is exactly in the ratio of the short distance *descended* to the longer distance *ascended*. Supposing that the passenger ascended 20 ft. and the car stopped 3 ft. from the top, then the modulus of the car, as a machine, would be $\frac{17}{20}$, and the amount of work expended on friction would be equal to 3 ft. multiplied by the total weight of the passengers.

Modes of Measurement.—As we now see how important it is to be accurately informed as to the relative quantities of work transmitted by machines, we may give a little attention to the methods adopted for testing with accuracy the efficiency of steam-engines and finding their modulus.

We shall first consider the apparatus usually employed for testing the work given off by an engine fly-wheel, and shall conclude our article by describing the means used for finding the work done in the cylinder and the final triumph of scientific reasoning in this direction—the indicator.

The work given off by the fly-wheel is determined by means of a brake, so applied as to just absorb all the work the engine is capable of performing.

The apparatus is so arranged that the amount of the friction acting round the fly-wheel rim can be accurately measured. Then, as we know by timing the revolutions the distance passed through by any point on the fly-wheel rim in one minute, we can, by multiplying them together, obtain the quantity of work that would otherwise be given to the belt upon the fly-wheel.

By referring to Fig. 4, a simple arrangement will be seen which shows the principle on which such brakes are constructed. Round the fly-wheel is passed a band, A, having a weight of w lbs. on its lower end. The other end is carried up to a spring-balance, which can be tightened up until the engine has all it can stand. Then a reading is taken off the balance.

What now is taking place? The weight, w, is supported by two forces. The friction of the band on the wheel was not enough to hold it till the tension of the balance was adjusted, so that the weight is held by the two forces together. Stated differently: Weight = friction + pull of balance. But we know the weight, and can read the balance, so that the friction = weight − pull of the balance. We now multiply this amount by the circumferential velocity of the fly-wheel in feet per minute, and the result is plainly the effective work given out by the engine. If, now, we can find the work in the cylinder, we shall have the two quantities necessary for finding the efficiency of the engine and determining its modulus. For example, let us suppose the weight, w, to be 200 lbs., and that, when the engine is loaded up all she will stand, the pull on the spring-balance is 15 lbs., then the friction on the fly-wheel rim is 200 − 15 = 185 lbs. Let us suppose the rim velocity of the wheel to be 1 200 ft. per minute, then the whole work done in one minute is 1,200 × 185 = 222,000 foot-pounds; and suppose that, by the use of the indicator, we find that the cylinder develops 250,000 foot-pounds in the same time, then our modulus is

$$\frac{222,000}{250,000} = \frac{111}{125} = \cdot 88.$$

We thus perform exactly the same operation in the case of the complicated steam-engine that we did in the case of the simple wedge; and this is the point which it is desired to emphasise—viz., that, however complicated a machine may be made, the process of testing its efficiency is the same in all cases.

We now come to the crowning achievement of scientific analysis, which in its beautiful simplicity and fidelity to discovered truth can be well compared with that of the phonograph; and our concluding article shall be devoted entirely to the Steam-Engine Indicator.

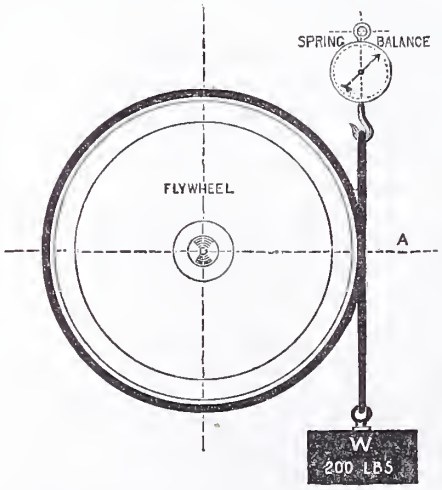


Fig. 4.—Arrangement showing Brake Principle.

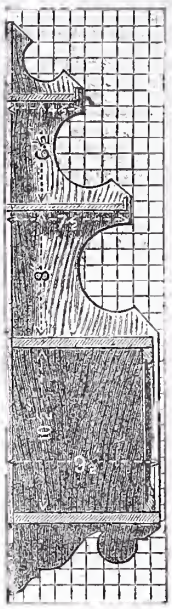


Fig. 1.—Sectional Elevation.

SIMPLE CARPENTRY: A STUDENT'S BOOKSHELF.

BY FRED CROCKER.

Materials—Construction—Polishing.

A hanging bookshelf is an article of furniture that one can always find a corner for, and although the one described in this paper is not very original as regards design, and is easily made, it looks very effective when finished. The cupboard at the bottom is used for the reception of drawing instruments and stationery, the shelves above, for text-books, and the top one for specimens.

Materials.—The sides, shelves, and front are made of $\frac{5}{8}$ in. and $\frac{3}{8}$ in. walnut, but baywood, or even pine, may be used if the maker does not like using walnut. The cupboard is backed with $\frac{1}{4}$ in. pine to keep out dust.

Construction.—Fig. 1 is a sectional drawing, not represented here to scale, but divided into squares, so that the reader may easily set it out to any size. The ends of the shelves are housed into the sides—which clean up to full $\frac{1}{2}$ in. thick—to a depth of $\frac{5}{16}$ in., and are glued. As the bottom shelf is the full width of the side, it should be only cut in $\frac{1}{8}$ in. deep at the front and the beads on shelf and side mitred.

Fig. 2 is a front elevation, giving a general view with panels, etc. The doors are framed, the stiles and rails being of $1\frac{1}{8}$ in. by $\frac{1}{2}$ in. walnut; the panels are $\frac{1}{2}$ in. thick in the centre and bevelled to $\frac{3}{16}$ in. at the edges, but if the maker has a taste for artistic

work these may be made flat and painted or carved. Some excellent designs are given in Nos. 63, 69, and 71 for painted and carved panels for hanging cabinets, and several others that may be adapted to the purpose will be found in the pages of WORK. A hollow or scotia is worked on the inside edges of the stiles and rails of the doors, and as the maker may not possess a tool for making this, a sketch of a rough one that will answer the purpose very well is given in Fig. 3. It consists of a piece of hard wood with a shoulder cut on it to form a guide, and a hand-saw kerf in which is fixed the iron of a No. 4 round, this being held in position by a wood screw. In using this tool, or scratch, as it is generally called, as much as possible is chamfered off with a chisel; then follows the scratch, and the ends are finished with the gouge. The same tool may be used to work a hollow or flute in the centre of the stiles and rails if required.

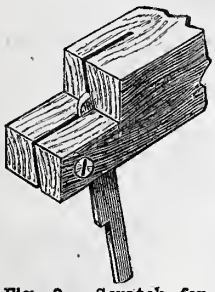


Fig. 3.—Scratch for making Scotia.

Fig. 4 is a sketch of another makeshift which is often used when a bead plane of the required width is not available. It consists of a piece of hard wood with a No. 12 wood screw turned into it and standing out the width of the required bead. In using, it is held in the same manner as a gauge, the nick acting as a cutter to make the quirk of the bead, which is finished on the outside edge with file and a little sand-paper.

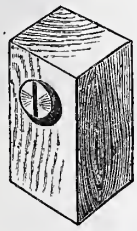


Fig. 4.—Beading Tool.

Each door is hung with two 1 in. by $\frac{3}{8}$ in. brass butt hinges, and it will be noticed that the doors are not hung directly on to the sides as is sometimes done, but a hanging piece is put on each side. This is mortised into the shelves and grooved into the sides to avoid an unsightly joint if it should shrink at any time. The other details of construction may be gathered from the drawings.

Polishing.—As the process of French polishing has been fully described in a previous volume, it will be only necessary to add that the sides, shelves, door panels, etc., should be polished as much as possible before putting together, or a difficulty will be experienced in finishing the corners.

PLASTERERS' WORK.

BY A WORKING PLASTERER.

RUNNING CORNICES, MOULDINGS, BEADS, ETC.—ENRICHMENTS—TRUSSES—CEILING FLOWERS—CASTING—MEASURING.

Running Cornices, Mouldings, Beads, etc.—Cornices are run with a wooden mould; a piece of hard wood, about $\frac{3}{4}$ in. thick, is cut to the profile of the mould, and the left-hand side, looking from the back, is chamfered away, leaving $\frac{1}{4}$ in.; a piece of sheet-brass or iron is then cut to the section of the mould and screwed to the wood, standing up $\frac{1}{4}$ in. above the wood; a block of wood, about $1\frac{1}{2}$ in. square and from 6 in. to 12 in. long (depending on the size of the mould), is fixed at the bottom of the mould, and a stay is fixed on the left-hand side, about $1\frac{1}{4}$ in. diameter. On the opposite side a triangular piece of wood is fixed, on which the surplus plaster cut off by the mould drops. Fig. 5 is a front and end view of a mould. The walls and ceilings are generally floated before commencing to run a cornice, except it is a very large one, with a good deal of work in it, when a screed only is floated, to prevent the floating getting too dry before the cornice can be finished. When a cornice has a large projection, in order to save materials, wood brackets are fixed at intervals, which are lathed and coated with mortar at the same time the ceiling is pricked up. The depth and projection of the cornice are then marked on the walls and ceiling in each angle of the room, and between these marks level screeds of gauged stuff are run on and made perfectly straight; lines of red chalk are then struck on the screeds upon the walls the exact depth of the cornice, and laths about 2 in. wide, with one edge shot straight, are nailed to these marks, forming a level surface on which the mould is to run. Two workmen are generally engaged in running a cornice. A pie of putty is formed on the board or banker; into this water is poured, and the plaster is then sprinkled into the water by hand, and the whole is mixed up by the gauging trowel. One workman then takes a quantity of the gauged stuff upon his handboard, and applies it on the line of the proposed cornice; the other workman then applies the mould at one end, and runs it along upon the lath. The surplus stuff cut off by the mould falls off upon the board at the right-hand side of the mould, and is, with another portion of the gauged stuff, applied to any portions of the cornice which have not been brought up full. When the cornice is nearly full up, the gauged stuff is made very thin, and dashed on with a brush,

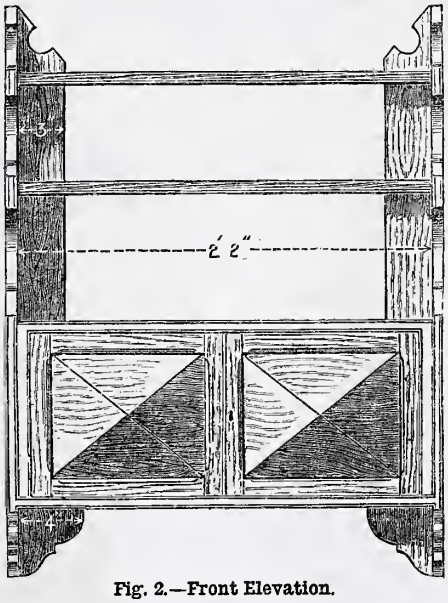


Fig. 2.—Front Elevation.

till it is run full up to the mould. Should any of the gauged stuff set, it must not be remixed with water, as it is what is termed "killed," and will not then set. Sometimes the mould (in beginning to run the cornice) is "muffled"—that is, the smaller members are filled up with plaster, which is allowed to set, and is cleaned out after the larger members have been brought up nearly full. It is essential, after the gauged stuff is mixed, that great expedition be used, so that it does not set. Where a projection, such as a chimney breast, occurs, the cornice is run past at each end as far as the cornice projects, a piece of lath being nailed on the back of the cornice lath to guide the mould. Two stays are also fixed against the projecting end of the lath to keep it firm while running the cornice. When the whole of the cornice has been run, the laths are taken down and the mitres or angles are put in by hand, by means of the mitring tools and rules. Beads, splays, and chamfers are run in a similar manner. Moulded skirtings are also run with a mould, the lath being nailed on the floor. When the skirtings are of Parian cement, they are cored or floated up with Portland cement, to save the more expensive cement.

In running circular beads or architraves, the centre is marked on a board fixed across the opening and an iron pin put in. The mould is fixed on a lath, the other end of which has a hole made in it, and which works on the pin. A screed is worked round the outside of the arch, and the mould is run round.

For elliptic arches a trammel (Fig. 6) is used. This consists of two grooves at right angles to each other. A slide with an iron pin in it works in each groove. The mould is fixed on the end of a lath, as for circular work, and two holes are made in the other end of the lath. These are fixed on the pins in the slides. As the mould is moved from left to right, the slide in the horizontal groove moves from left to right, and the slide in the vertical groove moves downwards till the centre is reached, when the horizontal slide still moves towards the right, and the vertical slide moves upwards. The distance between the two slides determines the form of the arch. When wide apart the arch is flatter, and when near, it approaches nearer to a circular form. Returned mitres, and other short pieces of cornice, are generally run on a board, squared and mitred by a saw, and fixed in position with liquid plaster.

Enrichments.—These are ornaments of various forms, cast in plaster-of-Paris. They are fixed between the members of a cornice, or at the top and bottom, and sometimes in both positions. They are cast in various lengths. Fig. 7 represents two forms of enrichments. In running the cornice, grooves or rebates are formed, into which the enrichments are fixed with liquid plaster.

Enrichments are also made of carver's compo, a mixture of glue, resin, and whiting; in papier-mâché, with a priming of whiting and glue over it; and in carton-pierre, with layers of whiting and glue. These enrichments are lighter and more flexible than those made of plaster, and can be bent and fixed with screws.

Trusses are cast in plaster-of-Paris, and are of various forms and sizes. Fig. 8 represents a truss. They generally have a moulded cap fixed on the top. They are fixed at the springing of arches and in similar positions.

Ceiling Flowers.—These are cast in plaster, and are in several pieces. Fig 9 shows one form of ceiling flower. They are fixed in the centres of ceilings, and in panels formed in ceilings. When a gas pendant or chandelier is fixed in the ceiling, the centre of the ceiling flower is cut out to fit the wood pateris of the gas-fitting. When the various pieces of the ceiling flower do not touch each other, centre lines for each separate portion of the flower are marked on the ceiling, to which the different pieces are fixed. They are also made in papier-mâché, etc.

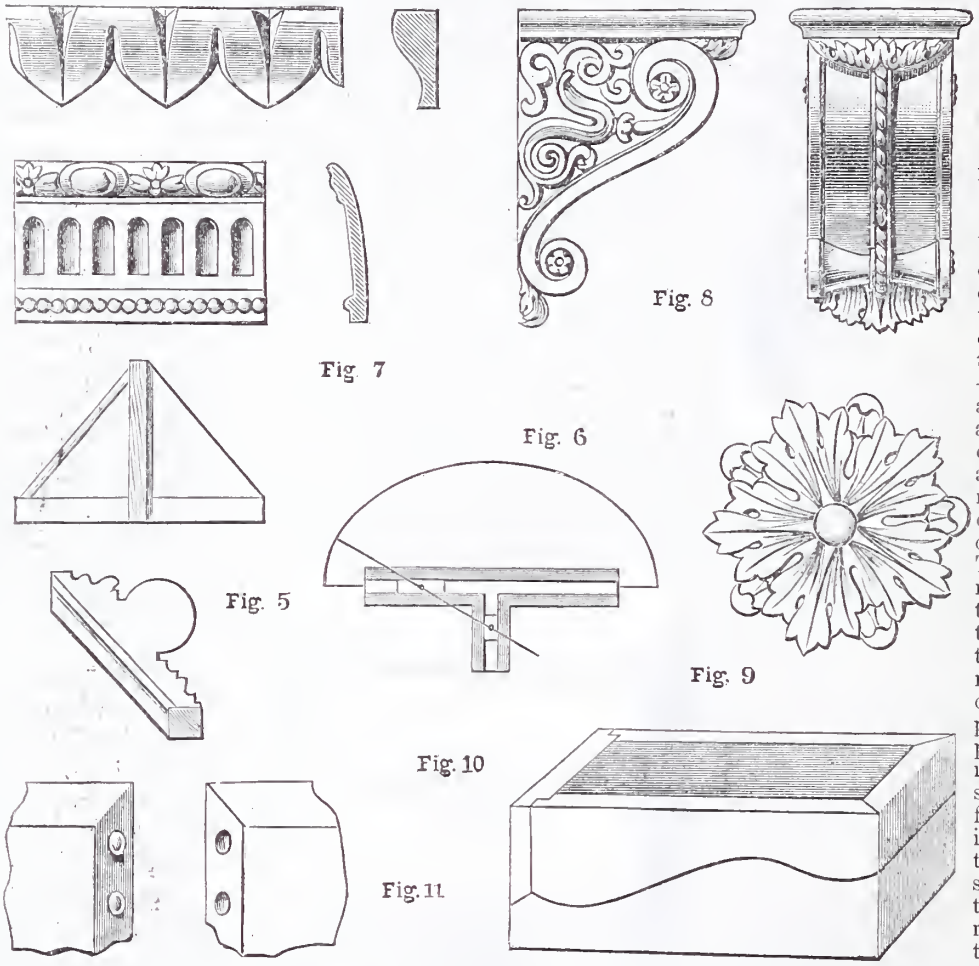
Casting.—The casting of ornamental

work for plastering is executed with plaster-of-Paris in moulds of wax, plaster, or gelatine. In order to make a mould, the pattern—which may be modelled in clay or may be an existing ornament—is well oiled on the face and laid on a board, or other level surface. An open frame of the requisite size is laid round it, and the melted wax, or liquid plaster, is poured in till level with the top of the frame. As soon as it has stiffened, the frame and the pattern are taken away and the mould allowed to set hard, when it is ready for use. The mould is then oiled and filled with liquid plaster, which is removed as soon as it has set and laid in a dry place to harden. When the moulds are made of plaster, they are varnished with one or two coats of shellac varnish, to prevent the oil sinking in. A backing of plaster is generally formed on enrichments, provision for which is made in the mould. When the castings are light and of open-work, a backing of canvas, wood, or pieces of wire is put on. When the pattern is undercut, a flexible mould is used, which is made of glue or gelatine in the following manner:—

The pattern is oiled and laid on a level surface, and covered with clay to the thickness of the proposed mould. A wall of clay is then formed round it at a certain distance, and in the space thus formed a case of plaster is cast, leaving a hole at the top for pouring in the melted gelatine, and a few air-holes round the side of the case. As soon as the case has set, the pattern, with its covering of clay, is taken out. It is again oiled and covered by the case, and the melted gelatine is poured in, the air-holes being plugged when the gelatine has risen up to them. As soon as the mould has set, the pattern is taken out, the mould is oiled and filled with plaster, and, when this has set, it is taken out of the mould. Great care is needed in removing the mould, so as not to break off any of the projecting parts of the cast. If the mould should get too hard, it is softened by heating or dipping it into hot water. In some cases a plaster case is not required.

Piece-moulds are also used for casts which cannot be drawn from the mould. They are formed of plaster, and jointed together. Fig. 10 shows a piece-mould for a truss in five pieces. It is formed in the following manner:—

The pattern is laid down and levelled up all round to the requisite height with clay, about 1 in. wide. Round this a wall of clay or open frame is laid. The pattern is oiled, and this is then filled with plaster. As soon as it has set the plaster mould is taken off, and dowel holes are formed on each side by cutting the plaster out (as shown in Fig. 11). The mould with the pattern in it is then laid down, and a wall of clay formed at each side. These spaces are then filled with plaster, which is removed when set. The plaster will have run into the dowel holes, and will form pins, so that it will go together again. Dowel holes are then cut in the ends of these pieces, and walls of clay formed at the two ends, which are filled with plaster, and so complete the mould. When quite hard it is bound tightly together with cord, oiled, and filled with plaster. When this has set the mould is taken away in pieces, leaving the cast.



Plasterers' Work. Fig. 5.—Cornice Mould. Fig. 6.—Trammel. Fig. 7.—Enrichments. Fig. 8.—Truss. Fig. 9.—Ceiling Flower. Fig. 10.—Piece-Mould. Fig. 11.—Piece-Mould Joint.

When piece-moulds are made for articles of a circular or irregular form, a plaster case is made for the pieces to fit into. A good deal of ingenuity will be exercised in making a good piece-mould, but when well made it will last a long time; and the only drawback to it is that small ridges are sometimes formed at the joints of the mould, which are easily removed by a scraping tool before the casts have set hard.

Measuring.—Plasterers' work on walls, ceilings, and stoothings is measured by the superficial yard. Ordinary sized openings are generally measured in, to allow for the labour of plastering the jambs or reveals. When the openings are deducted, the jambs and reveals are measured separately. The quirking of beads is measured by the lineal foot.

Rough casting and concrete floors are measured by the superficial yard.

Cornices, beads, splays, chamfers, skirtings, and architraves are measured by the lineal foot or by the superficial foot, the girth of the moulding being taken.

Mitres, breaks, and returns are counted at so much each.

Enrichments are measured by the lineal foot.

Trusses, keys, bosses, and ceiling flowers are counted at so much each.

Panellings, pilasters, fascias, etc., are measured by the superficial foot.

Copings, kerbs, and similar works are measured by the superficial foot.

The price generally includes all scaffolding, tools, etc., except in special cases.

THE IRONMONGERS' AND ARMOURERS AND BRAZIERS' COMPANIES.

BY A FOREMAN PATTERN-MAKER.

With the increasing demand for the more complete technical training for our craftsmen, it is time the City Companies—the lineal descendants and representatives of the old craft guilds—should assert their old prerogatives in the changed conditions of modern industry. They ought to do much more than they are doing for the advance of that training in craftsmanship upon which our industrial supremacy mainly depends. Our craftsmen have not the same opportunities for acquiring skill in hand-work which they formerly possessed; and this, therefore, is a cogent reason why the factory system of minute division of labour should be supplemented, and its evil effects upon individuals corrected, by the encouragement of an increased taste for hand-work. For in hand-work, after all, and not in the automatic production of machine-made goods, lies true individuality and artistic craftsmanship. Our suggestions, in brief, are as follows:—That the Ironmongers, Armourers and Braziers, and other allied Companies, shall not confine their operations to London only, but shall include the provinces in one broad scheme of practical training for the iron-work trades. That local centres shall be formed in connection with local technical schools, managed by local committees, working in unison with the City Companies. That local exhibitions shall be held annually, and prizes and certificates offered, and that the work of the prize-winners from all local centres shall be selected, and again exhibited in London, and higher prizes offered for the best productions

of the local prize-winners. In this way, London and the country towns will be brought into touch with one another, a generous spirit of rivalry will spring up among craftsmen who are at present practically as much sundered as though they lived at the Antipodes, and such a stimulus will have been given to artistic hand-work that will revive the best traditions of the mediæval ages, and do more to counteract the depressing influences of the modern factory system than any of the recognised labour movements of the time.

As regards the nature of the work to be done, it is clear that it must in all cases be work which can be done at home, without the aid of machines—that is, with tools and appliances operated by hand only, without the aid of motive-power. This puts whole classes of metal-work out of the category at once; but it would embrace light forging, light casting in brass, all model work, all repoussé work, work in bent iron, and all art iron-work suitable for lamp brackets, screens, grilles, hinges, locks, and almost all work in bent and hammered brass and copper, for domestic and ecclesiastical service. It would be advisable, perhaps, to give a wide range of choice of subjects to intending competitors in the field of design; yet, in some classes it would seem fairer to issue a design to be worked to—prizes to be given for the most perfect embodiment of that particular design. In the case of model work, for example, engines and other motors, and mechanisms might figure largely in the general class; but in special classes it would be well to confine competitors to the execution of small models in metal illustrative of, say, fundamental mechanical movements, kinematic chains, and the simple machines and motors. In this way a knowledge of the leading principles of mechanics would be combined with handicraft. Further, in this time of the development of the applications of electricity, models of the various types of dynamos and of installations of electric lighting might be placed in special classes for competition. So, too, boring small cylinders to micrometer measurements, and originating straight-edges and small surface plates, chasing screws by hand, filing cubical blocks, and so forth, somewhat on the lines of the competition for Whitworth scholarships, might be made matters of special competition. This would be fair and equal, because the question of design would not come in to complicate the choice of the judges in making awards for workmanship.

The expenses of such exhibitions would not have to be borne wholly by the Livery Companies. They could, however, do a very great deal. Vast potentialities lie in the Ironmongers' corporate, and trust income of £21,000, and in the similar combined income of £8,000 of the Armourers. But there is no doubt that the technical schools would be willing to accept a share. Public subscriptions would not be wanting, nor, perhaps, in time, grants of public money. Only in the incipient stages would difficulties present themselves. There is good work to be done in this direction; and none are so well fitted to take the initiative as the City Companies, with vested interests in the very heart of the empire, and with the traditions and *prestige* of centuries. Only those who are intimately acquainted with workmen have any idea how devoted these men are to the pursuit of hobbies. There is hardly a workman without his pet hobby. Here, then, is a fruitful soil for the City Companies to develop, to the advantage of the work-people themselves, and in the best interests of the nation. The Press should insist upon this.

COUNTRY CARPENTRY: A COW LODGE OF WOOD.

BY CHOPSTICK.

I HAVE commenced with a common cow lodge such as is to be found in every farmyard. Fig. 1 is the front elevation, showing the roof in skeleton—that is, before the tiles are on. It is built entirely of wood, except the quoins (A, A), which are brick, and the foundation walls (B, B), which are also brick: there are many lodges without even this, the posts being put into the ground, and the sills laid on the surface, but the better job is as here shown: brick foundations carried 2 ft. out of the ground for the sills to rest on, and brick quoins the same height to receive the bottom of posts.

As the roof of these buildings is usually framed on the ground at the timber-yard, I will proceed with that first. We never get timber long enough to enable us to get a piece 30 ft. long, so the first thing to be done is to splice the plates, or, as it would be called in some places, "scarf" them. The best way to do this is that shown in Fig. 3. I will suppose we are splicing the front plate, which is, or should be, 6 in. square. Before commencing the splicing, decide which is to be the top, front, or outside; the former should be a round side, and the latter a hollow side, for reasons which will be understood by everyone who has had any dealings with timber. This being decided on, we have a face to work from. We now take the iron square (shown in Fig. 5), and putting the long side, which is $1\frac{1}{2}$ in. wide, level with the front, we make a pencil mark along it, then moving the square to that mark, we make another and then another in the same way, when the timber will be divided into four equal portions. This answers the same purpose as the mortise gauge does in setting out joiners' work. Each member of the splicing should be 4 in. long, which will make the whole length of the splicing 16 in., and, if properly done and pinned tightly, it will be very stiff and strong. But I am getting on too fast, it must only be fastened together temporarily, as a piece of oak 30 ft. long and 6 in. square would be rather an awkward piece to handle. I need not say anything about the back plate, as that should be done in the same way.

The next thing to be done is to mortise the front and back plates to receive the end plates, which is shown in Fig. 9, the piece at W being simply waste timber, which should be left on at present. Be sure and cut away at X in the tenon, and allow for same when setting out the mortises; these mortises and tenons will be set out with the square instead of gauges in the same way as described before. Having made the mortises and tenons at all four corners, put the front plate on some blocks so that it is perfectly straight; place the back plate in its proper position, and insert the end plates in their proper mortises, when, if they do not fit, they should be made to do so by saw-scarving the shoulders. I forgot to mention that a $\frac{3}{4}$ in. hole should be bored through each mortise before fitting together; this is for the pin. When the corners are fitted perfectly, mark the pinhole on the tenon with the same bit as it was bored with (this is called "pooking" it), and then knock them apart and bore the hole in the tenon a bit nearer the shoulder than the mark, which will, on the pin being driven in, draw them firmly together and make a good strong job.

All the corners and splicings being now pinned together temporarily, block the ring thus formed level and straight, and out of winding, and this being done, the next thing to do is to fit on the ties, L. I have shown the proper way to do this in Figs. 5 and 8, the former showing how to apply the iron square so as to get a good fit, and the latter showing the "corking," as it is called, cut, the shaded portions being cut out, and leaving a dovetail in the middle which can be marked on the plates. Both ends of the ties should be marked at once, as it is a great chance if they do not twist somewhat, but by striking with the square as shown, they will bed down perfectly even if they are 1 in. out of truth. The ends can be left to be cut off after the rafters are on. We have now the ring with the ties "corked" on, and will next frame the principal rafters.

First take a common rafter and set it out to the proper length; this is usually found as follows: if the roof is to be covered with tiles the rafters should be as many times 8 in. in length as the building is feet in width (if slates, 7 in. will do); thus the present building being 15 ft. wide, we must get our rafters fifteen times 8 in. long—that is, 10 ft.; but as this is the length from the backing or throat, we must allow another 6 in. for the foot. We now draw a rough sketch of the roof on a board, when it is an easy matter to get the proper bevels; the thickness of the backing is usually $1\frac{3}{4}$ in. We now cut two common rafters and try them as they will have to go, when, if they do not fit, they must be altered until they will. When this is the case, mark one for the model and cut all the others from it.

It is the principals only we will deal with now. Having got them cut, take a pair of them and lay them on the frame of the building with the feet in their proper place, and the tops resting on the tie; put a block between them at the top an inch thick to answer as the ridge or pitch-board for the time being, then take a "collar" (N, Fig. 10) and lay it on the rafters about half-way up, but be sure and get it the same distance up on both, and mark on the rafters for the mortises, and on the collar for the shoulder. These are usually put together with what is called a "bare-faced" tenon—that is, only one shoulder—and the collar being only 2 in. thick, while the rafter is 3 in., it will bring it right. The tenons should be cut to the shape shown in Fig. 10, as they are then easier to mortise and put together. Before putting together for good, cut the notches for the purlin, I, when the principal can be pinned together finally, and the other framed in the same way on top of it so as to get them both alike. The next thing to be done is to set the rafters out. First measure off half the width of the building at each end for the hips, then set out between so as the rafters come even distances apart; do this both back and front, and also on the pitch-board, M, which is usually a 1 in. board, then put up the principal rafters close to the ties as shown at H, Fig. 1; put in the pitch-board, and nail temporarily. Put up the common rafters which come at the end of pitch-board close to the hips, as at O (Figs. 1 and 7), also the "jack" rafter (P, Fig. 7); this is only a common rafter.

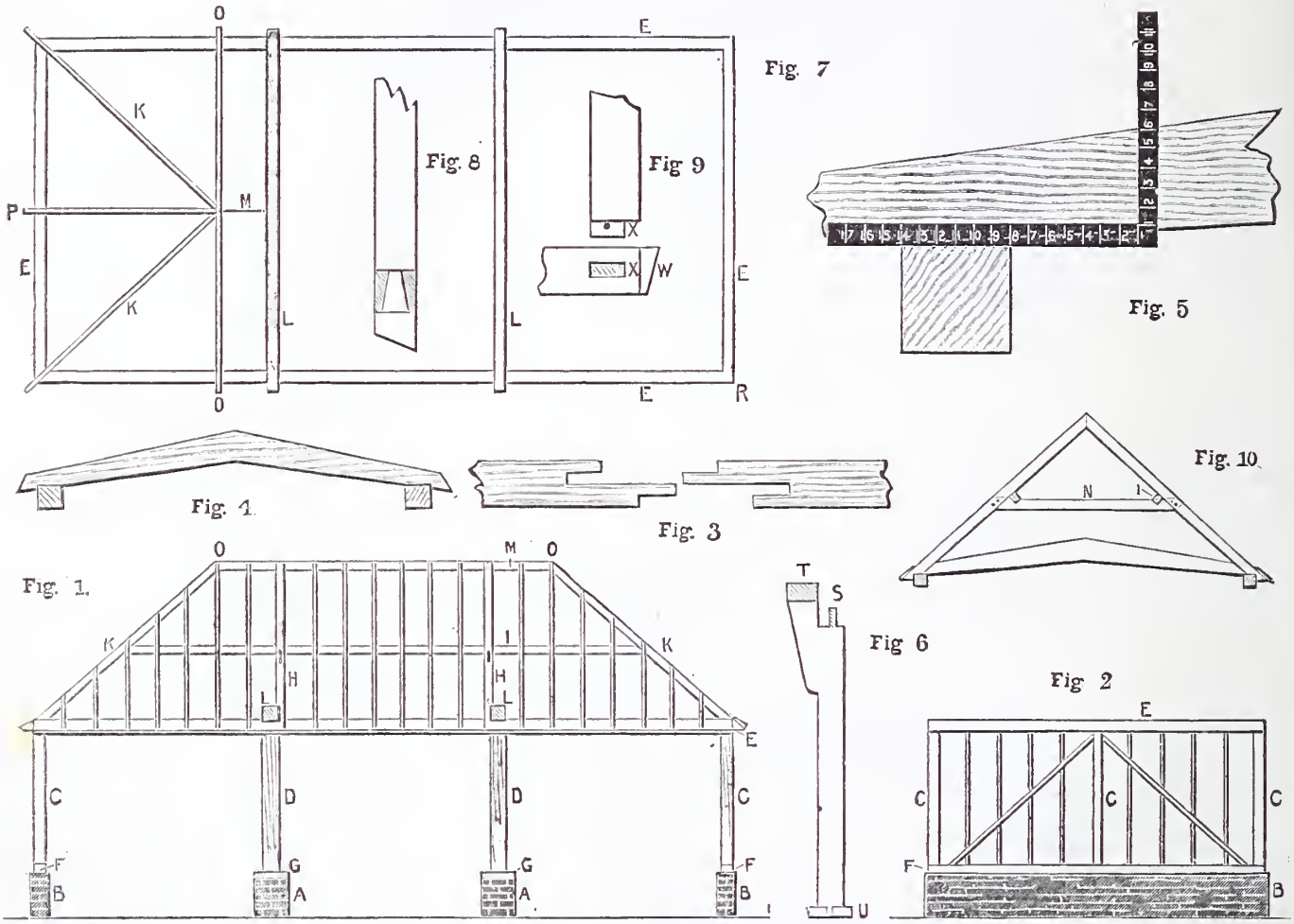
Having done this at each end, we will proceed to fit the hips (K, Figs. 1 and 7). To do this, cut off the corners as shown at R (Fig. 7), and hold the hip in its place and strike it; you will not get it right the first

time, but do not cut it too short, and you will then manage it after two or three tries. When it fits properly, try if it will fit the other corners as it should do; if so, you can cut the other three by it. The short rafters which come to the hips will require no explanation, as they only want cutting the same as the common rafters at the foot, and the right bevel to fit the hip at the top, but they should all be fitted and tacked up. The purlin can now be knocked into its place and fitted to the hips, and our roof is done so far. We have now to number every piece with red chalk before taking down. This is best done with letters, not figures.

as the back is framed in the same way, one explanation will do for the lot. First frame the plate E and the sill F to the posts C, C, C, then cut in the braces, and last the quartering, which should be mortised into the plate and sill, and nailed to the braces. I know it is the way in some places to put the braces in pieces, but that is decidedly wrong, and should never be done. The whole, having been fitted and numbered, can be taken to pieces again, and now we can put the building up in its proper place. This will require but few instructions, as it will be apparent to the most inexperienced that the sides must first be put up and then the roof. However,

also at the splicings. The end plates can now be placed in position and pinned to the front and back plates at the corners, and the frame of the building is safe.

Next get on the ties and pin to the teazle posts in front, and drive down into the corking at the back: this will fix the plates at the proper distance apart to receive the principal rafters, which should next be put on and fixed, and then the jack and hip rafters, all these being nailed both top and bottom. The quartering can be filled in at the back and ends, being careful to get the pieces in the right place according to their numbers, and also not to drive the plates up



Cow Lodge of Wood. Fig. 1.—Front Elevation. Fig. 2.—Elevation of End (Side Framing only). Fig. 3.—Method of splicing Front Plate. Fig. 4.—Method of fixing or "corking" Tie. Fig. 5.—Method of applying Square in fitting Tie. Fig. 6.—Teazle Post, showing Tenons. Fig. 7.—Plan of Roof Frame, showing Hips and Jack Rafter in Position at one End. Fig. 8.—Underside of Tie, showing "corking." Fig. 9.—Detail of Mortise and Tenon joining End and Front Plates. Fig. 10.—Elevation of Roof Principals. A, Front Quoins (Brickwork); B, Brick Foundations; C, Corner Posts; D, Teazle Posts; E, Plates; F, Sills; G, Padding Sills; H, Principal Rafters or Roof Trusses; I, Purlins; K, Hip Rafters; L, Ties; M, Ridge or Pitch-board; N, Collars: O, Common Rafters; P, Jack Rafters; R, Corner where Hip comes; S, Tenon to fit in Plate; T, Tenon to fit in Tie; U, Tenon to fit Padding Sill; W, Waste End of Plate; X, Haunching of Mortise and Tenon.

I will give a few examples of abbreviations when it runs to long numbers: for 30, instead of XXX. we make three strokes and cross them; for 35, three and a half, and so on. All the numbering being done, the roof may be taken down, and the plates taken apart, and we will proceed with the "teazle" posts (Fig. 6). These go in front immediately under the ties, and the tenon, S, is to go into the plate, and the tenon, T, into the tie; therefore to fit these it will be necessary to turn the ties over and put the plates on top of them, when they can be fitted and bored for pins as before. This being done, the padding sills can be mortised and pinned on the bottom of the posts, U (Fig. 6).

We have now to frame the back and two ends. I have shown one end in Fig. 2, and

I will explain in a few lines the best way to proceed. First, of course, the sills must be put in their place on the brick foundations; sometimes they are bedded on in mortar, though it is not necessary, and for my own part I think it is best done without. The sills being in their places, and pinned together at the corners permanently, next put up the corner posts—these can be braced by two small slips of wood (tiling laths will do)—and when all four are up, place the centre posts in their mortises and put on the back plate, and pin same together at the splicings. Then pin the padding sills on to the teazle posts and stand them on their quoins; prop them up with a common rafter or two, then place the front plate on them a piece at the time, and pin to the posts, and

in nailing the short quarterings. Next fill in the hips with the short rafters or strutters, and then the common rafters between the principals; put on the eave-lath, and our lodge is finished ready for the tiles, which do not concern us. I omitted to mention that the purlins should be put in their places immediately after the principals are up.

I have described one of the better kind of farmyard buildings. There are many modifications of the same, but these instructions will enable anyone to erect any of them if called upon to do so. There are some in which the brick foundation comes to the surface only, and some dispense with it altogether, simply laying a brick here and there to keep the sills from the earth; some are placed on wood stumps planted in the ground, and

some (and these are the commonest of all) are formed by wood posts in the ground, and the roof chopped up out of chestnut poles. These last are often built by an agricultural labourer, and are usually covered in with thatch, but I have been called upon to build several in my time, though I trust I shall never have to do another as in common with most workmen. I am not fond of using the broad axe, which is the principal tool required in erecting this sort of building.

HOW TO MAKE A PHONOGRAPH.

BY WILLIAM DUFF.

DETAILS OF CONSTRUCTION—THE BASE—THE UPRIGHTS—THE SCREW SHAFT—THE CYLINDER METHOD OF CASTING — THE MOUTHPIECE—THE STYLUS—THE DIAPHRAGM—TURNING THE CYLINDER.

HAVING in the last chapter briefly stated the principles upon which the phonograph works, I will without further ado proceed to give details of construction, or, in other words, to tell the readers of this paper "How to make a Phonograph."

Let me say this, however, before starting: it will not be necessary to adhere strictly to the sizes which I have given. The reader, if he decides to make one, may make it any size he pleases, but each part must bear a certain relationship to surrounding parts. For instance: the needle must be fixed so as to touch the cylinder, and be capable of adjustment; the cylinder itself must have sufficient space between the uprights to travel backwards and forwards in. So I would advise you to set out every piece full size before commencing the work of construction.

Fig. 1 (see WORK, No. 167, page 164) is a front elevation, with the mouthpiece and diaphragm removed. Each part is lettered, and is of reduced proportions to one which I have made. A is the base, which should be made of good stuff, with a drawer in the bottom in which the blank phonograms may be kept. The size should be 15 in. × 7½ in. × 2¾ in. The mouldings of the drawing may be copied, as they look very well, and answer the purpose admirably. B, B, are the standards or uprights. They should be made of inch-stuff; their shape and size will be seen at Fig. 2. Make two pieces, then, like Fig. 2, and fit carefully two small pieces of the same stuff, like Fig. 3. After they have been carefully fitted together, fasten the small piece with two screws, as shown in Fig. 4, and then with a ¾ in. bit bore a hole in each, taking care to have the hole in the position shown in the figure. The holes are the bearings for the shaft. This completes the standards, and they may be placed in position upon the base, and fastened with screws passing from underneath. They should be not less than 10 in. apart, and about ½ in. from the front of the base. C, in Fig. 1, is the top, and is simply a piece of wood, like the standards, 12 in. × 3 in., with a hole 1½ in. bored in the centre. It is hinged to the standards, as shown at F. Two brass knobs, shown at G, may be put at the corners. These serve a twofold purpose: they look ornamental; at the same time, they act as stops to prevent the mouthpiece from knocking against the cylinder when the phonograms are being placed upon, or removed from, the cylinder. The shaft, D, is a rod of ¾ in. iron or steel, 17 in. long, one end of which is tapped not less than 5½ in. The pitch of the screw should be about fourteen threads to the inch. The success of the instrument depends in a great measure upon the accuracy of the shaft; so, unless our amateur is well up in lathe manipulation, I would advise him to get this made by a practical man. I got mine made by an old friend who takes a pride in doing such work, and a finer piece of work I have never seen. After the shaft has been made as directed, two small holes should be drilled in it at right angles to each other, about the centre, or 7 in. from the screwed end. Two nails, or pins, are passed through these holes when the cylinder is being cast upon it, to prevent the possibility of the cylinder turning round upon the shaft. This will be seen at Fig. 10, where a piece of the shaft is shown with the nails in the holes. The cylinder (marked E in Fig. 1) is made of plaster-of-Paris. It is 4 in. in diameter and 4½ in. long, and, as already indicated, it is cast upon the shaft. To do so, a mould will be required. This may be made by a tinsmith, or an old meat-tin may serve the purpose, but the plan which I adopted was as follows: I got a round piece of wood 4¼ in. in diameter, with a hole in the centre to allow the shaft to pass through, and then I took a piece of pasteboard, and made a tube by bringing the two ends together and gluing a strip of stout paper on the outside at the join. I then tacked this to the wood. The inside measurement was 4¼ in. × 4¾ in. This mould was a complete success, and saved the trouble of getting a tin one made.

The next thing will be the casting of the cylinder, and if you have had no experience in using plaster-of-Paris you need not be disappointed if the first attempt is a failure. However, "never venture, never win." Get 14 lbs. of the best—"well-boiled," I think, is the builder's term—and before mixing with water place the shaft in position in the mould. First pass the nails or pins through the holes as before-mentioned, and pass the shaft through the hole in the wooden bottom. The top of the mould should come flush with the end of the screwed part of the shaft—*i.e.*, 5½ in. from the end and the bottom 7½ in. from the other. The shaft must be rigidly fixed in this position, and perfectly central from the side of the mould. When all this has been arranged satisfactorily, mix the plaster with water in a large wide-mouthed vessel, such as a wash-hand basin, stirring all the time, to prevent it getting lumpy, to the consistency of Nestle's Swiss milk or pancake dough.

When this has been done, pour it carefully into the mould, and wait patiently for it to set. Do not hurry this process in any way. In the meantime, you can be getting on with something else.

At Fig. 5 is shown a small piece of brass, which is to act as a guide for the screw. It is made from sheet brass $\frac{1}{16}$ in. thick, and shaped as shown, and must fit nicely in the thread of the screw of the shaft. Two small holes are drilled in the corners of it, through which pass two small screws to fasten it in position in the inside of the left-hand standard. It is indicated by the dotted lines in Fig. 4. The mouthpiece, or funnel, may now be prepared; it can be turned from a piece of wood 3½ in. × 1½ in. square. Fig. 7 explains this fully. For the stylus, or needle, a large-sized sewing-needle about 2 in. long may be employed. Soften it by heating to redness, and allowing it to cool gradually; nip off the eye, and tap a fine thread upon it for about ¾ in.; make two small nuts, tapped inside to fit the screw on the needle. This done, bend the needle twice at right angles, and then turn down the point. It, when complete, should look like Fig. 8. Now get a small block of wood or cork, about ¾ in. × ½ in. square; bore one hole right through from side to side, and another in the bottom about ¼ in. up. Make or buy a small brass screw with a flat head, and a square nut. Fasten the nut in the wood or cork by first sinking it in flush, and then putting a drop of glue or cement of some kind to keep it in its place; put in the screw, which must have plenty of room to pass upward, if required: this is for adjusting the pressure of the needle upon the cylinder. Run one of the nuts upon the needle as far as it will go, and pass the screwed end through the hole in the block; put on the other nut, and fasten up. Before putting the needle in the block, it will be well to re-temper it, and it will be advisable to flatten it out a little where the adjusting screw touches it.

This completes the needle and its mountings. The diaphragm is simply a thin circular metal plate, about 2¼ in. in diameter. It may be made from photographer's ferrotype or the bottom of a Swiss milk-tin. Whatever it is made from, it must be perfectly flat, with no buckles round the edge. The block carrying the needle should be cemented to the centre of the diaphragm with melted shellac or Carter's liquid glue.

Now, by this time I fancy the cylinder will be as hard as ever it will be, and will be ready for truing up. This can be done in a turning lathe; but if you have not such a useful tool in your possession do not despair, for it can be done in its own frame. I presume you have the standards fitted to the base either by screws or tenons, and the fly-wheel with handle fitted to the shaft. By all means have a fly-wheel, and let it be solid, as this helps greatly to ensure a uniformity of speed when rotating the cylinder. A fly-wheel from a hand sewing-machine, with the handle attached, might be used for this purpose. This being arranged, take out the screws from the small pieces (Fig. 3) in both standards, and place the shaft in its position. See that the small brass plate catches the thread of the screw. Replace the pieces, and screw them up tightly. Turn the handle, and you will find that the cylinder while rotating will travel endwise until stopped by the standard. Reverse the motion, and you will find that it will travel back until it reaches the other standard.

If you have been reading carefully, you will have observed that I allowed ¼ in. when casting the cylinder for truing up. The ends should be done first; they will not want much doing. Take a long-bladed knife—such as a table-knife—and hold the edge against the cylinder; turn the handle, and by this means you will be able to scrape the ends nice and smooth, and square. The turning of the face will be rather more difficult. Get a small turning chisel, pass it through a cork, and fix it fast in the hole of the top, C (Fig. 1), and allow it only to touch the cylinder lightly; on turning the handle, the cylinder will, of course, travel underneath the chisel, and the chisel will perform its part with precision. The cylinder must be turned backwards and forwards several times, as the chisel must only scrape the surface. A little patience and care are necessary at this point, as the plaster is very easily chipped and spoiled. The hinged top will be a help in regulating the pressure of the chisel.

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NOTICE.

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will be found at the foot of page 207.

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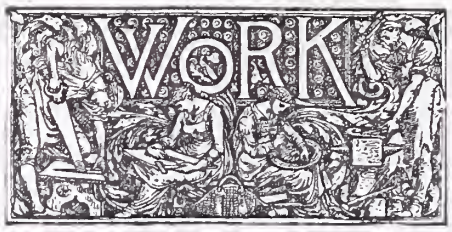

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PATENTS AND PATENTEES.—On the 14th of July last the President of the Board of Trade announced in the House of Commons, that "The country ought not to look upon the Patent Office as a permanent source of income," and that "it should be considered whether a reduction might not be made in the fees on Patents charged in the interval between four and eight years, so as to extend the cheap protection now given for four years to a longer period." It is gratifying to find that the Chancellor of the Exchequer in his Budget, which he introduced on the 11th of April, announced that on the 20th of September next a reduction will be made in the Renewal Fees, and that they will stand at £3, £6, £7, and £8 respectively; the fifth and sixth years will be £9 and £10; and after that they will be £11, £12, £13, and £14 a year respectively, and stated that it is "a reform the Government does not wish to delay." It is to be hoped that the Government will see "in the interests of the poorer patentees, and also of the further development of invention," as Mr. Goschen expresses it, that the present outrageous charge for a Patent ought to be brought within reasonable bounds, and that the grant should be obtainable for the sum of £10, of which £2 should be paid on application, £3 on the filing of the complete specification, and at the seventh year the other £5 should be paid if it is intended to keep the Patent in force. This reduction would, in the words of Mr. Goschen, "give extreme satisfaction to an extremely large class," and, moreover, conduce in no small degree to the "interests of the poorer patentees, and also of the further development of invention." He also stated that, "with regard to Patents, the new ones taken out after the 30th of September would enjoy the diminution of fees, but he would make a statement later on as to whether Patents taken out between the end of the financial year and that date should enjoy the same advantage." We quite agree with the remark of the President of the Board of Trade, that "the country ought not to look upon the Patent Office as a permanent source of income"; and seeing that the Patent Office is neither more nor less than a Record, or Registry Office, of all that has been, is being, and will be done in Inventions and Patents, is kept up entirely at the cost of inventors and patentees, without asking for the expenditure of one penny from the Government, it is very certain that so long as the sums paid by inventors and patentees meet the cost of maintaining the establishment, that is all that can reasonably be required. We hope that the increasing intelligence manifested on this subject will lead to the result we have mentioned, and remove the reproach that in Great Britain more is charged for an inefficient grant than in any other civilised country, and that the Government will see that this is a reform they should *not* wish to delay.

ENGLISH COUNTY ART.—The Hertfordshire Society for the Promotion of Art has set an example which other counties would do well to follow. Its object is "to encourage and develop art throughout the county," among all classes, and in every direction. It holds an exhibition yearly in each of the chief towns of the county in rotation, at which prizes are offered for drawings and paintings, for all kinds of wood carving, inlaying, fretwork, hammered and bent iron, embossed leather, and other branches of decorative art. The chief feature of these exhibitions is that the exhibitors are allowed to hear, through their local secretaries, the opinion of the judges on their individual work, or, if at the exhibition, may solicit and obtain criticisms from the judges themselves, which must be very helpful, and will also remove the cause of sore feeling and disappointment apt to be generated on such occasions, when exhibitors find the work they and their friends have considered absolutely beautiful passed over or condemned. In the eyes of a connoisseur such work is often, through its lack of art, "a monument of misplaced energy"; but if the faults are pointed out to the worker, and this energy turned in a different direction, the failure of one year may be followed by the brilliant success of the next. The Society is composed of two divisions, the first consisting of members and associates who subscribe 5s. yearly, the second of artisans who pay 1s. a year, and equally rank as members and associates. Only those belonging to or "connected with" the county of Hertfordshire can belong to the Society, but the condition for honorary membership is wide. Honorary members only need to be "persons interested in art." A wide latitude is also allowed in the matter of artisans' exhibits. The schedule informs them that anything they may have made, even if not included in the prize list, may be entered for competition if it "partakes of the nature of art," and is accepted by the exhibition committee. A special prize was given, for instance, in 1891 for heraldic painting, and in the first exhibition of the Society, held in Hertford in 1889, for some walking sticks with quaintly carved heads, cut by a working man at home. The committee of the Society received a grant of £1,500 from the County Council to enable them to carry on technical education in the villages, which they are doing with great success. The third exhibition, for 1892, is to be held at Watford in October. There is no reason whatever why every county in Great Britain and Ireland should not have a similar society for the promotion of art.

DESIGN AND DECORATION OF ALL AGES.

BY M. H. C. L.

Greek.

The chief characteristics of Greek art, the characteristics which have made it the inspiring principle for the art of the whole civilised world, are harmony, proportion, and restraint. When we compare Greek decoration, especially at its best period, with savage or Oriental decoration, the contrast is very striking. That remarkable instinct of perceiving the fitness of things, and avoidance of all excess which pervaded the Greek genius, is nowhere more marked than in this particular branch of art. Instead of covering the whole surface of an object with a crowded variety of ornament, the Greeks understood the beauty of plain spaces, and so applied their decoration as to give an effect of simple grandeur in the aspect of the whole, while the ornament itself, without obtrusively distracting the eye, gained in value by the sparingness of its use. When the Greeks decorated a moulding, the ornament followed the moulding, and its shape was that of the section of the moulding—a rule from which the less artistic Romans departed, so decorating their mouldings that the form of them was lost, to the ruin of the general effect.

Greek Ornament. Fig. 1.—Necking of Ionic Column, from East Portico of Erechtheum. Fig. 2.—Athenian Artificial Ornament. Figs. 3 and 4.—Decoration on Terra-Cotta Vases. Fig. 5.—Ornament on Stele. Fig. 6.—Leaf on Corinthian Column of Temple of Artemis at Ephesus. Figs. 7 and 8.—Egg and Tongue Mouldings. Figs. 9, 10, 11, 12, 13, and 14.—Varieties of Fret Pattern. Fig. 15.—Suastika. Fig. 16.—Figures on Vase, best Period. Fig. 17.—Border from Vase, Black on Red. Fig. 18.—Asiatic Animal from Vase, Transition Period. Fig. 19.—Part of Door Jamb from the Erechtheum. Fig. 20.—Ornament from Capital of Column, Temple of Artemis Eucleia at Athens.

a chisel, or piece of tapered wood or bone, and the patch tucked in, as shown at A (Fig. 3). This is to enable you, in sewing the patch down, to get the stitches as far back and as much out of sight as possible.

For sewing it to the sole, a sewing awl must be used: it is similar to the closing awl, only a stouter and wider blade.

The thread for ordinary work will need to be about ten cord of No. 9 Patent (price, 2d. per ball), and the awl, although it has to carry the two ends, should only be the substance of one.

The boot will need to be put on the knees, patch side up, and if the piece is on the side shown in either of the above figures, it must lay on the lap, toe from you, as Fig. 3. It must be held very firm on the knees, by means of a strap or stout piece of cord being placed round it, as B (Fig. 3), and passing under the ball of your foot. By this means, it can be held as tight as you please by simply pressing down your toe.

The stitching must be started from A (Fig. 4), the point of the awl being put in on the welt side A, and pushed through to the bottom of the sole, wriggling it a little, that it may find (or make) its own way through at C.

The bristle on the left side is put in first (in all sewing, stitching, or stabbing), and the one on the right side put in underneath it, so that when the stitch is set, it shall be between the thread (on right side) and the patch. This will not only help to lay the stitch back, but, if borne in mind each time, will make the stitches look even and lay flat.

The stitching must, of course, be continued right across to B (Fig. 4), setting about five stitches to the inch, and well tucking the patch under before each stitch is taken.

This done, and the ends cut off, the stitches on the patch side must be rubbed down with the bone, and hammered down lightly with a hammer on the sole side. The surplus of the patch can now be cut off level to the edge of the sole, as shown at C (Fig. 3). The edge can be blacked with ink or blacking, and then rubbed down. A little weak paste on the patch will, if let dry, make it smooth to receive the blacking; and when the whole is blacked and polished, will not only be a neat, but a very solid seam.

OUR GUIDE TO GOOD THINGS.

**** Patentees, manufacturers, and dealers generally are requested to send prospectuses, bills, etc., of their specialities in tools, machinery, and workshop appliances to the Editor of WORK for notice in "Our Guide to Good Things." It is desirable that specimens should be sent for examination and testing in all cases when this can be done without inconvenience. Specimens thus received will be returned at the earliest opportunity. It must be understood that everything which is noticed, is noticed on its merits only, and that, as it is in the power of anyone who has a useful article for sale to obtain mention of it in this department of WORK without charge, the notices given partake in no way of the nature of advertisements.*

30.—Smith's Tables and Memoranda for Mechanics, Engineers, etc.

This useful little waistcoat-pocket *vade mecum* for all who are engaged in engineering and the building trades has reached its fifth edition. Its nature and contents may be easily inferred from its title, which, when given in full, runs thus: "Tables, Memoranda, and Calculated Results, for Mechanics, Engineers, Architects, Builders, Surveyors, etc." The matter that it contains was first selected and arranged by Mr. Francis Smith, to meet the daily requirements of men engaged in various mechanical trades some ten years ago; but, in order to keep pace with the advances of science in every direction, the original matter has been carefully revised and enlarged; and a new section has been added, comprising numerous electrical tables, formulæ, etc., which renders the book of special value to electrical engineers. Its price is 1s. 6d., and it is published by Messrs. Crosby Lockwood & Co., 7, Stationers' Hall Court, Ludgate Hill, London, E.C.

31.—Hartley & Co.'s "Kristaline" and New Cold Lacquers.

I have much pleasure in calling the attention of metal workers, photographers, and others to whom such specialities may be useful, to the excellent lacquers prepared and supplied by Messrs. J. E. Hartley & Co., Electricians and Electro-Metallurgists, St. Paul's Square, Birmingham. I received samples of these lacquers, and specimens of metals and photographs treated with them, some time ago; but I have purposely withheld my notice until lapse of time should bear its testimony to their endurance, and, therefore, to their commercial value and utility. The samples of lacquers to which I refer were one of a pyroxilin dip lacquer, called "Kristaline," by Messrs. Hartley & Co., and two others of "Improved Hard Cold Lacquers"—a transparent lacquer and a gold-colour lacquer, for application to metals when cold—small articles, when brushed with these preparations, being placed on a stove to dry, but larger things, too large, in fact, to be placed on a stove, being left to dry cold. The specimens sent were: (1) a piece of steel, part lacquered with cold *transparent* lacquer; (2) a piece of brass lacquered, part with cold *gold*, and part with cold *green bronze* lacquer; (3) a piece of brass, silver-plated, then lacquered with Kristaline on one half of it, and afterwards hung over sulphur fumes to show that they have no tarnishing effect on the lacquered part; and (4) a photograph on opal, coated with Kristaline, which protects the gelatine film, and allows of dust or dirt being wiped off with a damp cloth without injury to the photo. In reference to these, I may say that what is said of the photo. is correct in every particular, while the lacquered metals are as bright and untarnished as they were on the day they reached me, though the *unlacquered* portion of the steel shows specks and spots of rust, and that of the brass is dull and clouded.

With regard to the method of applying the lacquers, it is necessary to point out that, although the cold lacquers may be, and I may say should be, applied with the brush, the Kristaline cannot be brushed on work owing to the pyroxilin it contains. Articles to be treated with it must be *dipped* in it; and if the articles be too large to be dipped, the lacquer must be poured or ladled over them, as in this way a small quantity is sufficient for a very large article.

Messrs. Hartley & Co. claim for the pyroxilin lacquer Kristaline: (1) that it is practically indestructible, as neither gases, acid fumes, nor sea air affect it; (2) that it is waterproof; (3) that it is perfectly transparent; and (4) that it is absolutely colourless. For the cold lacquers they claim: (1) that they can be brushed on cold metal, and on the largest articles, with as much facility as on the smallest; (2) that they have more body than ordinary lacquers; (3) that they leave no brush-marks nor treacly appearance; (4) that they can be applied by others than skilled lacquerers; (5) that as there is no loss from evaporation, one gallon goes as far as two gallons applied with heat: and, as skilled lacquerers are unnecessary, they are far more economical than other lacquers; and (6) that they resist atmospheric action longer than other lacquers. Messrs. Hartley & Co. have submitted the names of leading firms by whom Kristaline is used for lacquering silver and gilt ware, gilt and silvered navy buttons, brass foundry and opal photos.; but these, for obvious reasons, I cannot insert, as the names are mentioned for my own information only. The cold lacquers are used generally by brass founders, chandelier makers, engineers, electricians, bicycle and tricycle makers, steel workers, range makers, and for large work, where lacquers applied with heat are wholly inapplicable. I feel sure that Messrs. Hartley's specialities in lacquers will be appreciated by those to whom they are as yet unknown, and who may be led by this notice to become practically acquainted with them—as fully appreciated, indeed, as they seem to be by all who already use them. Messrs. Hartley & Co. will, I am sure, readily forward to any applicant their price list, which will supply all information with reference to prices, and which contains a few remarks on the pyroxilin lacquer, and describes the method of application at greater length than I can do here.

32—"Geometric Turning Simplified."

Many readers of WORK are, I am inclined to think, enthusiasts in turning, and especially in the higher branches of the art. To such as these, if they are not already acquainted with it, I venture to recommend a thin octavo volume of sixty-two pages, entitled "Geometric Turning Simplified," written by Mr. W. H. Northcott, C.E., the well-known author of "Lathes and Turning," and published by Messrs. E. & F. N. Spon, 125, Strand, W.C. The price of the book I do not know, but information on this point may be easily obtained by application to the publishers, or to the London Lathe and Tool Company, 37, Pomeroy Street, New Cross, London, S.E., by whom all the apparatus to which reference is made in the volume is made. The object of the writer is to show how geometric and ornamental turning may be practised without the need of the expensive lathes and apparatus hitherto thought necessary; and, in fact, the work described is done by the aid of a simple instrument devised by the author, which permits the operator to practise geometric turning of several sorts in any light lathe, however simple its construction, and in any light milling machine. The work is profusely illustrated with engravings of the apparatus employed, and the patterns that may be produced, each pattern, from those of simple form to others most complex and intricate in appearance, being accompanied by a description of the position of the tool, and the manipulation required in order to produce it.

33.—Colours for Marbling Purposes.

The following is taken from "Instructions for the Use of Colours for Marbling Purposes," to produce colours for extra shades and tints, issued for their customers by Messrs. George Royle & Son, Bookbinders' Tool Cutters and Material Dealers, Manufacturers of Marbling Colours, etc., 6, Lovell's Court, Paternoster Row, London, E.C. To produce a single colour from an assortment—yellow and carmine or dark red produce *scarlet* or *vermilion;* carmine and blue, *deep lilac, violet*, and *purple;* carmine, yellow, and black, *rich brown;* yellow and black, *bronze green;* carmine and white, *pinks of any shade;* azure blue, white, and carmine, *deep tones of lilac;* violet and white, *pale lilac* or *lavender;* Chinese blue and white, *pale blue;* Chinese blue, indigo, and yellow orange, *any tone of emerald green;* pale yellow, chrome, and carmine, *amber;* burnt umber and scarlet lake, *red brown;* burnt sienna, shaded with lake, *light brown;* burnt sienna and orange, shaded with white, *salmon*. The following are combinations of colours which harmonise well—scarlet, red, and deep green; light blue and deep red; orange and violet; yellow and blue; black and light green; dark and light blue; carmine and emerald; red, yellow, and blue; orange, black, and light blue; light salmon, dark green, and scarlet; brown, light orange, and purple; dark brown, orange, yellow, and blue; crimson lake, green, yellow, and black; black, green, dark red, and sienna; scarlet, dark green, lavender, and black; azure blue, vermilion, light green, and lilac; sienna, blue, red, and black. In order to give the desired effect for marbling purposes, the finest colours are required. Messrs. Royle & Son supply in 1 lb. tins, at prices ranging from 2s. to 26s. per lb., the following assortment of colours: finest drop carmine lake, second carmine, common lake—light or dark, indigo, yellow, orange, Chinese blue, drop ivory black, indigo black, burnt umber, azure blue, sienna, dark and light green, ultramarine. These will be found quite sufficient for all purposes, the instructions given above being such as will enable any marbler to mix his own shades. THE EDITOR.

SHOP:

A Corner for Those who Want to Talk It.

** In consequence of the great pressure upon the "Shop" columns of* Work, *contributors are requested to be brief and concise in all future questions and replies.*

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of Work *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given. Answers cannot be given to questions which do not bear on subjects that fairly come within the scope of the Magazine.*

I.—Letters from Correspondents.

Instruction Classes.—Rev. W. Wade (*St. Peter's Vicarage, Fulham, S.W.*) writes:—"Will you allow me to appeal to one or two of your readers who have a few hours' leisure at their disposal in the week? I am most anxious to start industrial classes for the boys of the children's guild connected with this parish. Unfortunately, the ordinary clerical training does not include instruction in any form of mechanical art, and my own fingers can do little else beyond wielding a pen. However, I hope this poor skill will stand me in good stead now if you will allow these lines to appear in your Journal. I should be most grateful if any gentleman, who could devote an hour or two in the week to the instruction of about a dozen boys (by way of a beginning) in one of the minor arts and crafts—such as wood carving, or the bent iron work now so popular—would communicate with me."

Dry Battery.—J. A. M. (*London, N.W.*) writes to H. E. (*London, N.W.*):—"In reference to your note in Work (No. 111, page 110) on how to make a dry battery, I have correctly and closely followed your instructions, and found them to be a failure. Thinking perhaps the quantities were not sufficient, I afterwards tried double quantities, and, after letting them stand for three or four days, I did not find the slightest result. If you will kindly furnish me with further instructions on this, or tell me of any other method of how to make a dry battery, through Work, you will oblige."

Decoration in Applied Art.—The Secretary of the City and Guilds of London Institute for the Advancement of Technical Education (*Technical College, Finsbury*) writes:—"An important meeting of representative men in the painting trade met recently at the above College, to consider what means could be taken to improve the quality of the workmanship in their trade. The chair was taken by J. D. Crace, Esq. A paper was read by Mr. Wm. Fourniss, Instructor in Decoration in the Applied Art Department of the College. A discussion followed, which resulted in the following resolutions being carried unanimously:—1st, That it is expedient that trade classes for painters should be established for the benefit of the trade. 2nd, That the Guilds of London should be respectfully requested to establish trade classes for painters at the Finsbury Technical College. Some discussion occurred in reference to the question whether or not certificates should be offered and given for proficiency in the painting trade, in which Mr. J. Shaw took part. No resolution, however, was come to in respect to this. Dr. Silvanus P. Thompson, Principal of the College, and J. D. Crace, Esq., chairman of the meeting, gave their entire concurrence with the objects of the meeting."

Mail-Cart Springs.—The Victor Cycle Company write:—"Several of your readers have written us, at various times, respecting springs for mail carts. We have now arranged to supply these as well as wheels."

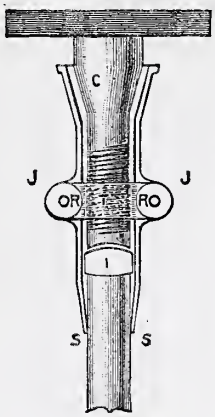
Small Tin Boxes.—A. G. (*Sheffield*) writes:—Mr. A. Truelove's address (see No. 112, page 126) is 111, Carver Street, *not* 14, as stated."

Cold Water on Saws.—A. R. (*Scorrier*) writes:—"In No. 113 of Work, page 139, W. H. R. (*London, N.W.*) writes in reference to trueing circular saws when buckled. A saw may run wild, as W. H. R. terms it, through undue heating, and by freeing the timber from the saw, and letting it run a little while, even if there is no water thrown on it, the saw being properly packed, it will run true again. A saw may run wild through unfair usage, and consequently become buckled; but if the plate is once buckled, throwing cold water on it will not take out the buckle. I have had to do with saws a number of years, but never threw as much as a pint of water on a saw to get it to run true. When I see men throwing water on a saw to try to get it to do its work, I am quite satisfied that there is something wrong. I know it is an old practice, but men in these days should get beyond such a system of working. In Vols. I. and II. of Work, there are several reasons given why saws run as stated by W. H. R.; and I would advise all readers of Work, who have not the above numbers, to get them. I think the price of each Vol., ready bound, is 7s. 6d."

Patents.—A. B. L. (*Newbury*) writes:—"I wish some one of your readers, conversant with the Patent Office, Patent Agents, and Patent Law, would consider the subject of a concise treatise to throw the fullest light upon all appertaining to Patents."

II.—Questions Answered by Editor and Staff.

Billiard-Cue Tips.—T. R. (*Belford*).—The tips of billiard cues are pressed in by a screw working in a socket which holds on to the cue the tighter the screw is applied. I send a rough sketch, useful to cue-makers; but most of these workmen have their own devices to ensure a close-down fit of rubber to the wood. The diagram is a sectional elevation sketch. A cross-handled key or screw-pin with a coned shoulder (C) fits into an expanding double-jawed gripper (J, J), which is formed of two blades of iron or brass slightly segmental, to fit the screw-pin and end of cue. These blades are jointed to a solid ring by lugs hinged to projections from the ring. The middle hole in the ring is threaded to take a screw on the pin (T). The extremities of the blades (S, S) furthest from the cores grip the cue by the action of the cone shoulder forcing open the opposite ends of the blades, acting as a vice on the cue, holding tighter the more the rubber is pressed down by screwing the pin on to it at T.—J. C. K.



Billiard-Cue Tip.

Flower-Box for Bay Window.—R. G. (*Streatham Hill*).—A very handsome-looking flower-box may be made for your bay window in the manner I am about to describe, and which I hope you will understand by the rough sketches given. Instead of making your flower-box in one piece as you suggest, and putting the tiles in the front of it, you will do much better to have the tiles in a separate front; it can then be lifted away from the sill when required, or the boxes can be removed for gardening operations if necessary. In Fig. 1 you have a sketch of the arrangement when in position. The front board containing the tiles should be about 2 in. back from the edge of the window-sill, and three boxes made to fit the spaces between it and the front and side windows. Fig. 2 shows a section through the front and the box. To get at the exact

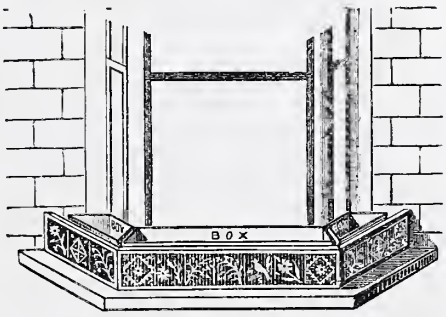


Fig. 1.

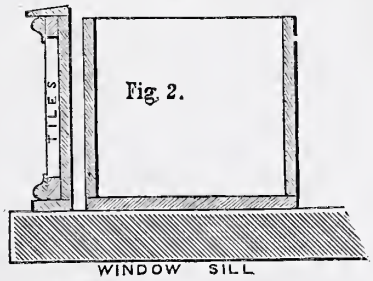


Fig. 2.

Fig. 3.

Flower-Box.

sizes of the wood, you must first purchase your tiles and then make the fittings to suit them; but, for the sake of example, I will suppose that they are 6 in. square: the backboard on which they are laid would thus be 8 in. wide, and would have a batten 1 in. wide, and just the thickness of your tiles, nailed along the top and bottom edges and down the ends of each of the three pieces of the front; the tiles are then laid in their place, and a 1½ in. moulding, of whichever pattern pleases you best, mitred round them. The ends of these front panels are now bevelled to fit each other, and held together by a pair of backfold engines at each joint; these hinges admit of the ends being folded flat to the front when the panelling is removed from its position, as, if rigid, it would be awkward to handle. To steady it when in its place, a hook and eye at each end may be used, the hook being on the inner side, and the eye either in the wall or on the woodwork of the window, whichever answers best. A piece of ⅝ in. wood runs along the bottom of the panelling, and a similar piece on the top, which is bevelled towards the front to throw off the water. Yellow deal should be used both for the front and for the boxes; the moulding you can buy ready for use at almost any timber yard. I think a few minutes' study of Fig. 2 will make the foregoing instructions clear to you, and Fig. 3 will show how the ends are meant to be hinged. The boxes should be made of ¾ in. wood, and may be lined with zinc if preferred; they will, however, last a good many years without lining, and a pipe should be run from near the bottom of each out over the window-sill to carry off the drainage. Another plan is to dispense with boxes altogether. Make your front panels as described, and when in position put your flowers in pots behind them; this is a very good arrangement, as it lessens the labour involved in carpentering, and also admits of changing the plants whenever required, thus enabling you always to have a good show of flowers at your window. A number of minor details and modifications may suggest themselves to you as you proceed with the work, and if you find any difficulty write again. That drawing attached to your letter was of the utmost service in giving me an idea of exactly what you wanted, and I wish all querists would adopt a similar method (where possible) when writing to Work for information; it would so simplify the task of answering, and tend to their getting the requisite replies. I may just add that if you still think of making three boxes, and not using a front as described, the details given for the panelling of the front will equally apply to the panelling of the boxes.—G. le B.

Electric Belt.—W. W. J. (*Great Broughton*).—Any size of wire may be used to connect the discs on the belt described on page 827, Vol. II. You may use brass wire uncovered if you cannot get silk-covered copper wire, or you may use uncovered copper wire. Fine wire braid is best, because more flexible than any other. By watching the replies to others in "Shop," you may learn much more about these belts.—G. E. B.

French Polishing.—V. S. (*Sheffield*).—By the time this appears in print you will no doubt have noticed that a series of articles on French Polishing has commenced in the present volume of Work—the first in No. 105, the second in No. 108—to be followed by others. These will, I feel certain, suit your purpose better than any book I can recommend. As regards your failures to obtain a level body of polish, perhaps you work your rubber too straight (this will get the work into ridges), instead of circular, as shown on p. 54, No. 108, Vol. III. of Work. A good saying of an old master of mine was, "Keep round the outside edges and well into the corners; the middle will take care of itself." This rule applies well in the case of narrow slips and panels; on a larger surface it will be necessary not to trust too much to the middle taking care of itself. Again, the shape and pliability of the polish rubber have much to do with success. You cannot get into sharp corners and close to the edges of sunk panels, etc., with a round or badly shaped hard rubber. The best shape is one resembling a pear cut in half. It will assist you in keeping the surface level if, when bodying up, you give the work a few slight taps occasionally with a little fine pumice powder tied up in a piece of rag. Use this with caution at first; many amateurs court failure by a too liberal use, thereby breaking up instead of levelling the surface.—Lifeboat.

Stain for Cabinet.—J. W. (*Tranmere*).—Fretwork is at all times difficult; it requires tact that can only be got by practice. This difficulty is rendered doubly so by attempting to do it with new rubbers. If you practised first on some flat surfaces, it would place you in possession of rubbers which would save you a lot of trouble, besides giving you such an insight into the *modus operandi* that will enable you to do your cabinet more satisfactorily to yourself. If it is light oak and you wish it simply darkened, this can be best accomplished by shutting it up in an air-tight box or cupboard, on the bottom of which has been placed an open dish of liquid ammonia; or if required darker, or walnut colour, it may be wiped over with a stain made as follows: One pennyworth of nut galls, ½ lb. American potash, 1 pennyworth of vandyke brown; 1 gallon of water; or a little vandyke brown and brown umber, and just a dash of black, made into a thin paste with liquid ammonia, and then thinned down with water till you have the required shade. But do not apply any liquid stain swimmingly; the less they are used on fretwork the better, owing to their tendency to cause it to twist. It is best to use a small sash tool to enable you to get into the interstices, which must not be omitted. Particulars of "How to French Polish" and "The Rubber in French Polishing" have appeared in Nos. 105 and 108, which please read.—Lifeboat.

Horse-Power.—F. C. B. (*Lambeth*).—One horse-power is the unit employed for expressing the rate of working a machine, and is equal to 33,000 foot-pounds per minute. This may be explained thus: If I lift a weight of 10 lbs. to a height of 3 ft., I do a certain amount of work; if I lift 20 lbs. through 3 ft., or 10 lbs. through 6 ft., I do twice that amount of

TRADE: PRESENT AND FUTURE.

*** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

HARDWARE TRADES.—The Sheffield stove-grate trade is dull in most departments. Makers here are busy with register stoves for the better class houses. The novelties known in the trade as the ventilating dog-grates are being extensively made. The latest types have a canopy of brass over the top, which, while improving the general appearance of the stove, prevents the smoking, which was an objectionable feature of the older types. They are usually fitted and mounted with brass in plain and fluted surfaces, these being more easily cleaned. Iron seems to be going out of use except for fire-resisting purposes, and brass and tiled patterns find most favour. In Sheffield the demand for railway material continues to be fairly good—in fact, much better than could have been expected from the troubles in the various industries. Manufacturers in the Sheffield district are anxiously looking forward for the termination of the Durham strike, as on this will depend the supply of hematite pig-iron. The whole of the available stock of reliable brands has been almost exhausted, and the furnaces have been damped down for the present.

IRON TRADE.—The Durham miners' dispute not having been settled, the Middlesbro' market was stronger. The complaint now is scarcity of supply, and practically the stocks of pig-iron are nearly all exhausted. There is only about 200 tons of No. 1 Cleveland, all in the hands of one firm, who decline to sell under 45s., which is equal to the best price paid during the recent "boom" on Swedish account. The only qualities in stock are No. 3 and white, but outside the warrant stores only small quantities can be had, and the stocks in the public warrant stores are being rapidly depleted. Shipments are comparatively heavy, consumers abroad pressing for deliveries. Makers will not accept less than 40s. for No. 3, but merchants offered to sell at 39s. 6d., and buyers offered 39s. 3d., but no business seems to have been done at that; Middlesbro' warrants were offered at 39s. 2d. cash. Iron founders are fairly well situated, and finished iron and steel producers are doing better. Steel plates are £5 17s. 6d.; iron ship plates, £5 10s., iron angles, £5 7s. 6d.; and steel angles, £5 15s.; common bars, £5 10s., all less 2½ per cent., and f.o.t. for forward delivery, but 5s. more is required for prompt delivery. Good South Yorkshire coke is delivered at 17s. 6d. per ton, and Durham foundry coke has realised 25s. per ton delivered.

OIL TRADE.—Turpentine is now much cheaper than usual, there having been a steady fall in value to 24s. 9d. per cwt. Linseed oil holds firm at 19s. 6d. to 20s. per cwt. Common resin, 4s. 1½d. per cwt.; medium ditto, 4s. 6d. to 6s.; fine ditto, 6s. 6d. to 9s. 6d. per cwt.

SHIPBUILDING TRADE.—The Liverpool shipbuilding trade is very quiet. Messrs. Potter & Sons have launched a sailing vessel of 2,460 tons, built of iron, and have on hand another vessel, a ship of 3,200 tons, both to order of Messrs. Maciver, Marshall & Co.

COAL TRADE.—There is a gradual slackening off in this business; for shipment steam coal is offered at from 9s. 3d. to 9s. 9d. per ton delivered at High Level or Garston Docks, Liverpool. In house coal there has been a moderate shipment to Ireland.

CABINET TRADE.—Liverpool cabinet makers are fairly busy. The rate of wages for cabinet makers is 8¼d., and for upholsterers 9d. per hour, but the pay is mostly for piece work.

WATCH TRADE.—In Birmingham the watch trade continues very dull. The English Watch Company's working hours have been reduced to thirty-six hours per week, Saturday and Monday being play days, which is expected to continue throughout June and July.

ENGINEERING TRADE.—There is no change in the Lancashire engineering and iron industries, the only new work of any weight coming forward being mostly of a special character. Boiler-makers, however, continue to issue satisfactory reports. The Whitsuntide holidays have been seized upon as an excuse for stopping several concerns for several days, and the iron trade is in consequence becoming still more unsettled. There can be no doubt that the present continued depression is in a large measure due to the very general feeling which prevails among manufacturers as to the urgent necessity of reducing wages. The opinion is freely expressed in this district that the Durham strike is only a prelude to a general movement of a similar character in the other centres. The question of reducing wages is certainly under consideration so far as the engineering industries of this district are concerned, and there is little doubt that any such attempt would lead to serious disturbance in the labour market. With such prospects, the condition of the iron trade threatens to become still more serious. The steel trade has of late maintained a firm tone both as regards raw and manufactured material, but only a small amount of business is being done. For steel boiler plates makers have lately remained firm at £8 per ton.

JUTE TRADE.—Trade in jute goods is flat in Dundee. Several spinners intend closing their works as soon as the jute they have on hand is used up. The market continues in a depressed state.

CYCLE TRADE.—In all the manufacturing centres of England and Scotland makers are fully employed, many of them working overtime. The "Swift," Coventry; "Star," Wolverhampton; "Sunbeam," Wolverhampton; "New Home," Glasgow; and "Elswick," Newcastle, with many other good makers, are in great demand, and dealers complain of the delay in receiving supplies from the makers. The North British Machine Company, doing a large wholesale business in Glasgow and Manchester, have done exceptionally good business this season, having disposed of nearly 1,000 Safeties in excess of the number sent out up to the same period last year.

TAILORING TRADE.—The Fraserburgh branch of the Amalgamated Society of Tailors has adopted the Scotch time-log.

TIMBER TRADE.—The dock deliveries show an increase. The figures are:—

	1892.	1891.
Floated Timber ...	1,206 loads	377 loads
Deals and Battens	4,093 stds.	3,212 stds.
Prepared Boards..	1,201 ,,	932 ,,

being an increase over last year for the corresponding week of 1,150 standards and 829 loads. A fine parcel of pitch pine timber in sizes from 9 in.×9 in. to 19 in.×19 in., and in lengths from 14 ft. to 46 ft. long, were sold at Liverpool by Messrs. Farnworth & Jardine, at from 11¾d. to 17½d. per foot. Some 4 in.×9 in., 3 in.×9 in., and 2½ in.×7 in. yellow, this year's import, were sold at Winchester House at from £2 15s. to £3 5s. per standard, *i.e.*, 4 in.×9 in., at 1¼d. per foot run, and 3 in.×9in. at 1d. Reckoning 23s. for freightage, and 10s. landing rate, it does not leave much for the timber.

BUILDING TRADE.—At Nelson a dispute is pending between the master builders and contractors on one part, and the stonemasons and stonewallers on the other. In Durham county trade is fairly brisk, the great difficulty being that of obtaining bricks. At a meeting of Edinburgh joiners an increase in wages from 7½d. to 8d. per hour was demanded. Progress was reported in the preparation of a uniform mode of measurement for carpenters' and joiners' work, similar to those in use in Glasgow, Dundee, and Aberdeen. In Rochdale and district the stonemasons are still out on strike for the ½d. an hour in dispute. All the other building trades are going on comfortably, there being plenty of work. A notice for an advance of ½d. an hour sent in by the joiners expires on July 1.

LINEN TRADE.—In Dundee there is a moderate extent of business in the finer descriptions of goods. Flax and tow yarns are dull.

CARRIAGE TRADE.—This is now at the zenith of briskness, though far from what it should be at this time of year. The shabby vehicles of all sorts far outnumber the bright ones, although a coat of varnish for a two-wheeler is only £1 10s., and for a four-wheeler or private carriage from £2 10s. upwards.

JEWELLERY TRADE.—There are a few orders about, but these are not of importance. It is unlikely that there will be more than a week or two's busy time, and should the election come on, there will not be the faintest chance for London trade for a month or two.

COTTON TRADE.—Two new mills have started with about 200,000 spindles. A strike at Accrington, which has lasted for seventeen weeks, has been settled. It was caused through the employers refusing to allow the spinners compensation for extra work.

SILVER TRADES.—Improvement continues in the Sheffield silver trades. Orders are coming from the Australasian colonies, and business is looking more hopeful all round.

DECORATIVE TRADE.—Liverpool painters and paperhangers are busy as usual at this time of the year, but not more than in former years. The fine weather of the last few days has created a demand for a few steady men.

SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

I.—LETTER FROM A CORRESPONDENT.

Hobbyists' Emporiums.—E. D. (*London, N.*) writes:—"This suggestion of yours, in No. 160, was such a valuable one to my mind, that I quite anticipated considerable correspondence from able pens would have resulted ere this. I am pleased to find J. W. R. (*East Liss*) starts the ball rolling in a recent number (No. 164). That an emporium would be a boon needs no confirmation; but how can it be brought about? I will venture a few suggestions with your indulgence:—An association of home workers with a title such as, 'Ye Home Arts and Crafts Guilde and Marte,' with a depôt as central as possible in London, for the display and sale of the works of members; and a stall occasionally at certain of the suitable exhibitions which are held in London—the Building and Decorative trades, for example. A small annual subscription, payable in advance, to entitle to membership; the first subscription to be accompanied by a printed form (to be obtainable on application to the secretary of the Guilde, with a stamped addressed envelope) making declaration:—'That the applicant will only offer such articles for disposal as are his or her own production, and that he or she will not submit in his or her own name articles made by relatives or friends.' All articles to be sent carriage paid to the depôt and at the owner's risk in transit. A small commission would, of course, be required on goods. It would be necessary someone be appointed at the depôt to receive goods, attend to customers, etc., and this person would have to be paid, and I would suggest part by salary, and a commission on the sales effected. Doubtless, little difficulty would be experienced in finding a trustworthy and suitable person, either male or female. The affairs of the Guilde to be vested in a committee of, say, eight members (elected annually at general meeting) and a secretary. The committee should form themselves into four sub-committees of two members each, and those should take a once a week supervision of the depôt, for a month at a time, three times a year. The question of remuneration (small) to secretary, and whether this service by committee could be expected to be entirely voluntary, I will not raise now. In fact, I think for the present enough is said, but must add a big suggestion, as far as you, Sir, are concerned, and trust you will not consider me too expectant:—Will you, for three weeks subsequent to the appearance of this letter, kindly allow any who view such a scheme as this emporium one favourably to send their name and address—at the same time their suggestions will be welcome—and offers of preliminary help from those in London, to 'Memrud,' care of the Editor of WORK, Messrs. Cassell & Co., Ltd., London, E.C., with 'Hobbyists' Emporium' written on top of envelope? And if you will give us help yet further by reminding readers in the three subsequent numbers of WORK to send in their names, I am sure you will merit and gain the gratitude of very many of us. At your convenience, at the end of the time, I would call or send for the letters, and endeavour therefrom, with some volunteer help, which will, doubtless, be forthcoming, to arrange a preliminary meeting." [Any letters reaching us will be received. E. D. had better call, as while we can accept no responsibility in this matter, the suggestion is entirely our own, and we should like to see the thing properly carried out through WORK, for the benefit of its thousands of readers.—ED.]

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Bicycle Varnishing.—A. W. (*Manchester*).—The information has been minutely given in WORK, both in the bicycle papers and to correspondents in reply to their queries. Consult Indexes for painting bicycle.—A. S. P.

D Dulcimer.—J. B. (*Fourstones*).—The inside treble bridge must be placed 2½ in. to the left of the centre in front and 1 in. at back, and the bass bridge 3 in. from, and *parallel* to, the wrest-pin block; the outside bass bridges at the same distance; the outside treble bridges do not stand in a straight line from front to back, but are placed somewhat irregularly, to obtain the chromatic scale. Their proper places can only be determined when the instrument is finally tuned. To find the positions for the sound-holes, mark the positions of the *inner* bridges on the sound-board; then draw a line down the centre of each division, and on these lines, at a distance of 4½ in. from the front and 3 in. from the back, will be found the exact spot required.—R. F.

Lenses.—SCIENTIFIC.—The best known optical glass makers are Chance, of Birmingham, Feil & Co. and Rosette, of Paris, Shott & Co., of Jena, Germany; but these big firms would not pay much attention to the small wants of the amateur. It is far better for you to go to some dealer. The best supplied of them, probably, is Mr. Caplatzi (see "Sale and Exchange" column). He has glass of all the above-named makers, polishing powders, and tools as well, and sells in any quantity, according to his catalogue. Those amateurs who like to make their own grinding tools will find it easiest to procure samples of the lenses they wish to grind, and use them as patterns to cast from in brass.—C. A.

Tempering Steel.—FAITHFUL READER.—Do you mean "crucible cast-steel" or steel castings? If the former, yes; if the latter, no.—J.

Forge.—TINKER.—I send sketch of forge in Fig. 1 without fan or driving wheels, so that you may see the construction more clearly. The pan or body of the forge is of strong sheet iron, turned up and rivcted together. A piece is generally cut out at each side, for laying articles level on the fire. The legs may be of gas-pipe, about 1 in. in diameter, bent out at the bottom, flattened at the top, and riveted to the pan. Two stays are shown riveted to the legs, the others being fixed to suit the position of the wheels and fan; or bars of iron, about 1¼ in. by ⅝ in., may be used for the legs. A hood is shown, which is made of sheet iron and riveted to the pan. A tuyere will be fixed in the side of pan, into which the air-pipe from the pan will be fixed. A fire-brick lump may be laid on the pan for the fire, which will protect the iron. The driving wheels and fan are shown in Fig. 2, and will be fixed at the

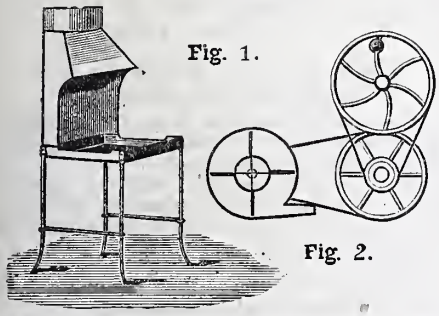
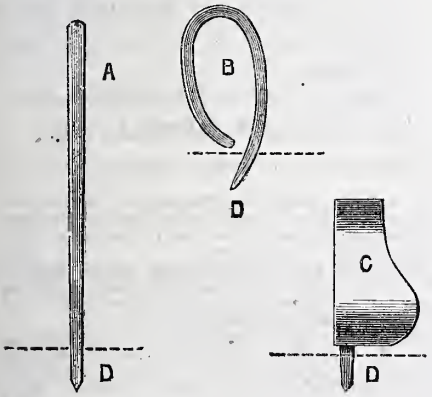


Fig. 1.—Forge. Fig. 2.—Section of Fan and Driving Wheels.

end where the hood is. The driving wheel may be 10 in. or 12 in. in diameter, with a belt to a 3 in. pulley on intermediate shaft, and another wheel 9 in. or 10 in. on this shaft, with a belt to the pulley on fan shaft. The fan should be about 9 in. in diameter and 4 in. wide, with case of sheet iron, and a ¾ in. iron pipe carried from it up to the pan. The arms of the pan are of iron securely fixed to the shaft, and the vaues of sheet iron riveted on. A handle is fixed on the driving wheel. Sometimes the driving wheel is a spur wheel with teeth gearing into a small pinion on the intermediate shaft; this will enable the wheels to be fixed closer together. Cross-stays are fixed to suit the centres of the wheels in which they are fixed.—M.

Zither.—J. D. (*Aberdeen*).—If you have Fittigs' instruction book, you have as good a one as there is in the market at the present time. Until you have gained a complete mastery over ordinary major chords, do not think about any others, or about the many various modes of accompaniment. Such things do not come within the scope of an elementary course (*vide* WORK, No. 151, "Shop," page 747, "Hints on Stringing the Zither," being a reply to a critic who advanced such methods of accompaniment as unteachable by my simple system). The Elégie zither is not the one you should have purchased, but it is possible for you to learn on it all right with a little more patience. As to the glissando, etc., you have no business to attempt



Zither Ring or Plectrum—Tongue of Horn, Tortoiseshell, or Metal before bending to fit, actual size; B, Ring bent to Shape; C, So-called "Concert Ring"; D, The "Tongue," the only important part.

any "graces" until you have entire control over your instrument. Let all such things rest for the present. With the "Triller" it is somewhat different, as this grace is required to *sustain* any note. It is easily managed, but requires a little patience at first. Practise it with either of the three fingers, keeping them *perfectly upright*, and let all the motion be from the last joint of the finger, and at right angles to the fret. Make it slowly at first: a rapid trill will come by practice. Only *one* "scale" need be practised on the zither; it is no use wasting time over them. Your ring evidently does not fit your thumb. Make one for yourself according to the diagram. If you buy one, you must fit yourself, but you will have to pay much more than the value, as there is nothing in them beyond the tongue, which may be affixed to the thumb in any way you prefer. Make one of horn, tortoiseshell, or metal—whichever you prefer. I prefer the former, as they give a better tone, being flexible. If you decide upon horn, file up the prong, and then boil it to soften, and bend it to fit while flexible. If metal, then thick copper wire, filed to shape, does very well. The proper shape is shown in the diagram. A ring of some sort is indispensable, which you can procure at any good music seller's. If there is not such a house in your town—or if they have not got one—write to Messrs. Henshaw & Loebell, Swan Street, Manchester, together with the size, by means of a hole cut in a piece of card. Also say whether you prefer the plain or the so-called "concert" shape, which is also shown in diagram. Fittigs' book contains plenty in the way of very simple airs—in fact, I cannot direct you to any simpler. If you devote an hour a day to practice, you may play very well in a month. Of course, you will not become a *virtuoso* in that time, but you will have acquired a practical control of your instrument, and will have all the necessary knowledge to carry you to any lengths—all the rest is application and practice. I ought to have said that, to fit properly, the ring should require to be *sprung on* over the thumb-nail.—OLD TEACHER OF THE ZITHER.

Camera Blind.—The width of the slot is usually about an inch, but is quite arbitrary, the more narrow the opening the more rapid the exposure, and *vice versâ*. One end of the blind should be supplemented by mere bands on each side attached to the roller, which have to be wound up before setting the shutter, in order to limit the uncoiling to the opaque portion containing the exposure slot. There are other methods of obtaining the same ends, but this is as convenient as any.—D.

Bookcase.—J. C. R. (*Culross, N.B.*).—Twisted pillars will not be out of character with the style you mention, although they are more properly associated with antique and Jacobean furniture. But even if they were, why regard the incident as of importance? The main object is always to provide suitable and tasteful articles, and whether the design is of a mongrel class, it matters little, in my opinion, provided the satisfaction given is what is desired. This is not the place to discuss styles, but I should have liked to launch forth on what I regard as the slavish humiliation indulged in by strictly building furniture on the accepted lines of the respective styles. I often see Early English cabinets in apartments with French, Italian, or antique chairs. This is a more idiotic course to adopt than would ensue by mixing the styles and fitting spindles to various parts of the chairs, and lions' heads, fruit, and other carving to the cabinet. You evidently like twisted pillars; then I should advise you to use them, whether some bigoted designer regards them as incongruous or not.—J. S.

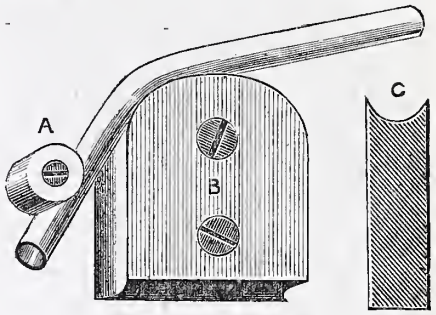
Dressing-Table, Working Drawings, etc.—A READER OF "WORK" (*Clonmel*).—You want working drawings of "back for a fancy dressing-table with a mirror about 18 in. by 14 in., length of dressing-table about 3 ft. 2 in.; a house ladder; and two meat safes—one for inside, the other for outside use." Perhaps some competent reader will put himself in communication with you. Of the cost I can say nothing, as each man usually charges according to the dictates of his conscience. I should have been pleased to assist you myself, but other work prevents such a result.—J. S.

Electric Battery.—SMITH.—This correspondent writes: "I bought an electric battery for my wife (who has been ailing with rheumatics) for £3 10s., about two years since. The vendor said it would last a lifetime with care. In six months after I was going to put in a fresh solution of sal-ammoniac, but it would not hold the solution. The cells are made of tin, and they were eaten full of holes with the salt." I quote this from your letter to warn others against dealing with such "professors." The sketch of your cells, which you have been good enough to send me, shows that he supplied you with two Bennett cells, each 4½ in. by 2½ in. by 2½ in., worth at the most only 2s. each. The cells are now useless. If you will write and tell me what you have besides these, and what you wish to do, I shall have much pleasure in advising you.—G. E. B.

Intensity Coil.—G. H. (*Rickmansworth*).—If the core is intended for a spark coil, it is much too short. A core ⅜ in. in thickness should have a length of 6 in. If you wish to use the core and carcase for a spark coil, wind two layers of No. 20 silk-covered copper wire over the core for the primary, and 8 oz. of No. 38 silk-covered copper wire for the secondary coil. With a condenser of fifty sheets of tinfoil 2½ in. by 2 in., and current from two pint bichromate cells, you may get a ¼ in. spark. If you wish to use the carcase for a medical coil of one power, wind four layers of No. 24 silk-covered wire on the coil for the primary, and 8 oz. of No. 30 silk-covered copper wire over this to form the secondary coil. The wire can be obtained from Mr. Bottone, Wallington, or from Mr. Caplatzi, 3, Chenies Street, Tottenham Court Road, London, if you cannot get it in your locality. You can also get the paraffin wax from the same vendors. You certainly could not make it at home, as it is *not* made by adding paraffin oil to beeswax.—G. E. B.

Battery for Telephones.—F. S. (*Deptford*).—If the telephones are of the Bell permanent magnet pattern, as described in WORK, No. 28, p. 439, Vol. I., no battery will be required; but such telephones can only be worked on short lines and in quiet localities. Long-distance telephones require a battery to work them. The battery in general use and favour for this purpose is the ordinary Leclanché as used with electric bells. Dry batteries—such as the Gassner, E.S., and E.C.C. cells—may also be employed to work long-distance and loud-speaking telephones.—G. E. B.

Pipe-Bending Machine.—J. P. (*Handsworth*).—The machine you refer to, described in "Shop" columns some time ago, was for turning tubes, not for bending them. You can bend them by filling with resin or lead. I have always managed to bend in a hole in the bench, rounding off the part where



Block for bending Tube, and Section of same.

the tube presses against so as to avoid bruising or marking. If it is a tube that has to be finished, bend before finishing. A wood block, as shown in sketch, screwed to the bench would perhaps suit you. A is a stop fixed to the bench by a screw, B, the bending block, C, section of same.—R. A.

Panelled Dado for Hall.—E. R. A. (*Devonport*).—I should not have room to give anything that would really help you in "Shop," but I will (with our Editor's permission) prepare an article which shall show a design for such panelling as you want, so constructed that any amateur carpenter can carry it out, and it shall be accompanied by all necessary working diagrams.—M. M.

"Sole Trimmer."—J. P. (*Reigate*).—You ask "if it will be worth your while to patent" the tool you refer to in your letter. Well, that I will not venture upon, but anything that is novel, or, in other words, original, is, I always think, worth a trial. From you saying it is like a spoke-shave, I think perhaps it may be a tool of some use in many kinds of work, such as heavy or wide welted (machine-sewn), or in riveted work, but then it would need a guard—not only, as you say, "to prevent it cutting the upper leather," but also to lay on the top of the sole while it is being run round, and this so that you may get not only power, but an even stroke also. You say "trimmed ready for the heel-ball without the knife, rasp, scraper, or glass-paper." By this you err, as it would, at least, need the sand or glass-paper to close the fibres of the leather after any instrument had passed over it in one direction only, as the finished edge would look rough. But, as you say, it would be very useful to amateurs. And

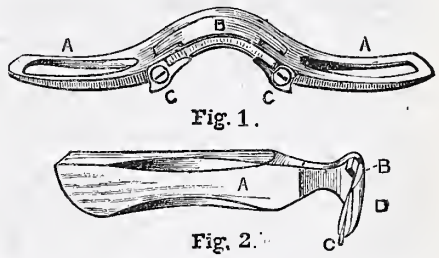


Fig. 1.—A Yankee Heel-shave. Fig. 2.—Improved Sole Plane.

now, having pointed out the way that you must look at it in, I will tell you what are already in the market, and their price, feeling sure that this to an intending patentee is one of the principal things to know, even if they are not a bit like his own idea, for he has then a better chance of judging that his is, or is not, a thing wanted and produced. Fig. 1 is a Yankee heel-shave, iron frame, price 2s. each; A, A, are the handles, B, the knife or cutting-iron, and C, C, the two screws that liberate it to be sharpened, or set for a coarse or fine cut. Fig. 2 is an improved sole plane, price 1s. 1d. each; A is the handle, B and C the cutting blade (B being the cutting end), and D the guard, which runs on the welt near the upper. You see, by this tool it is impossible to cut the upper; and, to end, I think I had better hint that all edges should be a little hollow, therefore your cutting-iron would need to be a little on the round.—W. G.

Billiard Tables.—W. W. N. (*Leeds*).—No such papers have appeared. We only await the advent of a thoroughly competent writer to take up the subject.—Ed.

Vol. I. of Work.—W. H. (*Huyton*).—The published price of Vol. I. of Work is 7s. 6d., but it is out of print. You should advertise for it in Work.

Sewing-Machine.—W. B. (*Walthamstow*).—An article on How to Adapt a Sewing Machine for Fret-Saw Machine appeared in Work, No. 56.

Brass-Polish—Glass Mending.—J. H. (*Leeds*).—You should advertise your books in our cheap "Sale and Exchange" column.

Chimney-Top.—J. R. (*Bagnalstown*).—The only way in which you can see if the design is patented is by searching the records at the Patent Office, London.

Zither Music.—F. P. (*Northwich*).—There is very little music published otherwise than in the treble clef. The reason for this is that there would be many astonishingly high and low notes in the accompaniment and bass were the latter written in the bass clef; so the very objection you make is a very substantial boon to the great majority of zither players. It is surely much easier to read one clef than two. As to zither music with words, there is plenty published—most of it in Germany. I cannot say where you could procure any with English words, but think it is likely that such is to be obtained. Write to Herr J. Goebel, Museum Street, London, or at Mitchell's Library, Old Bond Street, who will probably be able to furnish you with what you require, or, at any rate, to give you more information on this particular subject than I can, as I have had very little to do with zither music for some years. If you have A. Davis' series, you have as fairly representative a selection as any of which I know; but the gentleman mentioned above will most likely be in a position to put you on the right track, as he is a well-known performer, as well as a teacher, of the instrument. Having in view the very severe strictures which one correspondent has thought fit to pass upon my advocacy of the metal strings, it is satisfactory to learn that you fully appreciate their superiority. In my own opinion, their pre-eminence over the ordinary silk and gut ones is self-evident; but so much depends upon what sort of touch the player has acquired. I shall always be happy to answer queries respecting the zither, and regret that in the present instance I am unable to give a categorical reply.—A. O. T.

Zither Music.—C. S. (*Liverpool*).—The great bulk of music for the zither is published in Germany. I am unable to tell you where to procure any of English origin or with English words. Try Litolff's', who publish a fair variety of zither music, or Metzler. Failing these sources, your only course would be to get whatever songs, airs, etc., which you might select transposed to suit the instrument. This would mean the simplification of the melody or the re-arrangement of the chords, and the proper arrangement of the accompaniment in the treble clef, so as to avoid very high or low notes on ledger lines—which is the reason why the treble clef is retained for the accompaniment and bass in most zither music. I have seen music for the zither written as for the pianoforte, but there is comparatively little of it in the market. Nevertheless, inquiry among the publishers cannot fail to elicit all information as to such music. I am sorry I cannot give you a more satisfactory reply; but you must remember that the great majority of players are quite satisfied with the music of German publishers. Write to Treffenbrünner, of Munich, or Riendl, of Vienna, for lists of high-class zither music. It is possible that some English songs are published in Germany.—A. O. T.

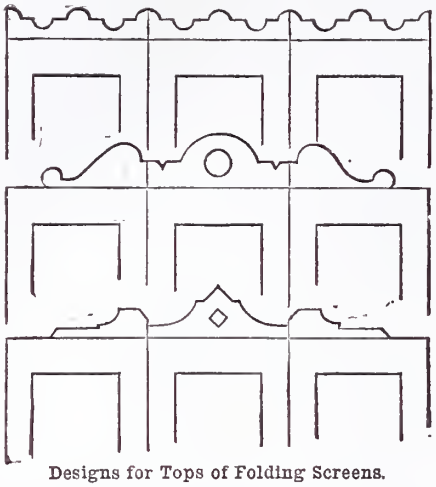
Phonograph and Platinum.—A Monthly Subscriber.—An article on "How to Make a Phonograph" appears to-day. About scrap platinum, write to Messrs. Johnson & Matthay, assayists, Hatton Garden, London.—W. D.

Wire Dulcimer.—J. L. S. (*Paisley*).—If by a "wire" dulcimer you mean an ordinary dulcimer of wood strung with wire, you will find full instructions for making such an instrument in Nos. 31, 38, and 41, Vol. I., of Work.—R. F.

Electrical Lessons.—H. C. (*Euston Road, W.C.*).—The construction of electric bells has been fully described and illustrated in the articles on Burglar Alarms published in Work, Vol. I., pp. 179, 279, 311, 418, 484, 537, 682, 699. You cannot do better than to get this volume, and continue reading electric papers in Work, Vol. IV.—G. E. B.

Course of Study for Engine Driver.—R. W. (*Birmingham*).—Study the principles of the sciences which govern the working of steam engines. You will find these in the lessons on Mechanics, Hydrostatics, and Heat in the "Popular Educator," and on the Steam Engine in the "Popular Educator" and in the "Technical Educator." As you are about to learn how to take charge of the engines and dynamos at a new public baths, you will find some lessons on Voltaic Electricity and on Machines for Raising Water in the "Technical Educator." To extend your knowledge of electrical science, I should advise you to study "Electricity in the Service of Man"—a good book. This and the Educators may be had in monthly parts, if you prefer to have them in this form, and then bind the parts together. Some of the best books on the steam engine and on electrical engineering are very expensive, but perhaps you may be able to get access to them in one of the public libraries or mechanics' institutes in Birmingham. A study of such books as I have mentioned, and a practical application of the principles gleaned from them, under the advice and direction of the engineer in charge—who will, I understand, teach you—should enable you to become a proficient workman. If you get into any difficulty in not being able to understand what you read or what you see, make use of us in the future as you have in the past.—G. E. B.

Top of Folding Screen.—T. D. (*Gateshead-on-Tyne*).—Something very simple will best suit the top of your screen. Here are three sketches, one of which will probably serve your purpose or suggest what you want. My plan would be to saw out the one selected from ¾ in. braid, and, as firm fixings



Designs for Tops of Folding Screens.

will be essential, I should, in addition to glue, run a long dowel or two into the broader part of each division, and through the narrower drive a screw down into the top edge of the screen. Your ornamental top will then be in no danger of being knocked off.—M. M.

III.—Questions Submitted to Readers.

*** *The attention and co-operation of readers of* Work *are invited for this section of "Shop."*

Marbling.—Effbee writes:—"I should feel obliged if any reader would tell me how to make water colours float on water for marbling purposes."

Wood Stain.—H. W. T. (*Harrow*) would like to know the best stains for wood to show the grain.

Cut Boot and Shoe Leather.—W. L. (*Leith*) writes:—"Would any reader kindly give the address of a wholesale firm who sells leather cut into soles and heels?"

Distilling.—G. H. L. (*Peckham*) writes:—"Having constructed a 'Liebig Condenser' from instructions by R. W. C. in No 157, I now want a worm condenser. Will R. W. C. kindly inform me if it should be of tin plate, or will the *drawn* tin pipe answer? Also, will a 3-quart saucepan—the size wanted—with a head fitted to it fulfil the purpose of distilling from a saccharine preserve similar to a fruit jam?"

IV.—Questions Answered by Correspondents.

Model Locomotive.—M. (*Bishop Auckland*) writes to E. W. L. (*Newcastle-on-Tyne*) (see No. 163, page 110):—"'Model Engine Making,' by J. Pocock, contains articles on 'Model Locomotive Making.'"

Knee-hole Desk.—M. (*Bishop Auckland*) writes to H. L. (*Oxford*) (see No. 163, page 110):—"If you write me with particulars, I will be glad to help you with instructions or drawings."

V.—Letters Received.

Questions have been received from the following correspondents, and answers only await space in Shop, upon which there is great pressure:—G. T. (*London, E.C.*); Patentee; A. B. (*Sheffield*); R. P. (*Horsham*); B. H. (*Winsford*); F. H. W. (*Southampton*); Constant Reader; C. B. B. (*Westbury-on-Trym*); S. M. (*Derby*); J. P. H. (*Oldham*); A. P. (*Nottingham*); J. B. (*Leeds*); Lawton; J. W. B. (*Huddersfield*); L. G. (*Bradford*); H. H. (*London, S.E.*); G. S. W. (*Dewsbury*); A Reader; W. R. (*Stepney Green*).

"WORK" PRIZE COMPETITIONS.

The Editor of Work has the pleasure of calling the attention of his readers to the following scheme for Prize Competitions, which he will feel obliged by their bringing under the notice of friends and others interested in any of those departments of work, or employment, which the prize scheme is intended to stimulate.

Fully sensible of the interest which many thousands of the readers of Work take in matters of a competitive nature, this prize scheme has been deemed a suitable sequel to the Work Exhibition, in which so many readers obtained honours.

A general subject has been considered best with which to commence: and as most of the readers of Work and thousands of the outside public know something of bicycles and tricycles, competition is invited for the best essay upon

"The Cycle: Its Worth to the Nation."

For the three best essays the following prizes will be awarded—

First Prize, £3;
Second Prize, £2;
Third Prize, £1.

Conditions and Rules of the Cycle Essay Competition.

All Essays to bear the Work Prize Coupon, cut from one of the numbers of Work in which the prize scheme is announced.

Each Essay to be signed with an original *nom de plume*, and to have the writer's real name and address securely attached to the manuscript in a sealed envelope.

No Essay to exceed more than two pages of Work in extent, including any diagrams that may be necessary to elucidate the text.

In the work of judging regard will be had to original suggestions of value affecting the improvement of bicycles and tricycles, especially where such improvements are shown by diagrams.

All Prize Essays and Drawings to be published, if desired by the Editor, in Work, but the copyright thereof to remain with the authors.

Copies of MSS. and Drawings to be retained by the competitors, as in no case can the return of MSS. be undertaken.

The Editor of Work will supervise the judging of the Essays, and the selection as determined upon is to be final.

All manuscripts intended for the Cycle Essay Competition must be addressed to the Editor of Work, c/o Cassell & Co., Ld., Ludgate Hill, London, E.C. They must reach him not later than Saturday, June 25, and should be legibly endorsed on the envelope or wrapper, "Work Cycle Essay Competition."

Next Week's Work (*No.* 170) *will contain full directions and diagrams for making* A Cheap and Portable Tent for Seaside or River Bathing Purposes.

SALE AND EXCHANGE.

Victor Supply Co., Grimsby, sell Mail-cart Wheels and Parts. [4 R

Caplatzi's Matchless Technical Collections embrace most things electrical, optical, mechanical, chemical, photographic, models, materials. Catalogues, 2d.—Chenies Street, Bedford Square. [9 R

Lettering and Sign-Writing made Easy.—Also full-size diagrams for marking out eight alphabets, only 1s.—F. Coulthard, Darlington Street, Bath. 100 Decorators' Stencils (60 large sheets), 2s. 6d.

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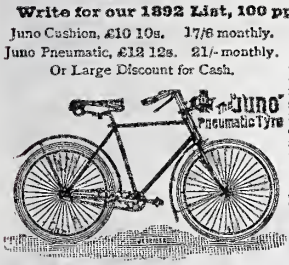

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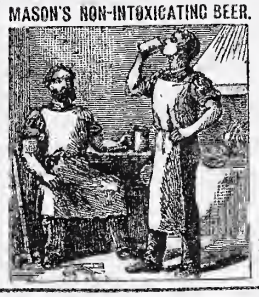

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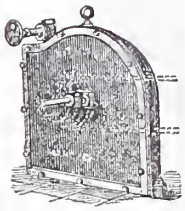

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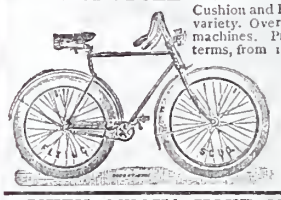

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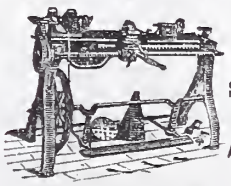

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An Illustrated Journal of Practice and Theory

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VOL. IV.—No. 170.] SATURDAY, JUNE 18, 1892. [PRICE ONE PENNY.

WORK WORLD.

A NEW tire protector has been brought out. It is composed of very thin compressed raw hide, in 1½ in. sections, which overlap each other. It is very light, is puncture-proof, and shaped to fit closely over the tread of the tire. Cyclists will note.

* *

The finest Persian carpet in the world—the Holy Carpet of the Mosque of Ardebil—is on view in London. It measures 34 ft. 6 in. by 17 ft. 6 in. The maker's signature is accompanied by the date 942, which is 1535 of our era.

* *

Sheffield is largely interested in the new Admiralty battleship—the *Resolution*. 2,500 tons of her armour plating were turned out at the Atlas Works. Sir John Brown & Company, Limited, are furnishing the armour for a sister ship—the *Revenge*.

* *

A submarine boat recently tested attained a speed of ten miles per hour under water, turned round, and rose and sank under perfect control. When on the surface it is driven by steam, and when below by a storage battery charged by the propeller engines. Saving life at sea ought to be possible with this.

* *

The economy of heating feed water by steam direct from the boiler—commonly called "live" steam—has been shown by experiment, and is now beginning to be recognised by the Whitehead Torpedo Company, who have ordered a second apparatus on this principle.

* *

An optical pyrometer has been designed, based upon Cornu's photometer; it is a much simpler instrument than the thermo-junction electric pyrometer, and therefore more suitable for everyday use. The methods of measuring very high temperatures yet calls for investigation on the part of practical men.

The number of gun barrels proved during 1891 in the Birmingham Proof-house was 561,631, an increase of 40,691 over those in 1890. Failures in proof were much smaller in number than might have been expected, considering the great increase in the common class of work and the falling off in the best work. The common class of barrels are very much exported abroad for foreign guns, and are not likely to favourably impress foreigners with the quality of English workmanship.

* *

Although the electric light may be put anywhere and used without the adventitious aid of match or fire, yet Mr. Preece, F.R.S., maintains it is not always absolutely safe. Security is to be obtained only by good design, perfect materials, first-class workmanship, and rigid inspection. Imperfect materials erected by cheap contractors lead to many disasters. Everything ought, as much as possible, to be kept in view, and the conductors ought not to be hidden under wainscots or floors, or above ceilings. All this is worth knowing.

* *

A Labour Exchange has been opened in Paris. The building has been erected by the municipality, which paid 1,000,000 francs for the site. It contains a hall accommodating 1,600 persons, and has 150 rooms, which will be used by 230 trade unions, the building being left entirely to the management of the unions. It is hoped it will contribute to social pacification, to the success of the just claims of labour, and to international relations, resulting one day in universal peace! Where is London?

* *

Many German engineers prefer masonry to iron for bridges, and they have revived the practice of building masonry bridges with lead joints at the key and points of rupture near the spring lines. The Romans used sheets of lead between cut stones, and in bridges built in England in 1833 bands of lead were placed in the joints for two-thirds of the distance above the spring line. The use of lead is for maintaining the proper interval of joint, and for uniformly distributing the pressures.

Milling machines are doing away with much of the vice work of the practical engineer. Double eyes, and other fitting parts of engines and machinery that were formerly carefully filed up at the vice, are now turned out at the machine by skilled labourers at about four-sevenths of the wage of mechanics. Work that was done a year or two ago at the slotting and planing machines, and afterwards fitted, is now designed so that it can be finished by milling cutters alone, afterwards being highly polished by the aid of buffing wheels and belts.

* *

The street music joys of the metropolis are likely to be increased. Mr. J. Charles King, the writer and worker upon the technics of coachmaking, has patented some carriage musical gear, which he proposes to apply at first to children's mail carts and perambulators in the shape of chimes and simple tunes. When the idea is extended, and every vehicle gives off a tune to the revolution of its wheels, the reputation of England as a musical country will be materially strengthened. Whether the general result will be a matter for national rejoicing or a cause for profound despair lies in the future. But England is so musical!

* *

An oppressive shop-tax exists on all coachmakers, with the added indignity of Excise espionage at all hours of the day, and the annoyance of having to keep books of accounts to suit this humiliating official action of the Government—under the risk of severe penalties for any contravention of the Excise dictum. Every carriage repaired must be entered, and owner's name and address submitted to the exciseman. Every carriage sold must in like manner be entered. Carriages bought of private users must be entered in the trade books. Forms supplied by Government have to be accurately filled in. The particulars of all carriages sold must be precise as to number of wheels, and if with a pole-socket on the bed for a pair of horses or not; and the coachmaker must answer any question of sales or repairs to the exciseman, or submit to be "Star-chambered" at Somerset House, which authority is despotic in its judgments.

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Introduction.—In all staircases that we have previously examined the "going" has required nothing special beyond careful attention in setting out the number of steps, so that they should not project beyond a given point.

The plan, however, we now propose working upon being strictly limited, the space for the "going" will require careful study, to enable us to reach the floor above in a reasonably easy manner. This it will be found can only be achieved by introducing at the bottom a series of graduated steps, called *winders*. Winders are placed in various positions, according to circumstances; hence we often find them at the top of a flight of stairs, again at both top and bottom, and finally the whole of the landing (as in the drawing) is converted into winders, in which case they are called a *half-space of winders*.

As I have before mentioned, winders should always be avoided where possible; but as they are so often indispensable, we must make them as easy as circumstances will allow. The following examples have been taken as representative of the various forms of winding stairs in common use, and will fully answer our present purpose.

Working Drawings.—The present flight of stairs is arranged to be placed between two walls, with entrance at right angles to the staircase at the bottom. There being a room on each side at the top, a landing becomes a necessity. At first sight it might appear that the winders could have been dispensed with, by leaving a space at the bottom similar to the landing at top, thus making a straight flight do. But upon examination it will at once be seen that this will not answer, the "going" being so little that the number of *risers* necessary to carry us up would only allow of a very narrow "tread" indeed, therefore we bring in the *winders*.

Position of Winders in Newel.—As the most dangerous position on the winders is of course round the newel, we must make them as large as possible at this point.

Many people strike out the winders from the centre of the newel (as at Fig. 7); but this is not desirable, the better plan being to keep the *fliers* back (straight steps are called fliers), so that the winder may be a short distance behind the newel (as at A, Fig. 8). At times it is also possible to have the *first* winder in *front* of the newel (as at B). This is the case where there are steps in two directions—that is, with a quarter-space of winders.

Drawing Plan and Elevation.—To set out the plan, first draw the enclosing walls, with landing and doorways in their respective position; then place the newel as seen at N, and draw the riser, No. 4, at a distance of 2 in. beyond. Now draw riser No. 1, then with a radius of 15 in. strike an arc from the centre of newel, and divide into three equal parts. Divide the two sides of the newel into as many portions as this line, when lines drawn through these points give us the necessary risers. Now, by measuring off the space (*a* to *b*) occupied by the winders, it will at once be seen that the distance *b* to *c* is all that we have at our disposal for the *fliers*.

Having decided upon the number of risers —viz., twelve—this will, as we know, give us eleven "treads." We therefore deduct the three winders from this number, which leaves eight *fliers*; so of course the space *b* to *c* must be divided into eight equal parts.

The elevation must now be drawn as previously described, the only difference being the winders. The winders can also be projected from the plan, and the easement on string drawn as seen.

Full-size Drawings.—As the winders require careful handling to make a satisfactory job, it is necessary that a full-size drawing of them be made. This can be done by fixing a few boards together by ledgers for a drawing-board and marking them on its surface (as at Fig. 10), the method being described in setting out the plan.

Setting Out the Wall-Strings.—Having found the necessary length for our wall-strings (from Fig. 1), we proceed to set it out with the pitch-board, starting at the *top* and working *downwards* until riser No. 4 is reached (as seen in Fig. 6). At right angles to this riser draw a line *a b*, equal in length to *a b*, Fig. 10. This gives winder No. 3. Next draw riser No. 3, *b*, and again draw a line square off this the length from *b* to *c* on Fig. 10, thus obtaining *one* side of winder 2. Draw the line *d* 1 in. beyond *c*, this being the thickness of return-string (Fig. 5), which enters a groove (as shown at Fig. 4).

Fig. 5 represents the wall-string that takes the winder No. 1 and part of No. 2. The part A corresponds in plan and elevation. To set this string out, set a *bevel*, B, to any convenient angle, and apply it to string (as seen in Fig. 5), making *i e* the same as *i e*, Fig. 1. Make *e d* equal *e d* (Fig. 10); draw riser *d d*, at right angles to which draw winder No. 1, making *d e* the same as *d e*, also on Fig. 10.

Gluing up the Wall-Strings.—As it is obvious from Fig. 6 that a 9 in. board would not be nearly wide enough for the winders, pieces must be glued on the string (with a tongue in the joint) as at *e f g*, the dotted line representing the joint-line.

Easements on the Strings.—The easement on the string in Fig. 6 should be made as shown, keeping the line as close as convenient to *b*, or otherwise the depth of string above the second winder will be unsightly. This depth must, of course, be the same on the string (Fig. 5), forming an easement to meet one at the bottom of string from the skirting.

Mould or Template for Winders.—This mould is very useful indeed, as by its use both time and material are saved. It can be made from any odd strips of deal, about 1 in. wide and ⅜ in. thick, and is screwed together at the angles (as seen in Fig. 11). To apply the mould, lay the strips upon the lines *f*, *b*, *c*, *d*, in our full-size drawing (represented by Fig. 10), and screw them together. Be sure to allow about 1 in. *beyond* the lines for the nosing, etc. Now place the mould upon the board (see Fig. 11), and mark round the outside, and cut it out to the shape. This will leave the board with a long angle, *f h*. Now, by turning the mould over, the angle can be brought into use for the piece that is required to make out the winder at S, thus saving a good piece of stuff.

The mould must be fitted to the other winders in the same manner, but these will only require three strips, as reference to the drawing will show.

Gluing up the Winders.—Having cut off all the stuff, the winders must be glued up with a tongue in the joint, as it makes them stronger and less liable to part company in a damp position.

Cutting Winders to Size.—When the glue is dry, the winders should be placed upon the full-size plan and marked for cutting to proper size.

It must be remembered that the lines on the board represent the *risers*, therefore 1 in. must be allowed beyond at front for nosing; the same at the back, to pass under the riser above; ⅜ in. must also be added at the parts that enter the strings and newel. Fig. 3 shows one of the winders cut to its proper size, the dotted lines representing the edge of strings, riser, and newel respectively.

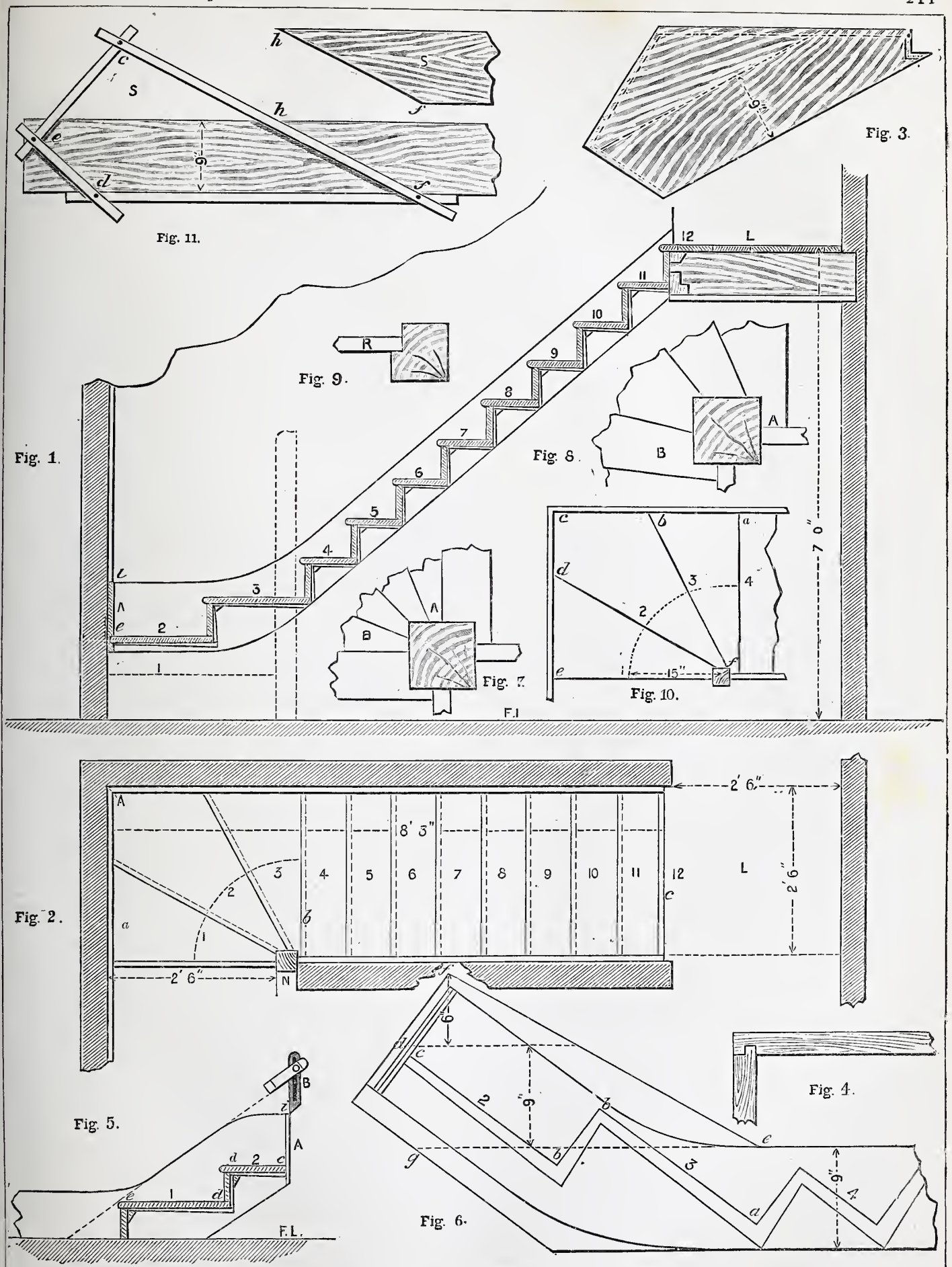
Housing Winders in Newel.—To house the steps and risers into the newel, start at the bottom riser, R (Fig. 9), and cut out ⅜ in. from the newel. Now mark up the other steps, placing each in its proper position, which is obtained from the full-size drawing. Then fit the steps in the same manner; and all that remains is to fit the outside string to the newel at the height seen in Fig. 1, the dotted line being the newel.

Placing Stairs in Position.—A point of great importance to the staircase hand lies in the query, Can our stairs be placed in their position if put together in the shop? It is *always* better that they should, if possible, as it saves a deal of time and temper in the building. This can often be arranged with care. In the present instance, if it were possible to drop in the stairs from above, the newel should be placed with its edge, N, fair with the outside of the string, thus affording no impediment to its passage downwards.

Failing this, the tenon should not be fixed, and the wall-string cut in a line with riser No. 4, then continuing the cut in the form of a *bird's mouth*. If this is done, the stairs can be put together in two parts —the winders in one, and the fliers in the other.

Models.—Should any doubt exist in the mind of the student as to his ability to successfully make a winding staircase over a given plan, I should strongly advise him to prepare a set of *working drawings*, as here described, and make a model to them, working upon a scale of, say, 1½ in. to the foot, as by this means confidence will be assured. The wall-strings would be sufficient, as the other string presents nothing special beyond that which we have attempted before. It might be marked out on a piece of stiff cardboard, as there is no occasion to cut it out for steps, but only the level lines at top and bottom, with the proper easements. Should he do this, he will be astonished at the progress made, as it is very convincing.

Staircasing. Fig. 1.—Sectional Elevation. Fig. 2.—Plan. Fig. 3.—Step. Fig. 4.—Joint between Strings. Fig. 5.—String—B, Bevel; F L, Floor Line; A, Tongue. Fig. 6.—Enlargement of String for Winders. Figs. 7 and 8.—Alternative Method of placing Winders. Fig. 9.—Housing Risers (R) in Newel. Fig. 10.—Sketch for Full-size Drawings. Fig. 11.—Sketch of Template for Winders, showing its Application to Board in Practice.



Staircasing. For Inscriptions to Figures see previous page.

MICRO-PHOTOGRAPHY WORK.

BY ARTHUR RENAUD (B.A. OXON.).

METHOD OF MAKING THE LANTERN SLIDES (1) BY CONTACT; (2) BY REDUCTION—COLOURING SLIDES—FINISHING SLIDES—STORING SLIDES—CONCLUSION.

We now come to the last stage of our subject: viz., the conversion of the negatives into lantern slides. The thing to aim at is the production of negatives free from stains, and the field should be so dense that all round the object may be clear glass in the lantern slide printed from it, and yet not so dense but that the details of the object itself may have every chance of making their appearance on the slide. The actual manipulation is simple enough. The negative is placed film side upwards in a printing frame, and on the top of it is placed the lantern plate, film to film; the printing frame is now shut up, and the exposure takes place, either to artificial light or daylight, the former being the most easily controlled. The red shade taken off the lamp or candle, when the latter has been placed before the printing frame, and replaced after a few seconds, is enough.

In developing the lantern plate, we want as fine a deposit and gradation of tone as we can possibly get. It is a rule that quick development produces a coarse deposit, and a slow development a fine deposit: consequently, the greater time given to development the better. But a too protracted development is liable to give stains and other evils of its own, and is therefore to be avoided. From a quarter to half an hour will probably be about the time taken if the exposure was correct. Some say that great diversity of tone can be made by adding substances to the developer, such as honey, raspberry-syrup, etc.; I should never dream of utilising any such messes.

There is nothing for removing yellow stains like a solution of perchloride of iron—not too strong; I think the actual strength does not much signify—to which a few drops of hydrochloric acid have been added. If the plate is placed in this after fixing, the yellow stain will at once depart. After it has gone, place the plate in the fixing bath again for a few minutes, and wash well. This is a reducing agent, and too dense negatives can easily be reduced to the right depth by its use, but the operator must remember that the full effect is not produced until the plate is in the hypo bath, and he, therefore, must not allow it to remain too long in the iron solution, or it will become too weak when in the hypo.

If the photographs have been made on quarter or half-plates, they can be reduced to lantern-slide size by means of a special instrument made for that purpose. It goes by the name of the "lantern-slide making camera," and is a perfectly indispensable instrument to those who wish to make lantern slides from larger negatives without using their own camera. The cost is not excessive (12s. 6d. for half-plate size), and they are sold by all dealers of any note. But it is as well to have one so made as to take in the *whole* of the negative on the slide, and not merely part of it; this costs 2s. more, but is worth the price. It also necessitates the use of masks, which are, however, generally used in any case, though these have to be of a special shape. The dealer will supply these too. The large negative can also be reduced to lantern-slide size by merely photographing it with the camera in the ordinary way, using a lantern plate instead of a dry plate of ordinary make. The negative is fixed in a hole in a board which exactly fits the window, so that no light enters the room except through the negative. This plan has the advantage that one can get the picture on the lantern plate any size one likes, and take in part or the whole of it according to the subject by altering the position of the camera. The mask having been fastened on, the name of the object is written on the black paper in Chinese white.

The question of lanterns is too deep a one to go into in this paper, especially as there is plenty on that subject in the past numbers, and more promised in the future. If well made, the slides will stand any light—even the limelight lantern.

In conclusion, a few words on colouring the slides may be useful. It stands to reason that colouring adds very much to the effect produced by the slide, and it is worth while to attempt it when you have mastered the manufacture of slides without colouring. Aniline dye colours are used for this work, and it must be done by daylight, or blunders of colouring will ensue. You will want a broad camel's-hair brush, a medium-sized fine-pointed sable brush, and a very minute sable brush for very small work. Besides these and the colours, all you will require will be a bottle of gum arabic solution.

The slide, when made, must be carefully freed from every trace of hypo by prolonged washing, and there must be no incrustation on the film from hard water or other causes. When about to colour the slide, a few drops of colour from one bottle and a few drops of gum from the other are placed side by side on a plate. If the groundwork is to be coloured, it can be done while the slide is wet, and it must be kept very wet while the tinting is going on, by keeping the brush moist with water. The operator's own taste must tell him what tints to employ, and how deep they are to be. If too much colour is put on the first part, while the slide is wet, soaking or brushing with fresh water will remove it, but this cannot be done so easily when the whole slide is coloured, and it is therefore necessary to be careful. When the groundwork is finished, let the slide dry for a little while. Before it is quite dry is the best time to finish it off by colouring the object, which must, of course, be done with great care, using the smallest brush for delicate details. Of course, the great thing is to make the picture on the screen resemble nature.

When dry, the coloured slides are mounted as usual with cover glass and mask. The colours will not interfere with their keeping qualities, as they are permanent, having sunk into the film of the plate.

If it is necessary to leave the plate while at work, put it under a bell-jar, or similar protection, to keep it from dust. If any dust settles on it, don't try to rub it off, or the film will be ruined, but rinse the plate well under a tap. Blue is the only colour that can be reduced to any extent after putting it on by rinsing in fresh water; it is, therefore, necessary with the other colours to avoid going too far, and having to retrench one's footsteps.

When finished, the slides are stood up in grooved boxes similar to those used for negatives, with labels attached outside to denote their contents. In a very large collection it would be best to follow the ordinary classification system adopted by experts in the branches to which they belong, or the whole contents of one box can be made to tell the history of one insect, the contents of another telling the history of another, or of some different subject altogether.

INDUCTION COILS: HOW TO MAKE AND WORK THEM.

BY G. E. BONNEY.

SMALL SPARK COILS—HOW TO LENGTHEN THE SPARK FROM A COIL—THE CONDENSER: ITS ACTION AND PRINCIPLES OF CONSTRUCTION—HOW TO MAKE THE CONDENSER—THE DISCHARGERS: HOW MADE AND HOW USED.

ON starting the small coil (made as directed in my last paper), and connecting the two terminals of the secondary coil by bridging the two with a piece of No. 8 copper wire, a short thin spark will be seen to play between the end of the stout wire and the screw of the terminal. This spark will not satisfy the maker of the coil, who will expect to see one quite ¼ in. in length—that is to say, on first connecting the wire with the terminal, and then gradually slipping the end of it off, he will expect to see a spark follow the end of the wire when this is quite ¼ in. off from the terminal. The shortness of the spark may be due to bad insulation of the wire (there may be no spark at all if there is any defect in the wire), or the break may not work right, or the battery may not be in good order. If one pint cell does not work the coil, try two such cells in series, but no more for such a small coil. If too many cells are employed in trying to lengthen the spark of a defective coil, the defect will be intensified, because the tension of the induced current will then be raised, and it will break down the already defective insulation of the coil.

But suppose the insulation and continuity of the wire coils to be perfect, and the right battery power employed, and the break or interrupter in working order, why is the spark shorter than we anticipated? The cause lies in the fact that the primary current passing through the primary coil is subject to a serious hindrance, arising out of the self-induction of the current. At the instant when the current is interrupted, it charges the primary coil with electric energy, and this is discharged against the current when the primary circuit is restored. In this battle much energy is lost which might be transmitted to the secondary coil. We therefore need some addition to the coil: something to absorb the back-lash of the current: something to act as a thrust-block or buffer to this opposing force. This addition is named a condenser.

The Condenser of a Coil.—This is a storage chamber for the extra current set up in the primary coil by self-induction. The inductive charge of the coil is sent into this chamber instead of being allowed to rush back on the primary current, and from this is discharged in the same direction as the primary current when the circuit is restored. The baseboard of spark coils is either made in the form of a shallow box, to form a condensing chamber beneath the coil, or a space is hollowed out in the baseboard to receive the condenser. The chamber itself is only a receptacle for the condenser, which is made up of a number of sheets of tinfoil, insulated from each other by sheets of waxed paper, but connected alternately at the ends. These sheets receive the extra current from the primary coil, and then give it back again to the primary circuit.

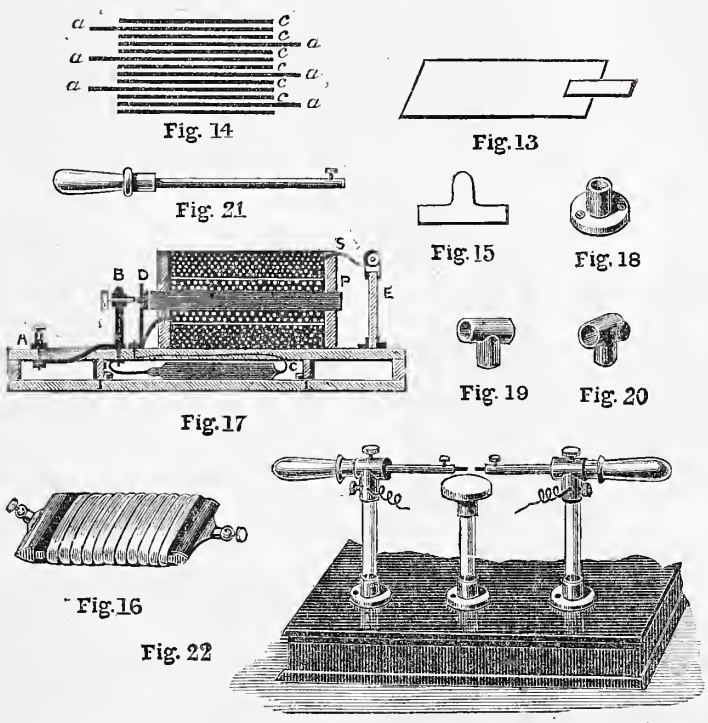
How to Make the Condenser.—First determine the area of the condenser and the number of sheets to be employed in it, such being arranged to suit the size of coil. For small coils to give ⅛ in. spark, we shall require 25 sheets of tinfoil, 2 in. in length

by 1 in. in width; for a $\frac{1}{4}$ in. spark, use 40 sheets of tinfoil, having an area of 2 in. by $1\frac{1}{2}$ in.; for a $\frac{1}{2}$ in. spark, use 50 sheets, 2 in. by 2 in.; for a $\frac{3}{4}$ in. spark, use 60 sheets of 4 in. by 4 in. The dimensions for larger coils will be given later on, when we deal with those coils. The tinfoil must be quite smooth, and free from holes and cracks. It will cost about 3d. per lb., and can be obtained from any dealer in electrical apparatus, or from a chemist. Cut the tinfoil in strips of the required size (using a sharp knife and a straight-edge on a smooth board or sheet of glass), and lay them aside as cut. If the condenser is to be used for a large coil, it will also be advisable to cut a number of small strips of tinfoil, $\frac{3}{4}$ in. in width by 2 in. in length (an equal number to that of the sheets of tinfoil), to be laid on the ends of the sheets (as shown at Fig. 13) to form connecting lugs. The same arrangement may be made for the condenser of a small coil; but this is not usually done, connection being made with the overlapping ends of tinfoil.

The sheets of tinfoil will have to be built up into the form of a block or book, with sheets of waxed paper between each sheet of tinfoil. We must, therefore, prepare the paper for the purpose. The paper selected for this purpose must be thin and tough, and free from glaze, size, or salt of any kind. It must be smooth, and quite free from cracks, flaws, and pinholes. As each sheet is cut, it should be held up to a strong light, and thus examined for flaws. In making the condenser for a small coil with overlapping sheets of tinfoil, cut the sheets of paper 1 in. wider than the sheets of tinfoil, so as to have $\frac{1}{2}$ in. of paper on each side of the foil; but in cutting the paper for larger condensers with connecting lugs, give 1 in. of paper all around each sheet of tinfoil. When all the sheets have been cut, examined, and selected, put the perfect sheets in a shallow dish (such as a baking-dish) one at a time, with a few shavings of paraffin wax on each sheet; then put the dish in a moderately heated oven until the paper floats in melted paraffin. Paraffin wax may be obtained of any dealer in electrical sundries, or through any chemist and druggist. The price is about 1s. per pound. It varies in quality. The best for this purpose is a hard, dense white substance, resembling white wax of best quality. If a choice can be had, choose this in preference to that having a yellowish tint, and a soft, crumbly appearance.

When the paper has been well soaked in the melted paraffin, take up each sheet with a pair of forceps by one corner, allow the hot paraffin to drain off, then place each sheet separately on a clean board to get hard. This will only take a few minutes, as the wax will harden almost immediately. The tinfoil and sheets of insulating paper are now ready to be built up in the form of a book.

The covers of this book will be of wood. We must therefore get two pieces of thin mahogany or similar hard wood, $\frac{1}{4}$ in. less in length and breadth than the paper insulators of the condenser. These must be well smoothed and varnished on both sides. Lay two sheets of paraffined paper on one of these boards, then a sheet of tinfoil, with one end overlapping one end of the paper to the length of $\frac{1}{2}$ in. On this lay another sheet of paper, exactly coincident with the lower sheets; then lay another sheet of tinfoil on this, with the opposite end overlapping the paper to the length of $\frac{1}{2}$ in. Thus go on building up the pile with alternate sheets of paper and tinfoil, each alternate sheet of tinfoil overlapping the paper to the left, and each other sheet overlapping the paper to the right (as shown in annexed sketch, Fig. 14). If the condenser is for a large coil, this arrangement may be modified by placing all the sheets of tinfoil coincident with each other, and placing on each sheet alternately, right and left, the small strips of tinfoil cut for the purpose to form lugs.



Induction Coils. Fig. 13.—Shape of Tinfoil Sheet and Lug for Condenser. Fig. 14.—How to build the Condenser—*a*, Tinfoil; *c*, Paper. Fig. 15.—Brass Lug for End Connection. Fig. 16.—Condenser Complete, bound with Tape. Fig. 17.—Section of Coil showing Position and Connections of Condenser—A, Binding-Post Terminal; B, Contact Pillar; D, Break-Spring; C, Condenser; P, Primary Wire and Core; S, Secondary Wire; E, Discharger Pillar. Fig. 18.—Socket for Foot of Discharger Pillar. Fig. 19.—Brass T for Head of Pillar. Fig. 20.—T fitted with Set-Screw. Fig. 21.—Discharger Handle and Rod. Fig. 22.—Discharger Complete, with Ebonite Table.

When the pile is complete, put on the top board or cover, and apply pressure to the whole pile to the extent of several hundredweights, applied gradually, so as to compress the whole firmly together. This done, bind the whole bundle tightly together with broad tape, wound around across its breadth. All the projecting pieces of tinfoil at one end must now be soldered together, and those at the other end of the pile must be similarly connected to form connecting lugs for the wires from the coils. The best method of doing this is as follows. Get a thin piece of sheet brass or thin copper sheet, and cut out two pieces of the form of Fig. 15. Clean and tin both sides of the widest parts, place them in between the projecting pieces of tinfoil, so as to have half on one side and half on the other, then lightly solder them on both sides to the connecting strips. Binding screws may now be soldered to the strips for convenience in connecting these to the coil wires (as shown at Fig. 16). The condenser will be placed in the cavity beneath the coil, and its two ends will be connected by short wires to the contact pillar and break-spring of the coil, so as to form a connecting link between them. Thus, a wire will go from the foot of the contact pillar to one of the terminals on the condenser, and another wire will go from the opposite end of the condenser to the foot of the break-spring (as shown in the diagram, Fig. 17). The extra current of the primary (which gives a smart spark at the tip of the contact screw) will now pass into the condenser, and the length of spark will be lessened at the point of contact.

The Discharger.—In making a small spark coil with moderately thick bobbin ends, we may mount a small binding post on the ends, and connect the ends of the secondary coil to these. In the holes on the upper part of the posts we may insert two stout brass wires, and slide these in the holes until the tips are near enough for the sparks to pass. If the brass wires of this improvised discharger are furnished with small handles of hard wood or of ebonite, they may be worked without feeling a shock; but if not thus protected by an insulating medium, the operator will get a twofold result from his coil, one of which will be unpleasantly felt. If square ends are employed to the bobbins, both ends of the secondary wire may be brought to small posts at one end of the coil. Such an arrangement would be manifestly inconvenient for use with a large coil, and might also be dangerous to coil and operator alike. It is therefore desirable to have the discharger as a separate piece of apparatus.

How to Make the Discharger.—Get or make brass sockets, with foot flanges (shaped as shown at Fig. 18), and large enough to hold a $\frac{3}{4}$ in. or $\frac{1}{2}$ in. glass rod. Fix the sockets 3 in. apart on the baseboard of the coil, at the opposite end to that of the contact breaker, and cement into each a 3 in. length of glass rod or ebonite rod. Next get two T-sockets (shaped as shown at Fig. 19), the upright branch of each to fit the tops of the glass pillars, and the horizontal tube on top to fit the sliding bars of the dischargers. These may therefore be $\frac{3}{8}$ in. or $\frac{1}{4}$ in. Each tube should also be furnished with a set-screw in the side (as shown, Fig. 20) to hold the discharger in position, and another set-screw and hole to receive the ends of the secondary wires. Cement these T's to the tops of the pillars, taking care to have the tubes on top in line with each other. Now get two 4 in. lengths of brass or copper rod to exactly fit the tubes. At one end of each, fit a small handle of ebonite, or baked hard wood soaked in melted paraffin. In the opposite end of each rod drill a $\frac{1}{16}$ in. hole to the depth of $\frac{3}{4}$ in., and drill a $\frac{1}{8}$ in. hole to intersect this hole half-way. Tap this hole for a screw,

and fit to it a small short set-screw with a milled head. These holes will be employed to hold bits of wire used in experiments with the coil. Midway between the pillars of the discharger we may fix another insulated pillar, capped with a small table of ebonite. This will be found useful to hold substances subjected to experiments with the coil, as the chosen substance can be placed on the small table whilst the sparks are sent through it.

How to Use the Discharger.—Connect the secondary wires to the T-sockets on the discharger pillars, or, if the ends of the secondary wires are already connected to brass terminals, lead wires from these to the T's on the pillars. Hold one of the discharging rods by the insulated handle, and slide it through one of the T's halfway, then fix it there. Take the other rod by the insulated handle, and slide this through the other T until the tips of the two rods are near enough to allow the charge of the secondary to discharge itself between them. If one of the sliding-rods is graduated in parts of an inch, the exact length of the spark can be ascertained at once. The tips of the rods should be first fitted with bits of platinum wire—these are the permanent discharging points—but may afterwards be replaced with bits of other wire with varying and pleasing results.

In making a discharger for a large coil, the various parts should be enlarged to match the coil, and a ball and socket T will be found to be a convenience instead of a fixed T on top of the discharger pillar. In this all joints must be well fitted, to prevent corrosion by sparking. This accessory to a spark coil is known by the name of Henley's discharger, and is sold by dealers in electrical apparatus at prices varying from 13s. 6d. to 25s.

LADIES' SADDLES, AND RECENT IMPROVEMENTS.

BY J. CHARLES KING.

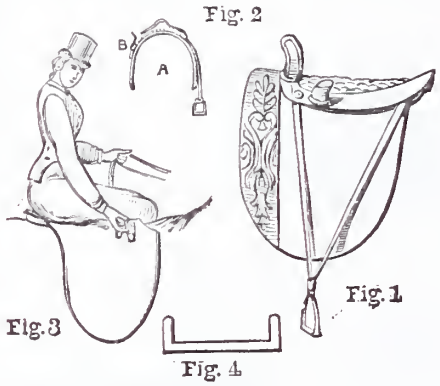
In England the large makers of saddles know more than their sewers, but it is chiefly the technical names of saddles and their prices. Whether a saddle is a good one for a horse or rider they know little, and care less, so long as it sells—that is their business, and they stick to it like men of business.

If you want to see any improvement in saddlery, do not look for it in a saddle-making town till it has had the run of England and the Colonies. One or two trading exceptions might be named; but it is with the lady's riding-saddle we are concerned, and to point out the distinct merits of pommel-fitting, and a stirrup-leather which has been tested now for some time with increasing satisfaction by users. A lady's seat on horseback is not so secure as a gentleman's, and therefore should have every improvement made prominent for trial by women riders.

Formerly there were only two pommels to a side-saddle, to hold one leg in a sort of crutch. It was to decide a wager made by two sporting men—of an aged rider with a side-saddle and a young man with a cross-saddle—that the third pommel, to go over the other leg that was in the stirrup, was suggested by Mr. F. Oldaker, of London, and by its aid the old rider beat his competitor in a race.

This extra pommel was so good that it was adopted, and the off-pommel removed as useless. This was a great advance, and a gain to women riders. The next improvement was to cut off to a level the high pommel-head of the seat; this is becoming quite general everywhere. The next improvement was the stirrup-strap girth that a lady could alter by pulling up the flap on the off side and drawing up or letting out the end of the stirrup-strap to suit the rider. This was found not safe or easy to do, so the stirrup-strap was carried obliquely to the "cantle-point" just at the off side of the seat of saddle. All these inventions were English, but called French, though not seen at French saddlers' for years till quite common in England. The side-saddle had remained as described, but still far from satisfactory, several ladies having been killed and lamed for life from these latest-improved saddles; hence the further improvement by the gentleman, not a saddler, who made the first level-top saddle for his daughter's riding.

The principle of equitation for men is "knee-grip," for women "balance." To aid the balance the stirrup is of immense help if under the equipoise of weight of rider, but if away from it, as usual, even with the best saddlers' saddles, it is deceptive in security and causes painful riding to the



Ladies' Saddles. Fig. 1.—Improved Saddle. Fig. 2.—Section. Fig. 3.—Stirrup-Leather Buckle Position. Fig. 4.—Culvert-Plate Bridge.

horsewomen and tender backs to the horses by side-wrench and rocking of saddles.

The illustration (Fig. 1) shows the improved saddle with the stirrup hung so that the foot is back under the rider's weight, and cannot dangle forward. The projecting edge of seat, which is built out about 3 in. from the horse's back in most saddles, is quite removed here, so that the rider's stirrup-leg and near half-seating is quite close to the animal, and low down on his back, so that the rider is not decentralised, as by an ill-made saddle, which causes the side-wriggle of a woman when riding a trotting horse. It will be seen that the stirrup-leg pommel is about 3 in. back more than in ordinary side-saddles, and lower down on the side of the saddle. This gives the requisite power for the stirrup-leg—even when nearly straight, as it should be—an unfailing leverage to support the rider's equilibrium, forward or sideways. The front pommel checks the backward sway of the rider in the saddle by the clutch of the seat-leg.

The girth stirrup-leather is ordinarily made of great length; it hangs the stirrup from a fixed loop in the saddle, and has a double fold of leather under the stirrup-leg, then goes under the horse as a girth, up to off-side cantle; so that it is about 7½ ft. long from stirrup to altering buckle, with an indirect action. It is not easy to alter, by its complication and oblique pull through the girth-loop, and it often sets fast, and is useless; and being fixed to a loop in the saddle that gives no release in case of a dragging fall—the usual one with women riders—the stirrup-leather has no release, which is a serious matter.

It will be seen by examination of Fig. 1 that the front hanging of the stirrup-leather passes over to the off side of saddle to a buckle. This is shown in Fig. 2, a sectional view of it; and in Fig. 3 is a rider in the act of altering the length of the stirrup-leather while riding. By the illustration (Fig. 2), it will be seen that, from the stirrup, half the length of leather goes direct to the buckle near to the rider's hand for easy altering, and that the stirrup-leather is not under the rider's knee to bruise and chafe it. The improved saddle has a releasing latch at the back-hanging of stirrup-leather.

The opening at the front of saddle-seat, now common with best saddles, is covered by a thin flap of leather only, so as to keep the seat level in front. In the improved saddle the tree is strengthened by a bridge forming a culvert-plate (Fig. 4). This serves as the channel for the stirrup-leather to slide in; a roller at each end of this culvert-plate makes the strap move freely through the channel.

With such a saddle, riding is both safe and pleasant for horse and horsewoman, however long the day; and the added ease and grace of pose on horseback is material to enjoyment, as a lady is always critically scanned by fellow-riders, and feels proud of admiring glances.

The saddles being so much lower in price, by a sovereign or two, though of the best make, may be something else in their favour.

A NEW MAP OR GUIDE-BOOK REST FOR CYCLES.

BY PERCY C. RUSHEN.

The following is chiefly written for the benefit of cyclists, and consists in a few designs for a clip or appliance for holding map-books or tourist-books (to be affixed to the handle-bar) while riding a bicycle. I submit several designs, because out of ten bicycles which would be seen on a country road hardly two would be alike.

The first device, illustrated in Figs. 1, 2, and 3 of the accompanying drawings, is made out of strong wire of about ⅛ in. or $\frac{3}{16}$ in. diameter, and a piece of board of any size, preferably the size of the books you mostly study while riding. It consists of two pieces of wire bent to the shape represented in the said figures, and attached to the piece of board by staples.

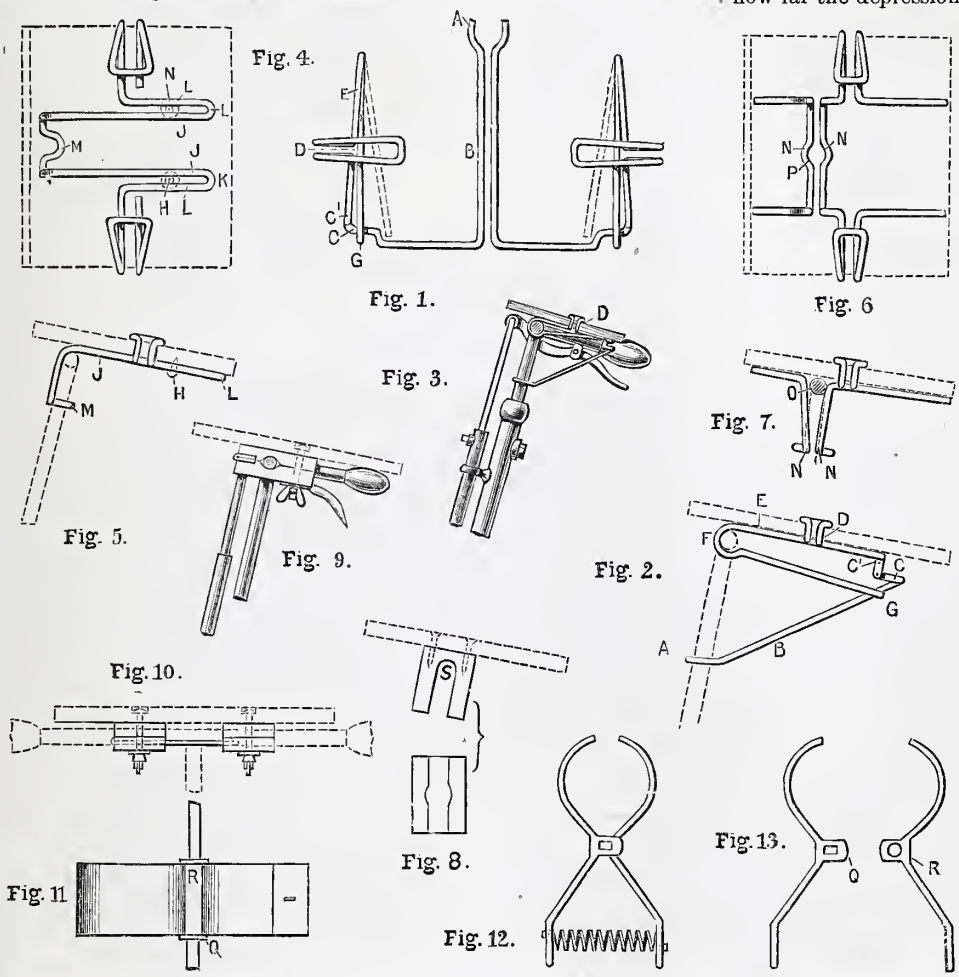
Fig. 1 is a plan and Fig. 2 a side elevation of this design. Fig 3 is a side view of the same fixed on the handle-bar of a safety bicycle. Taking the end, A, of a piece of wire, it is bent in a semicircular figure as represented in Fig. 1, and for a distance of about 5 in. or 6 in. after this curve it is bent at a slight angle from the plane of the flat side of the said curve as seen in Fig. 2 and marked B. It is then bent at right angles to this length, and continued straight for about 3 in. or 4 in. Then, keeping in the same horizontal plane, it is turned inwards, that is, towards the end, for about ½ in. at right angles to the last length, and then bent back to the same straight line again as seen at C. This only continues for about ½ in. or ¾ in., when it is bent upwards for about ½ in., at the same time bending it towards the steering-post in its subsequent position on the handle-bar nearly parallel to the length,

B, as seen at C^1 in the said figures. This continues for about 4 in., having preferably in its middle the clip for holding the pages of the book down when placed on the board.

This little clip, I think, needs no description, not forgetting when bending it that the parts D had better project as far as the length of the board you are going to use, no further, as it will then help to keep it in place. At the end of this length, which is marked E in the accompanying drawings, it is bent into nearly a circular figure, as seen at F in Fig. 2, and continued for a length a little longer than the length, E, as represented in the said figure, and cut off, which end is marked G. When this length of wire has been bent as described, another must be bent exactly like it, excepting that it will be bent the reverse of the one you have just bent, and after being placed in the position represented in Fig. 1, fastened permanently on the board by staples passing over the length or side, E.

When placing on the handle-bar, it must be placed a little to one side of the steering-post, to allow of the passing between the end, G, and the bent-down end of the length or side, E, attached to the board of the handle-bars. It is then slid along to the centre, and the fork composed of the ends, A, dropped on to the steering-post. The ends, G, are then slightly bent to one side, that is, towards the bent-back pieces, as illustrated in Fig. 1 in dotted lines, and then pushed back on to the inner pieces, E, and the circular piece, F, then partially grips the handle-bars. The thicker the board the better, as it is less likely to warp, and if its ends are mortised it is better still. You will find this appliance pretty firm, owing to the fork bearing against the steering-post, and when not in use it can be let down after removing the fork and let swing. If the edge of the board is found to be inconvenient to the working of the treadle, it may be fastened more towards the front of the machine still.

Another form is shown in Figs. 4 and 5, showing a plan and side elevation respectively. It is formed of one piece of wire, and the manner in which it is bent will, I think, be seen from the said figures. The board in this case is adjustable, and can be slid either towards or away from you by the screws, H, working between the parallel lengths, I, J. The screws do not require turning when first driven in just tightly enough. In placing upon the handle-bar, the wire part must be placed upside down, and the steering-post placed between the ends, K and L, and the ends then carried over the handle-bars, when it will be found to drop in its place right side up, the socket, M, receiving the steering-post. The board is then slid on from the front. Two hooks may be placed in the board wherewith to hang it on the frame of the velocipede when not in use.



Map or Guide-Book Rest for Cycles. Fig. 1.—Plan of Upper Side of Wire Rest of two Lengths of Wire. Fig. 2.—Enlarged Side Elevation of above, showing Clip before final fastening. Fig. 3.—Side Elevation of above, showing its Position upon Handle-bar. Fig. 4.—Rest made from one Piece of Wire in Plan of Upper Side. Fig. 5.—Side Elevation of Rest, shown in Fig. 4, in Position. Fig. 6.—Modified Form of Rest of two Pieces of Wire in Plan of Upper Side having a Spring Action. Fig. 7.—Side Elevation of Rest (Fig. 6) in Position. Fig. 8.—Simple Form of Rest. Fig. 9.—Clamp Rest in Side Elevation in Position. Fig. 10.—Back Elevation of Clamp Rest (Fig. 9). Fig. 11.—Side Elevation of simple kind of Clip for position upon Steering-Post. Fig. 12.—Plan of Spring Clip. Fig. 13.—Parts of Spring Clip (Figs. 11 and 12) separated.

The appliance represented in Figs. 6 and 7, which represent a plan and side elevation respectively, is perhaps more simple still. After the foregoing descriptions I think it needless to describe how this is bent, as it will be readily seen from the drawings. It is very simple to put in position, only requiring to be pushed on to the head of the velocipede, the spring ends, N, bending out to admit of the passing between them of the handle-bars into the position O, when the said ends, N, spring back again and clasp lightly the steering-post in the circular space, P.

Fig. 8 represents, in plan of underside and side elevation, a modification of the last form made out of wood, and more suited to those handle-bars which are connected to the steering-post by direct welding—that is, without the addition of a piece of angle tubing or an enlargement. A depression with a semicircular end, S, is cut in a block of wood, and the said block attached to the board by screws. To place it in position, it is only dropped on to the handle-bars.

Two pins attached to chains, placed through holes in the block on each side of the steering-post, and directly underneath the bottom of the handle-bars, prevent the uplifting and sliding of the appliance. Of course, the height of the board depends on how far the depression is cut in the wood. This appliance is very rigid.

In Figs. 9 and 10 still another convenient form is illustrated in side and back elevation respectively. It is formed of two clips, each clip consisting of two pieces of wood joined together at the front by a hinge, which clips clasp the handle-bar between semicircular depressions cut in each piece of wood, by means of bolts having washers and fly-nuts working in holes through the board and each clip. A pin passed through one bottom block of one clip, and partly through the bottom piece of the other clip, prevents the slipping away of the board downwards if the nuts are not tightened quite enough, or a wire fork may be attached to the board to rest against the steering-post.

A handy clip is illustrated in Figs. 11, 12, and 13, which may be used for many purposes. It consists of two pieces of sheet brass bent or fashioned as seen in Fig. 12, which is a plan of the same. The length and breadth are seen in Fig. 11, which is a side elevation. Fig. 13 represents the two arms separately. It will be seen that the bent-over pieces, Q and R, have holes made in them, the hole in the bent pieces, Q, which overlap those marked R, being square, and the hole in the bent piece, R, being circular to such an extent as to rotate on a square wire of the size of the square hole, Q, being placed through the holes. This wire is bent at one of its ends and attached at the other end to the board, and a strong spring placed between the two ends of the arms in the manner shown. This is adjustable, and can be used by itself for many purposes; or one arm may be made flat and screwed on to the bottom of the board.

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NOTICE.

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will be found at the foot of page 223.

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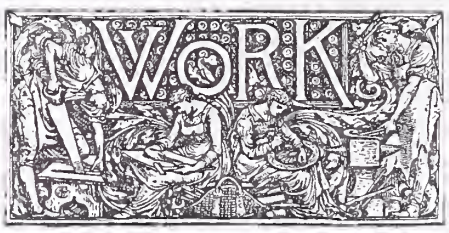

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ELECTRICITY FOR HORSES.—The uses of lightning are endless; one of the very recent ones is to stop runaway horses in pleasure carriages. There are few families of eminence in England but what have suffered from carriage accidents or bolting saddle-horses. The invention of the use of an electric discharge into the nostrils of a horse is known to cause him to stop instantly. Why, we cannot stop to inquire. Horsemen know what a nervous animal is the horse, and that fear is the prime cause of bolting. The shocks to the brain of the horse at the inner part of the nostril seem to paralyse its impulse to run. Two metal balls are fixed on copper wire which branches from a stem applied to the front of the nose-band; within the nose-band, the connecting wire is carried to the sides of the nose-band, and from thence to the carriage, as extra reins would be. A push-button connects them with a dry battery in the carriage, so that it is somewhat like the operation of an electric bell arrangement. A button for the coachman may be supplemented by one for a rider in a close carriage in case of an accident to the coachman. Trials recently by an American gentleman proved effective; a runaway pair of horses was stopped instantly and began to "back" till pacified by one of the party going to their heads. Coach-makers, harness-makers, riders, and drivers, will have to study their respective parts, and operate with critical accuracy what each has to do to ensure efficiency without added risks. Harness-making is in a low state just now, both as to its efficient make for restraining horses, and its fitness to prevent backing, rearing, or kicking—we refer to the machine and slop-made harness—so that the work and the workers may be bettered by this new fitting. Nose-bands will have to be made rightly, and held by the check-pieces properly; now only a few are so; with the general run of riding and driving bridles they are defective. It is proposed to apply the electric wires under the girth for stimulating shocks to make the horse go: this is not desirable. The poor animal has enough stimulating persuasion from the whip and voice. The electric current had better be applied to act as a motor to move the wheels of the carriage, and help the horse.

FREE TECHNICAL SCHOOLS.—This large and important question seems likely to receive a share of the attention it deserves at the hands of the London County Council. We need scarcely say that this should be so, and as it is a matter which we have much at heart, we shall watch it with the greatest possible interest, and give any well-devised measures our full support. With our many thousands of technical readers throughout London and the country, we know something of the wants and requirements of the professional worker as well as the amateur. The existing provisions for technical education in London are lamentably inadequate, and what exists in the way of necessary machinery for technical education of youths and workmen is surrounded with deterrent conditions, which render it useless for the very people who most need it. We maintain that if there is a need in the London parishes of a free public library, a free technical school is a still greater want; and these should, if possible, be worked in conjunction with the Board schools. In these latter we are educating the children of the masses up to a fine point, only to leave them at the moment when they most need opportunity to enable them to become dexterous workmen instead of clerks and kid-gloved gentlemen. The ratepayer would do well to face an increase in the rates for the establishment of free technical schools rather than make a rod for his own back by slowly eliminating the British craftsman as is now being done under the system of educating him in everything else but his craft. Mr. Sidney Webb, the Chairman of the Special Committee on Technical Education, sees the importance of the situation, and has urged it upon the Council. We trust that the £500 which is asked for to defray the necessary expenses of suitable inquiries into the existing provisions for technical education is but the prelude to some such grant as £500,000 for the cause of craft instruction in London alone—a sum of money which the country, and not poor ratepayers, should pay, saving it in some of the many directions where it is uselessly and wastefully thrown away for mere bauble purposes. Parliamentary candidates should take note.

CARPENTRY AND JOINERY.—An exhibition of works in wood has just been held at Carpenters' Hall under the auspices of the Worshipful Company of Carpenters and Joiners. The carving exhibits were very good, but looked at from a joiner's point of view, were very meagre indeed. It is a difficult thing to get a thorough exhibition of joiners' work, because joiners' work proper is of no practical use except for the particular purpose for which it is designed; yet surely such an influential body as the Company of Carpenters and Joiners could prevail upon the leading firms of builders and joiners to lend, for the purpose of exhibition, various pieces of work that are from time to time in hand. Such examples might be left unpolished and sent in, and then taken away and polished as they are required; this would give joiners and the public generally a very good idea of what work in wood really means. The work shown by the students of various technical classes, though commendable enough, was a long way behind that of the continental schools.

A COLLAPSIBLE TENT FOR RIVER OR SEASIDE BATHING, ETC.

BY ONE WHO MADE IT.

The collapsible and portable travelling tent which I am about to describe will, I think, supply a long-felt want—viz., a tent that can be easily and cheaply constructed, adapted for use on the sea-shore, river bank, garden, or elsewhere.

There must be a great number of people who have got stowed away in some corner or lumber-room an old-fashioned "gingham," or gig umbrella. For certain, a great many must be scattered all over the country somewhere.

Anyone who possesses one of the above has an excellent foundation for a "portable tent"; and even if there is not one in the house, a few inquiries would be almost sure to bring one to light in that of a friend's; and failing this, there would be very little trouble in buying one at an umbrella maker's for a shilling or two; but one should be selected (if there is a selection) with the ribs as stiff as possible.

Those readers who desire a tent of the above description (see Fig. 1), and who have not got, and cannot readily purchase, an old gingham frame, can buy all the fittings through an umbrella maker at a very reasonable figure, and by following the method I shall now proceed to explain, can easily make the thing complete themselves. Those who are fortunate enough to have a frame by them need not trouble themselves with that part of the description relating to it.

We first require two strong 1 in. hardwood sticks, about 3 ft. 6 in. long each. An agricultural tool handle will do if you cannot get what you want at the place you buy the other fittings. Joint these together by means of a piece of brass tube about 7 in. long, about 3 in. of which should be fitted and driven on one end of what is going to be the top piece, and secured firmly to it with screws, and the end of the other, or bottom stick, should be made to fit nicely into that part of the socket left, so that these two sticks form one. The bottom part should be pointed, to enter the ground or sand, like a cricketing-stump, but, of course, a little further. These two sticks make the pole of the tent when complete.

We now require the notch (see Fig. 2), runner (Fig. 3), stretchers (Fig. 4), ribs (Fig. 5), ends for ribs (Figs. 5 and 6), and springs.

First get your ribs (which should be of cane, about ½ in. in diameter) all to exactly the same length—say 3 ft. 2 in.—and fit and fix the top and bottom ends, or ferrules, on, either by rivets or by making several indents in them with a sharp tool. Now measure down from the eye of the top ferrule the exact length of the stretchers, which will be about 1 ft. 4 in. long, and this will give you the position for the holes for the rivets for the top of stretchers (Fig. 4). Split pieces of very thin brass tube, about 2 in. long, and pass it round the ribs (as shown at A, Fig. 4), and secured by indenting it as described for ferrules; keep the joints on the outside of ribs, and then drill the holes for rivets, and rivet the tops of stretchers to them, allowing the stretchers to hinge freely.

Now secure the top of the ribs to the notch. To do this, pass a piece of stout wire through the eyes of top ferrules, and, holding the notch in position, with the ribs in their respective grooves, by means of a pair of pliers, turn the two ends of the wire round and round until you tighten it into the hollow of the notch, and fasten the wire off opposite the cut (shown at B, Fig. 5). This wire forms the centre on which the ribs work or open, and when shut should appear as Fig. 6.

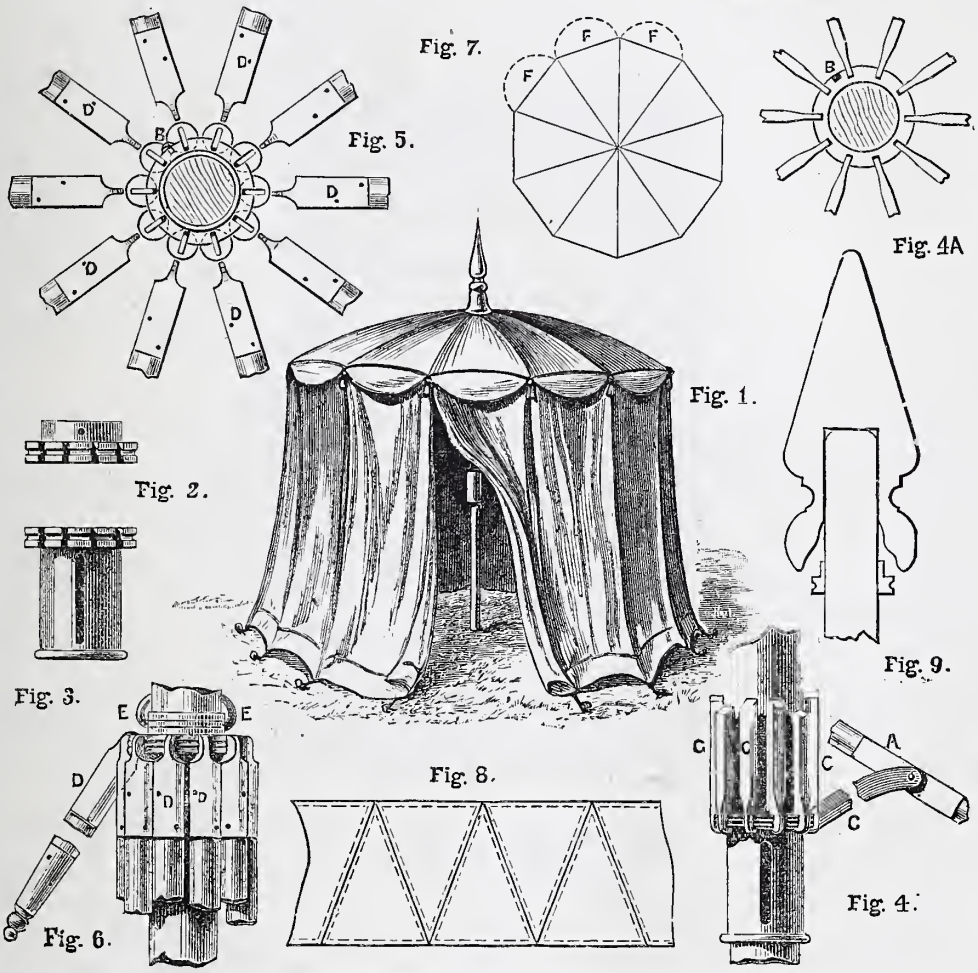
The bottom ends of the stretchers should now be secured to the runner in the same manner, and when so secured, should appear as Fig. 4.

If the stick is next passed through the runner and notch, and the latter temporarily fastened in its place, you can, by raising and lowering the runner, see where to put the springs. Now take out the stick, and let in and fix the springs, after which the stick should be replaced, and the notch properly secured to it by passing a piece of stout wire through both and fastening off the ends (as shown at E, Fig. 6).

The frame is now ready for covering. I have purposely made the above explanation very brief, because everyone possesses such an excellent example in an ordinary umbrella of what I mean.

Now for covering. The material, of course, depends on the amount of money one wishes to spend; and as one of the greatest recommendations of this tent is its extreme cheapness, I should suggest unbleached calico. This material is not water-proof, neither is it as suitable in many respects as others I could mention, but it is very cheap. A great many people think that it is a very difficult matter to cover an umbrella; but it is not so, as the following description will show.

There are ten spaces between the ribs of the frame in question, each of which form an isosceles triangle, their bases being the sides of a ten-sided figure, or "decagon" (see Fig. 7). Now, all that is necessary to do is to cut ten equal triangles, with their two long sides the exact length of the ribs, from the hole at the points to the centre of the stick, allowing for the seams. These segments should be cut on the "cross," as it is termed—that is to say, the height of the triangle should be the width of the stuff (see Fig. 8). Then sewing these segments or triangles together, we have a complete decagon. Now pass the top of the stick through the centre, and firmly bind the ends of the various pieces to the stick, just on top of the notch, with strong waxed thread, with the frame unopened. Next firmly stitch with strong thread the other ends to



A Collapsible Tent. Fig. 1.—The Tent complete. Fig. 2.—Notch. Fig. 3.—Runner. Fig. 4.—Elevation showing connections of Stretchers, Ribs, and Runners. Fig. 4 A.—Plan of Runners, showing Stretchers connected and open. Fig. 5.—Plan of Notch and Ribs, also Ribs detached and opposite their respective Grooves. Fig. 6.—Elevation of Ribs shut and connected to Notch, with one Rib partly open. Fig. 7.—Plan of Roof. Fig. 8.—Width of Fabric, showing Method of cutting Segments. Fig. 9.—Finial. A, Thin Tube; B, Grooves for finishing off Wires; C, Stretchers; D, Ferrules; E, Wire securing Notch to Stick; F, Lappels.

the holes at the points of each rib, and just above and below where the stretchers hinge to the ribs.

Now carefully open the frame, and you will see that the stuff will give to the bending of the ribs, and a nice tight cover will be the result.

The stuff being cut on the cross at the seams allows of its being drawn up to the necessary curve, and not being cut curved, as is generally supposed, this draws the bottoms up; so I should advise anyone who has not done this sort of thing before to allow sufficient material on the bottom of segments to form the flaps or lappels (as shown at Fig. 7), and cut and bind them afterwards.

The walls are formed by sewing ten pieces of the same material together, their widths being the same as the length of the bases of the triangles. The heights or lengths are, of course, determined by the length from the bottom of roof when the pole is stuck in the ground or sand. There is no necessity to make a joint at each corner if the material is wide enough to make two or more sides; but the narrower the material used the cheaper it is, as a rule.

To secure the walls to the roof, firmly sew by the middle a piece of strong tape, about 15 in. long, to the joint of each side, about 1½ in. down from the top on the inside, and by passing each end over its respective rib, just above where the covering is secured to the point of the rib from the inside, and tying them, the walls or sides are secured to the top, and the lappels hide the joints. The opening, or doorway, can be secured with large hooks and eyes or tapes.

If the tent is proposed to be used for the sands, pockets should be formed all round the bottom of the sides on the outside, and by filling these pockets with sand or stones, the tent is held securely in its position. By sewing cords at the bottom joints of the sides, they can be secured to tent-pegs driven in, in the ordinary manner, on any sort of ground.

The ends of the fabric above the notch should be covered with a turned finial (as Fig. 9).

The approximate prices for the various fittings are as follows:—Notch, 7d.; runner, 9d.; stretchers, 2½d. each; ribs, 3d. each; ends for ribs, 1½d. each; sticks, 6d. each.

HELICAL GEARS.

BY J. H.

Principles of Formation.

Proposed Treatment—Sense in which the Term "Helical" is Used—The Principle of the Helical Tooth—Definitions—Method of Contact—Helical Bevels—Development of a Helix upon a Cone—Principle *v.* Practice.

Proposed Treatment. — This paper is written in response to a request from a correspondent. The querist, being a pattern-maker, asks specially for information relative to the making of core-boxes. In order to render my reply useful to pattern-makers in general—and especially to those who may have to make helical tooth blocks for wheel-moulding machines—and also to engineering readers, I propose to give a condensed account of the principles, as well as the practice involved in the construction of helical gears.

Sense in which the Term "Helical" is Used. — At the commencement I must, in order to guard against possible hostile criticism, say that whenever I use the term "helical teeth," the *double* helical type is always meant. Single helical teeth are seldom used, because of the unbalanced diagonal pressure transmitted through them to their shafts.

The Principle of the Helical Tooth.—A helical tooth is, in principle, a very short section of a screw of very long axial pitch. By axial pitch is meant the total longitudinal distance traversed by a helix in making one complete revolution. Thus, in Fig. 1, A is the axial pitch. The parent of the helical tooth was the old stepped gear (Fig. 2), the invention of Dr. Hooke, which may be seen even now in the racks of many planing machines. The advantage of the stepped gear consists in this: that the sliding and rubbing of the teeth over one another which occurs in ordinary wheels during approach to, and recession from, the line joining the centres of the wheels, is greatly minimised; for the stepped teeth are in effect cut into short sections, and each section is set a little in advance of its fellow around the periphery of the wheel. The total rolling and sliding contact of a pair of ordinary teeth is, therefore, divided and apportioned equally between the number of slices into which the stepped teeth are divided, and are reduced exactly in that proportion. A given pair of stepped teeth, during their total contact from one side of the wheels to the other, make as many distinct contacts as there are steps, and these contacts take place approximately, though not entirely, on the line of centres, and back lash is lessened. But then, the stepped teeth are weak and difficult to make, and injurious rubbing and sliding are only partially eliminated. Their advantages scarcely counterbalance their disadvantages, and hence they have never been popular, or come into common use. But now obliterate the sharp angles, merge the steps into a smooth continuous helix, and we have the typical helical tooth.

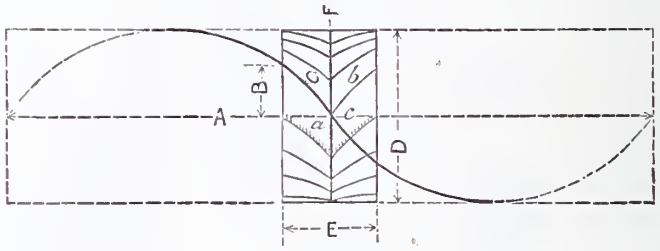


Fig. 1.—Diagram to illustrate the Relation of the Helical Tooth to the Screw.

Definitions.—In Fig. 1, A is axial pitch, B circumferential pitch, and C normal pitch; B is the only pitch which is required to be known; D will represent the pitch diameter of the wheel, and E its breadth; F is its middle plane. We have, therefore, single helical teeth, *a*, *b*, to right and left of F, each tooth forming a short portion of a long helix of axial pitch A, developed on a cylinder of diameter D.

Method of Contact.—In the teeth of a pair of such wheels gearing together, mutual contact continually occurs exactly upon the line of centres passing through the wheels. The path of contact travels across the wheels from side to side, as at A (Fig. 1). For an instant, and only for an instant, each successive section of a pair of teeth is in gear, and the total action is the same, and as devoid of injurious rubbing and sliding as that of two smooth screw threads rolling in contact.

Helical Bevels.—In helical bevel wheels the action and the principle are exactly the same as in helical spurs. A bevel wheel is in principle a frustrum of a cone. The tooth of a helical spur wheel is a section of a helix developed upon a *cylinder*. The tooth of a helical bevel wheel is a section of a helix described on a *cone*. A helix can be developed upon a cone as well as upon a cylinder. Into the primary methods of describing these helices we cannot enter much here. They can be drawn upon a revolving cylinder, or upon a cone, with a marker held in the slide-rest; or they can be drawn by dividing the axial pitch and the circumference of cylinder or cone into the same number of equal parts, and delineating the helix through successive points of intersection.

Development of a Helix upon a Cone.—Fig. 3 represents the development of a helix upon a cone. The base, A, of the cone, and the height, B, are divided out as shown, and right and left-handed helical curves, C, D, drawn through successive points of intersection. Substitute teeth for these curves, and we have a helical bevel wheel, in which A is the major pitch diameter, E the minor, F the middle plane, and G the breadth of rim. A little examination of the figure will render the relationship of the lines clear. A number of horizontal lines are omitted in the elevation of the cone.

Principle v. Practice.—Yet these fundamental principles and methods, which it is necessary to know in some kinds of work, are not actually applied in the practice of helical wheel construction. We do not even want to know the axial pitch of the segmental teeth of helical wheels. But, then, it is obvious that the amount of *slope* or *twist* given to the teeth is of importance. If it is too little in amount, one pair of teeth will be quitting gear before the succeeding pair touch each other, and the action will be jerky; if it is too much, there will be prolonged contact of the first pair during the early portion of the engagement of the second, with consequent undue friction and liability to fracture. The slope of the teeth is, therefore, settled, not with reference to axial pitch, but with reference to the circumferential pitch (Fig. 1, B) and the width of the wheel—the condition being that the engagement of one pair of teeth shall terminate simultaneously with the commencement of the engagement of the next pair. This relation is shown in Figs. 1 and 3 by the lines *c* in each figure touching the apex and the base of contiguous teeth. Hence the coarser the pitch and the narrower the wheel, the greater will be the slope of the teeth, and *vice versâ*. The slope will vary in different wheels by as much as 40 or 50 degrees.

When large wheels—and even those of moderate diameter — are concerned, the screw-formation of the gear may be practically ignored, and straight teeth—*i.e.*, teeth without any twist whatever—be fixed diagonally on the pattern block. The reason is, that in these wheels the length of the teeth bears so small a relative proportion to the axial pitch of the fundamental screw and the diameter of the primitive cylinder, that the twist upon them is quite imperceptible. In these, therefore, straight teeth are used. But as wheels diminish in diameter, or are increased in breadth, the fundamental screw-formation must be adhered to, in order to correct working.

MEANS, MODES, AND METHODS.

New Planes.—New planes are often a source of trouble to an amateur, and very often professional workmen are troubled with new planes choking up—the shavings get fast in the mouth, and the plane refuses to take any more until the wedge and iron have been removed, and all cleared out. The reason of all this difficulty is that the "eye" or "mouth" of the plane is too small. Sometimes workmen cut a little out with a chisel, but it is a practice to be strongly condemned, for in many instances it results in spoiling the tool. In a short time the bottom of the plane wears away, and consequently the mouth gets larger; and in course of time it gets so large as to require a piece planting in to enable it to work clean. What we want, then, is something that will open the "eye" of the plane as long as needed, and when the plane bottom is sufficiently worn it can be placed back in the original position. This can be effected by cutting a strip of soft leather, about ¾ in. wide, and gluing it down in the mouth of the plane under the top end of the iron; this will cause the iron to be more upright, and consequently a larger opening in the mouth (two thicknesses can be put under, if necessary). It will then be found that the plane will clear itself and work nicely. When the plane bottom has worn a little, the leather may be removed; and after the plane has worn away so much that the "eye" becomes too wide to work nicely—especially with smoothing planes—a piece of leather may be glued in the mouth under the bottom end of the iron, which will cause the iron to come nearer to the wood and closer in the "eye." The leather forms a bed for the iron, and the plane will be found to work much sweeter, and to clean up cross-grained wood better.—H. H.

ABOUT THE CAISSON WORK OF THE FORTH BRIDGE.

Few persons, besides those technically acquainted with this stupendous monument of modern engineering, can intelligently grasp the details of it. They hear, in a general way, of the Forth Bridge (or the Tay Bridge) being a mile and a half long, and that it contains so many tons of steel. They admire the fine structure, but perhaps they do not think that the wind may, and can, exercise a pressure on it of twenty pounds to the square foot; but a resistance of fifty-six pounds per square foot has to be provided for—an impossible pressure!

The Forth Viaduct is 1½ miles long; the total length of the bridge and approaches is upwards of 1¾ miles. The actual lengths of the respective approaches and the spans are as follows:—

From Queensferry side to span, 1,979 ft. 11 in., ten spans of 168 ft. each being included in this approach. The first span from that side measures 689 ft. 9 in.; the two great centre spans are 1,710 ft. each, and either would comfortably hold the Eiffel Tower within its length. The Fife span is, again, 689 ft. 9 in.; and the length of its approach, including five small spans of 168 ft. each, is 966 ft. 7 in.

A few more plain facts ere we describe the work. The foundations are carried 88 ft. below the surface. The weight on the base of a single circular pier is 16,000 tons!

The total height of the Cantilever Masonry Pier above *high-water* mark is 209 ft., while it measures 240 ft. in girth. There are twelve circular piers, of which half were constructed by pneumatic caissons, the men working in compressed air.

There are steel plates of 1¼ in. thick in this structure, and tubes 38 ft. in circumference, while upwards of 40 miles of steel plates have been employed in these tubes alone! The channel is more than 200 ft. deep; and with these data before us we may form some opinion, and gain some impression, of the Forth Bridge and the work it demanded.

Besides some 55,000 tons of steel, there are 140,000 cubic yards of masonry. The strength of the structure is made to equal a tension of 30 tons to the square inch. The rolling load, or weight of traffic, was tested up to 1 ton per foot, or "two long coal trains, two engines and tenders, and sixty waggons each on both lines, at once on the bridge."

These were some of the questions or, rather, problems which had to be solved before the bridge could be pronounced secure.

Yet a great deal had to be done before the engineers reached such a stage, and of all the many interesting portions of the work, perhaps the foundations of the piers were the most

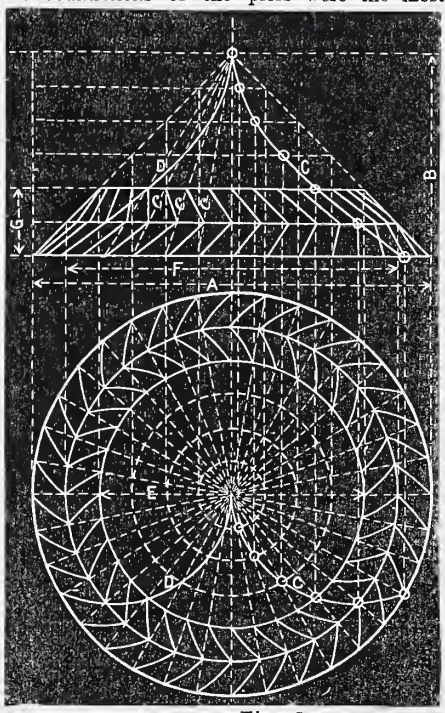


Fig. 3

Fig. 2

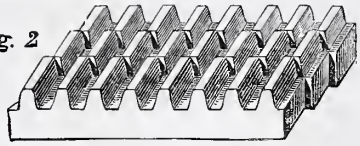


Fig. 2.—Hooke's Stepped Gear. Fig. 3.—Development of a Helix upon a Cone.

striking. These foundations, upon which the cantilevers were to rest, were sunk in the bed-rock and boulder-clay of the estuary. Of course, the work was done under the water, and we will just describe how it was done.

Take the South Queensferry pier. The caissons in which these foundations were laid had to be specially constructed. They were immense coffer dams, 70 ft. in diameter, and were sunk by air-pressure. These immense cylinders have the concrete built within them, and four piers were thus built.

The caissons were sunk about 83 ft. into the estuary after having been carried out on iron cradles. These permanent caissons consist of an inner and an outer shell. In the base is a space denominated the "working chamber." Above was an *air-tight* roof supported by girders. The air inside the caisson was compressed, and of much higher pressure than the water outside it. Consequently, as this great chamber was slowly pressed down, the water and the silt and sand, diluted, were ejected by pipes. Men "liquefied" the more solid mud, and sent the stiff clay up to an outer platform to be thrown away.

The rim of the cylinder cut down lower and lower; and as fast as the soil and water were thus forced into the space it was discharged by the occupants working in the air-chamber, and secured by air-locks. If you stick a roll of stiff paper endways into some yielding material, and pick the inside of the roll clean continually, you will understand the situation.

At length, after much effort and hard work, the caisson or cylinder rested upright and firmly at the bottom of the Firth. The water, mud, and silt had all been sent out and sent up. In the immense, hollow, air-tight chamber, or compressed-air chamber, the men worked under unnatural conditions of pressure. They had now to fill in the caisson to the top (low-water mark) with concrete for the foundation.

How could they get the concrete into the air-tight caisson? Very easily, as it proved. Above, of course, the air was at its usual pressure; a kind of passage with two doors, air-tight, was made, and when the upper door was shut the passage or "lock," as in a canal, was full of air of the ordinary kind. But by opening a tap into this air-lock, compressed air of the same pressure as the lower and working chamber was admitted. The lower door was then opened, the concrete shot down, and the men at once began to lay it on the floor, etc. The lower door was then shut, the upper air admitted, pressure with the outside world equalised, and so *da capo*—filling above, and emptying below. Thus the caisson was packed and rammed full of concrete, the level rising gradually. Working in these chambers is unpleasant at first, and there is much singing in the ears. It is hard to work in such pressure of air; speaking and hearing are difficult, and one cannot whistle! Sickness sometimes supervenes, and on emerging there were cases of paralysis. Our own experience was confined to bleeding of the nose and much discomfort in the head, with a dazed sensation for a couple of days.

Nevertheless, the work was continued. Electricity restored the afflicted, but new hands were continually required. At length the foundation reached to one foot of the top—low-water mark; and here the granite-faced superstructure was commenced. Timber stages were erected, cranes fixed, plates and beams, etc., hoisted up. The steel work was fixed on these platforms, and fastened; the stages were gradually raised as the work proceeded. No scaffolding was employed. The bridge was commenced outwards from the piers on the cantilever system—a kind of mutual bracket support, the structure being gradually added to as each portion was fixed; each piece supporting a successor, and being braced by opposing stresses. Thus the structure is rigid.

Sir B. Baker described the principle so well and so simply at the Royal Institution, that we cannot do better than quote him:—

"Two men seated on chairs extend their arms, supporting them by grasping sticks resting ('butting') against the chairs. This represents two double cantilevers. The central beam was, in this case, represented by a short stick slung from the near hands of the two men, and from the anchorages of the cantilevers by ropes extending from the other hands of the men to a pile of bricks. When stresses were brought to bear by a load on the central beam, the arms and the anchorage ropes came into tension, the sticks and chairs into compression." So rigidity and compensation of structures is the result.

This is, briefly, the idea of the cantilever system. On the Forth Bridge the superstructure of the main spans is composed of three great double cantilevers, which rest on the piers. The centre one is 1,620 ft. in length, the shorter pair being 1,505 ft. each. The centres of the wide spans are formed of girders 350 ft. long and 50 ft. deep in the middle.

From these details we may form some notion of the immense mass of material with which the engineers had to deal, and the tremendous difficulties to be surmounted. All these were happily overcome, and when the railways get into thorough working agreement, and the stations are equal to the autumn traffic, the real advantages of this splendid viaduct will be perceived, and the expenditure (£1,600,000) will not be unproductive.

TRADE: PRESENT AND FUTURE.

*** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

IRON, STEEL, AND COAL TRADES.—The collapse of the Durham strike has restored tone to a somewhat weak market. Hematite stocks have been all but exhausted, and will rise slightly. In coal, appearances seem to point to an early reduction in prices. In railway material, orders are still coming in freely. There is also an increased call for material to be used in the staple trades. The stove-grate industry has improved slightly, and brass-workers are busier.

FILE, SAW, AND TOOL TRADES.—For files, saws, shipbuilding and other tools, there is but little wanted. The engineering trades are brisk, and the wire trade is firmer. Rolling mills are not doing average work.

CYCLE TRADE.—Trade is at its height, extending even to Malta, where the Crypto Cycle Company have filled three orders for geared ordinaries. The North-Western Cycle Company, Manchester, have been awarded the gold medal at the Sportsman's Exhibition. Mr. R. A. Vogt, one of Scotland's foremost path racers, is pushing the sale of the Elswick cycle, a machine which has taken immensely with Scotch riders.

JUTE TRADE.—In Dundee business is confined within the narrowest possible limits. In the linen trade a moderate degree of activity prevails, and values are maintained. The reports from France and Belgium regarding the new crop of flax are not favourable.

PLUMBING TRADE.—What promises to be a somewhat serious labour dispute is in progress at Bolton, where the master plumbers and glaziers have decided to lock out the men pending settlement of a dispute which has occurred as to the non-union hands who have been lately imported into the town.

BUILDING TRADE.—This trade is in fair condition in the West of England. More bricklayers, etc., are required. There is no sign at present of an end to the strike at Cardiff. In Rochdale and district all branches are busy. The stonemasons are still out on strike. At Stockport a strike of bricklayers' labourers has taken place, the men standing out for an increase of from 5½d. to 6d. per hour. It is stated that 6d. per hour is the rate prevailing in most of the towns round Manchester, while in the latter city 6½d. per hour is paid.

ENGINEERING TRADE.—Business remains in a dull state. Locomotive builders are somewhat better situated for work than they have been during the past month, and one or two large orders have been booked for cotton machinery, intended chiefly for abroad. Boiler makers continue to be fairly well employed, but there is little doing in the stationary engine branch; while machine tool makers have great difficulty in finding new work of any kind. The Whitsuntide holidays have unsettled the iron market, but the prices of outside brands of pig iron have fluctuated considerably of late. The demand for steel boiler plates has remained fairly steady. The shipbuilding and marine engineering industries continue in the same depressed state, with the exception of Barrow, where work is still plentiful.

SILVER AND CUTLERY TRADES.—There is not much alteration in the volume of trade in the silver and allied branches of trade. The cutlery trade is inactive, excepting in the more valuable departments.

TIN AND SHEET METAL TRADES.—Manufacturers in the London district are fairly well engaged. Country reports also indicate increased activity. Dairy appliance makers are doing a brisk trade. The London tin-plate market shows a slight improvement. South Wales and Monmouthshire are doing a heavy export trade. The galvanised sheet trade is in a very low condition.

SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

I.—LETTERS FROM CORRESPONDENTS.

Maori Ornament.—J. W. P. (*Holborn, W.C.*) writes:—"Referring to the article on 'Design and Decoration of all Ages' in WORK, No. 163, it may not be generally known that the Maories, or natives of New Zealand, derived the motive of much of their ornament from the convolutions seen in a transverse section of the tree-fern. I may add that in the early days of the settlement lengths of this tree-fern were used extensively for drain tiles, the soft inner pulp speedily decaying, and the outer fibre also becoming readily disintegrated, leaving a horn-like structure of generally annular form, which answered the purpose admirably."

5-oz. Egg.—G. W. (*Monmouth*) writes:—"On April 30 a Minorca hen presented us with an egg, 5 oz. in weight, 8½ in. girth long way, 8 in. girth small way. On examination, I found it contained a usual sized egg in centre, shell and all complete, and was filled up between shells with white. I have damaged the outer shell a little in trying to blow it, as it was my intention to have kept the shell."

Horse-Power.—F. B. C. (*Liverpool*) writes to H. B. P. (*Stockport*):—"Thanks for letter. Watt's experiment has been doubted by some, and it has even been published in 'The Manufacturer's Gazette' that the figures actually obtained by Watt were 22,000 foot-pounds; but to encourage his business, he offered to sell engines reckoning 33,000 foot-pounds to a horse-power. Whether this be true or not I cannot say, but many think that very few horses could do 33,000 foot-pounds per minute continuously for eight hours. This is, however, a matter of small moment, and it is sufficient that the unit called a 'horse-power' is equivalent to 33,000 foot-pounds per minute. It is an 'arbitrary' unit, because no unit based on such variable conditions as a horse's state of health, treatment, and capability of work can ever be absolute; and, further, because a 'foot' is an arbitrary unit of length, and a 'pound' an arbitrary unit of weight."

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Scene Painting.—G. A. S. (*Old Trafford*).—A series of papers on Scene Painting appeared in the following numbers of WORK: 92, 95, 97, 101, and 103.

Brass Handles.—W. B. (*Northumberland*).—You had better consult the hardware fittings dealers in your own town, and, failing these, get one of them to send your sample to Birmingham. If it can be matched anywhere, Birmingham is the place.

Tinman's Tools.—W. S. (*Barking*).—The machine you speak about is called a "jenny," and you could not make one yourself, or anything simpler, that would answer the purpose, except a half-moon stake, and that will only do one of the numerous things that can be done with a jenny. The price of a jenny, small size, is about 30s. Consult the articles in Vol. II. of WORK for description of this and other tools.—R. A.

Green Stain.—H. E. T. (*Harrow Weald*).—The usual staining medium is verdigris steeped in hot vinegar, though I have found the aniline dyes, such as Tomlinson's, very good. The olive-green colour to which you refer is much in vogue in America for small tables, etc., and is gained by giving two coats of green stain and one of black; or the work might be stained green, then use a black filling-in previous to polishing, which latter, by the way, should be done by the white or transparent polish. H. C. Stephens' stains can be procured in most large towns either in liquid or powder form; they include two shades of green.—LIFEBOAT.

Sheet-Metal Workers' Guide.—RESIN.—The best book I know of on the subject is C. T. Millis' "Sheet-Metal Work," published by F. & N. Spon (9s.); and for electric bell work, I can recommend F. C. Allsop's book, published by the same firm, (3s. 6d.). The articles that have appeared in WORK from the pen of Mr. G. E. Bonney are also thoroughly practical and reliable, and contain all necessary information.—R. A.

Battery for Silver-Plating.—J. K. (*Cathcart Road*).—Illustrated articles on Silver-Plating and Gilding, specially written for jewellers, were given in Nos. 107, 110, and 112, pp. 35, 82, and 118, Vol. II. of WORK. In these you will find full instructions for making a suitable battery. I may add, in passing, that I have found the dry battery sold by the Electric Stores Co. very handy for doing such little jobs as gilding or plating a few rings, pins, brooches, alberts, etc. It is always ready and clean. The E. S. Co. supply it with a "plating set" for amateurs, and it is giving much satisfaction.—G. E. B.

Resolution of Forces.—CORKSCREW.—*Erratum.* No. 162, page 93, second column, seventh line from the bottom, for "$R^2 = P^2 + 2\ PQ \cos \alpha$," read "$R^2 = P^2 + Q^2 + 2\ PQ \cos \alpha$."

American Chuck.—TAYLOR.—I do not think you can buy the chuck used on American braces separately. It is extremely cheap, but not good enough for holding work in a lathe; also it would look too big, and have too much overhang to do well on such a little lathe as you could drive with the treadle of a sewing-machine. Remember, the foot-power you can exert on a sewing-machine treadle is not sufficient for any but the smallest work, and it would be useless to put a lathe of more than 2½ in. centres upon it. On such a small affair, with, say, a ½ in. mandrel, a chuck 3 in. long and an inch in diameter would look awkward. I would not have a self-centring chuck, but a simple one with ¼ in. hole, and a set-screw for the larger drills, to be made from ¼ in. round steel, and another with ½ in. hole for smaller drills to be made of ½ in. round steel. There is a handle made hollow for about a dozen tools, and at one end a chuck something like those on American braces. It costs 4s. at the tool shops. A friend of mine used this in his 3½ in. centre lathe, and also in its proper handle. I think it screwed into its handle, so he could make a chuck with a similar screw to hold it in the lathe.—F. A. M.

Souvenir Play Books.—G. S. (*Lambeth*).—I know nothing of the book. Write to Hawes Craven, scenic artist, The Lyceum Theatre, W.C., would find him.

Reliable Patent Agents.—J. B. (*Huddersfield*).—It is beyond our province to name any firm in particular to whom you might entrust your invention, but the names of several respectable firms have appeared in the advertisement pages of WORK.

Painting Letters on Roller Blinds.—K. M. D. (*Harling*).—There is no medium mixed with the colours that I am aware of. Coat the fabric with some rather strong parchment size. The colours should not "ciss" or "run" on this prepared ground.—H. L. B.

Agglomerate Blocks.—F. W. P. (*Clapham*).—To make agglomerate blocks for Leclanché batteries, you will require a very powerful press for compressing the agglomerate mixture whilst hot into an iron mould. The mixture of granular carbon and manganese peroxide and shellac is then made hot—to melt the latter ingredient—and the whole subjected to very heavy pressure in a heated iron mould. No other cement is used.—G. E. B.

Dynamo.—H. S. (*Birkenhead*).—Laminated sheet iron fields are of no use whatever in a dynamo. Your machine may give fair results as a motor, but will not be satisfactory as a dynamo. The fields of a motor are best when easily and readily magnetised and demagnetised. The fields of a dynamo should retain a magnetic charge. With only 12 oz. of No. 20 wire on a 2¼ in. armature, and 6 lbs. of No. 16 wire on the fields, you would not get much current shown on your small galvanometer when connected in series, because the galvanometer has a high resistance. When the armature coil is connected in shunt with the field magnet's coil, and driven at a speed of 1,500 revolutions per minute, you should get a current of two ampères at a pressure of 20 volts from the machine. If you put a drum armature in your machine, you will get poor results, since with an armature 2¼ in. × 4 in. there will be as much dead as active wire. It will be the same with a ring armature. The ends of each coil must be connected to two neighbouring sections of the commutator, and there should be as many sections as there are coils.—G. E. B.

Incubator.—C. O. P. (*Bacup*).—The cause of your regulator not acting may be: (1) tube too small; (2) either too strong, or too much of it; (3) damper not properly balanced. Read over the instructions again, carefully noting these points, and you will probably then find where the mischief lies. I think from your letter No. 2 is the wrong one.—LEGHORN.

Lathe Attachment.—T. B. B. (*Stoke Newington*).—Any tool merchant will get the attachment you want to your order. We cannot insert the petroleum engine address.

Keltic Ornament.—H. C. K. (*Liverpool*).—There is no error in the design to which you refer.

Magic Lanterns.—A CITY OF LONDON SCHOOLBOY.—Much upon this subject and optics generally will be given in the present volume of WORK, which commenced with No. 157.

Current for Electric Lamp.—H. McM. (*Bootle*).—It is quite true, as you suppose, that it is the current volume, expressed by the term ampère, "that gives the heat and, consequently, light to the lamp"; and your friend the electrician was quite right when he described the lamp as a ½ ampère lamp. But (and this is a large "but" of great consequence) the description of the lamp, as given by your friend, leaves you in a fog, unable to determine how you are to get half an ampère of current through the lamp, for electric current must have potential or pushing power (named E.M.F.) behind it to push it through the resistance of the lamp filament, and this is just the important factor lost sight of when only stating the ampèrage of current needed to light the filament. On the other hand, if a lamp is described as an 8-volt or a 16-volt lamp, we know that it takes a current with a potential of 8 volts or 16 volts to push the requisite ampèrage of current through the filament. There may be 100 ampères of current in the generator, but we shall not get enough of it through a 16-volt lamp unless the E.M.F. of the current is 16 volts.—G. E. B.

Battery for Coils.—AMATEUR.—Instructions for making a Leclanché battery were given in No. 27 of WORK. Instructions on batteries for coils, and illustrated details of a medical coil, will be given in the series of articles on coils about to be published in WORK. You will also find much of interest on the same subject in my book on "Induction Coils." We have not yet published an article on Magnetic Electric Machines, but may possibly do so at some future time. Room cannot be found for a description of one in "Shop."—G. E. B.

Corrosion in Steam Boilers.—J. M. (*Dawley*).—Scaling in steam boilers has always been a source of trouble, and the experience of two generations does not show us any cure—really reliable—for it; prevention is better, and easily effected. Heat your feed water with live steam direct from the boiler in a suitable feed water heater; the scale, if any, will then be precipitated before the water enters the boiler, and, moreover, some economy ensues.

There is no waste of heat in this process, and in practice a gain of about six per cent. has been proved in marine work.—F. C.

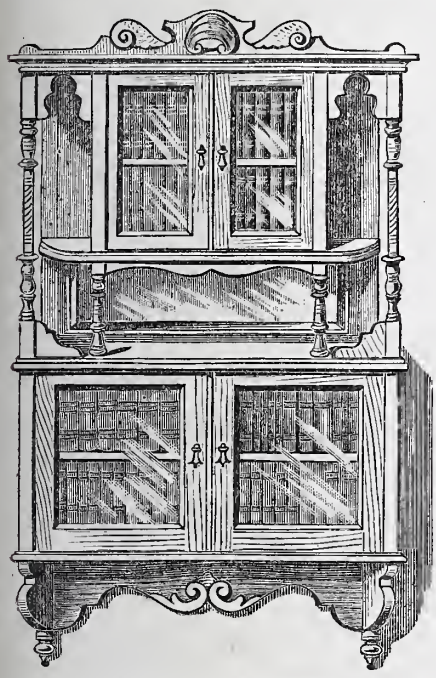
Jewel-Case Making.—FITTER.—These articles are in preparation by a first-rate hand, and we hope to include them in Vol. IV. of WORK.

Upholstery.—MAPLE.—This subject shall be given in WORK as soon as we are suited with a thoroughly good man capable of writing about this branch of work. There is an Upholsterers' Club in the neighbourhood of Tottenham Court Road. Consult the London Directory.

Zinc and Copper.—OLD READER.—If you have the ingots by you, you may send them to be rolled to gauge by the Old Park Rolling Mills Co., Sheffield. Failing this, write to Messrs. Tucker, York Street, Sheffield, stating your requirements, who will, no doubt, be able to suit you, being agents for all the best houses in the trade.—N. M.

Examinations.—ENGINEER.—There is no official examination which the drivers of stationary engines are required to pass. A very excellent book to study is "Stationary Engine Driving," by Michael Reynolds, price 4s. 6d., published by Crosby Lockwood & Co., Stationers' Hall Court, E.C.—J.

Hanging Bookcase.—R. T. C. (*Newcastle*).—According to your wish, I have designed you a hanging bookcase. As you are perhaps aware, considerations of space prevent a printed description of



Hanging Bookcase Design.

details; but if you are doubtful on any particular point, and cannot satisfy yourself by references to back numbers, write again explaining your difficulty.—J. S.

Hard Stopping.—T. H. R. (*York*).—The address where this can be bought ready made is W. H. Palmer & Co., Old Street, London, E.C.; it can also be bought from Mr. Kingston, veneer merchant, Pershore Street, Birmingham.—LIFEBOAT.

Plant Propagator.—BARRA.—An illustrated answer appeared in No. 167.

Sheet Vulcanite.—A. D. (*Birmingham*).—A hand fret-saw and a little patience will enable you to accomplish your task with ease.—QUI VIVE.

Small Spark Coil.—KALLITYPE.—A coil of the following dimensions will give a $\frac{3}{16}$ in. spark when worked with current from one pint bichromate or chromic acid cell: Soft iron core, $\frac{3}{8}$ in. diameter by $3\frac{1}{2}$ in. in length; bobbin ends of ebonite or hard wood, $\frac{3}{4}$ in. in thickness by 2 in. in diameter; primary wire, two layers of No. 24 silk-covered copper wire; secondary wire, 4 oz. of No. 40 silk-covered copper wire; condenser, 40 sheets of tinfoil 2 in. by $1\frac{1}{2}$ in. Run all wire through hot paraffin wax to thoroughly insulate it; have two folds of paraffined paper between core and primary, and three folds of the same between primary and secondary. Baste each layer with hot paraffin wax before winding on the next.—G. E. B.

Mastic Paints.—J. A. (*Glasgow*).—Messrs. Tolhurst's address is King William Street, E.C., *not* Tooley Street.

Chick Rearer.—D. C. (*No Address*).—This, as you will have seen, appeared in No. 151 of WORK, so that you need no longer keep your chicks in an "old hat." That you have got the chicks proves the value of LEGHORN'S articles in WORK.—ED.

Window Frames, etc.—APPRENTICE LAD.—Articles on the above appeared in Nos. 135, 139, 147, and 153 of WORK.

Child's Mail Cart.—A. N. (*Uxbridge*).—"How to Make a Mail Cart" appeared in WORK, No. 30.

Lacquering.—CONSTANT READER.—The reply to H. J. (*Oxford*) appeared in WORK, No. 164.

Sycamore for Violin.—E. H. (*Rock Ferry*).—As you have not got the irons, the only way I can suggest is to try and bend the sycamore wood by the aid of steam, bending it gently, so as not to snap it.—A. J. H.

Model Yacht.—A. H. D. (*Marylebone*).—The gentleman who is our model boat specialist has kindly promised to give you an interview with your model. Please send your full name and address, that this may be arranged.—ED.

Decorations of Organ Pipes, and Alphabets for Sign Writing.—R. G. (*Grantham*).—I am unable to point out any published set of coloured designs for church organ pipes; possibly some reader of WORK can and will do so. There are hints on the subject in WORK, Vol. II., p. 160, No. 62, which may perhaps be useful. As regards alphabets, there is Mr. F. Coulthard's advertisement in the "Sale and Exchange" column of WORK weekly, which looks as if it might be the very thing to suit R. G., but I have not seen his letters.—S. W.

Fret Market.—S. W. (*Chesham*), AMATEUR, ARDROSSAN, and OTHERS.—For selling fretwork apply to S. P., 26, High Street, Bromsgrove, who should advertise in WORK.

Etching on Bone.—A. E. S. (*Glasgow*).—Use sulphuric acid.—S. W.

Engine.—J. S. (*Glasgow*).—No book specially on a *horizontal* engine, but plenty on engines in general. There is Holmes's, published by Longmans at 6s., and Jamieson's, published by Griffin at 7s. 6d. If you want to know *how to make* such an engine, you cannot do better than read F. A. M.'s papers, just completed in WORK. A small vertical engine will be described in the present volume of WORK.—J.

Turbine.—J. B. (*Keighley*).—Gunther, of Oldham, can supply such a turbine.—J.

Striking Medals.—J. E. (*Liverpool*).—Any engraver can get these dies made for you.—J.

Castings.—W. H. H. (*Colne*).—Do you mean stoving the moulds in which castings are made, or the process of varnishing or japanning the castings themselves? Say which.—J.

"Statuary Ware."—J. E. L. (*Middlesbrough*).—The chief London makers of figures, etc., in plaster and similar materials (which, and not objects of high art, are, we presume, the "statuary ware" required) are D. Brucciani & Co., Russell Street, Covent Garden, W.C. Try them.—M. M.

Bamboo.—W. W. (*Liverpool*) will find an article on this material—method of working, tools, etc.—in Vol. I., page 318 (No. 33). There are also many useful hints on the subject scattered up and down the columns of "Shop" in the three vols. of WORK, which are too numerous to be specified.—M. M.

Cabinet-Makers' Journals.—K. M. D. (*Harling*).—In addition to the *Furniture Gazette*, price 4d. monthly, there are *The Cabinet-Maker*, 6d. monthly, and *Furniture and Decoration*, 6d. monthly. Fuller particulars will be supplied upon inquiry at any newsagent's. If you purchase "The Directory of Technical Literature," price 2s., you will find therein named many good American magazines, which, if you can afford their purchase, would assuredly prove of great service to you.—J. S.

Banjo Making.—G. H. H. (*Leeds*).—Much has been said on Banjo Making in "Shop." You should purchase the indexes to Vols. I., II., and III.

Brass Fittings.—W. H. (*Liverpool*).—Your best plan is to keep your address before our readers in the "Sale and Exchange" column.

Æolian Harp.—J. U. (*Bournemouth*).—"How to Make an Æolian Harp" appeared in WORK, No. 55.

WORK, Volume I.—H. W. H. (*Bath*) and other correspondents write to F. C. J. (*King's Cross*), offering Volume I. of WORK for sale.—[These correspondents would do well to advertise in our "Sale and Exchange" column.]

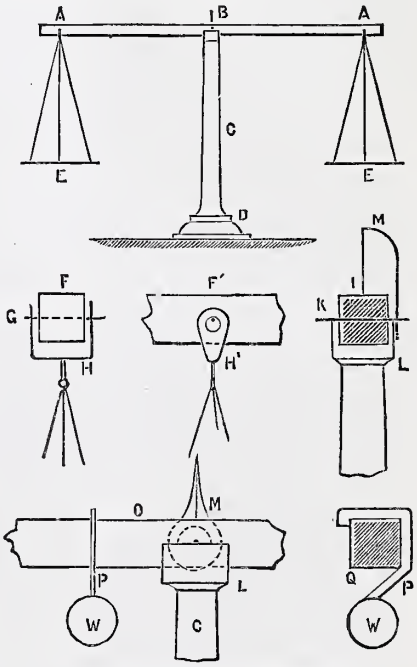
Photographs on Tin.—BAPTISTA.—The tintype or ferrotype plates are procurable at Fallowfield's in Charing Cross Road. They are usually worked with wet collodion, and as such are quite unsuitable for your detective camera, which requires plates as rapid as possible. They are also sold coated with emulsion, but the price would not be very much lower than glass. A shilling a dozen is not a very high figure; the wonder is they can be made good so cheaply. The speculа lens, although working very well, is scarcely quick enough for hand-camera work.—D.

Domestic Oil Motor.—A. G. (*Lhanbryde*).—Benzoline is too dangerous. You should go to Priestman Bros., Holderness Foundry, Hull, and 73, Queen Victoria Street, London; they make engines actuated by common petroleum oil free from all the danger connected with the lighter oils, and no extra insurance is charged. A launch 28 ft. long has been fitted with a 5 h.-p. oil engine for exhibition purposes, and can be seen at Hull; it can be put in motion in a few minutes. This engine has been adopted by the Elder Brethren of the Trinity House, the Irish Lights, and the Northern Lighthouse Board.—F. A. M.

Enamelled Hollow Ware.—WILLM.—For enamelled ware, try the following: Baumann Brothers' agents, Oscar Mœnich & Co., Coleman Street, London (the production of this firm is twenty tons daily); or the Thale Ironworks, Thale-a-Hasy, Germany, who employ 2,500 hands, with a daily output of 35,000 pieces—English agent, James Slack, Bishopsgate Street Within, London. There is also The Patent Process Enamel Company, Bradford, England, for sign-plates, etc.—R. A.

Litho. Press.—CHIPS.—I do not think that you would find the friction of the roller fixed to the handle sufficient to carry the bed of the machine backwards and forwards underneath the scraper. You at least want two or three, two being underneath, one on each side of the handle; and, if it is a large machine, an extra one at the back.—A. J. A.

Analytical Scales and Balances.—T. W. M. (*Bolton*).—Scales and balances, as supplied by good makers, always involve very exact work, and demand long experience in the workmen; in respect to analytical and chemical balances, the nicety of the work is incalculably increased, and the expense very great. It would be hardly possible for an amateur to turn out such a balance on the lines of those made in the trade, but in other ways a very serviceable and reliable one (illustrated herewith) may be produced. I have made and used such myself with much success. In the side elevation C is a pillar, which may be of mahogany or cedar wood well seasoned; there is a cavity in its base (D) filled with lead, to give stability, and on the top is a bearing for the beam at B. The beam may be of



Analytical Scales and Balances.

ebony or mahogany thoroughly seasoned, and about $\frac{1}{4}$ in. square by 18 in. long between the points A and A, from which the scales (E, E) are hung, exactly equidistant from the centre (B). The scales are cut out of thin mica, and supported by fine silk threads. The lower sketches show details. Some sewing-needles are selected, and the central cylindrical parts used as described below. At A and A needles (G) are passed through the centre of the beam (shown in end view at F), to carry thin steel straps (H) through holes in which the needles pass, as shown. A side elevation of this detail is shown at F', H'. These details are about full size. I shows a cross section of the beam at B. A needle (K) is passed through it *a little above its centre*, and rests upon the turned-up edges of a thin steel strip (L). The edges of this strip must be ground so as to be in exactly the same plane, and should be rounded rather than sharpened. An index needle (N) may be fixed in the beam, and a gauge point (M) to the strip (L), to indicate when the beam is horizontal, but I prefer to let into the centre of the length of the beam a very small spirit-level for that purpose, as that will act whether the column is on a horizontal base or not. A side elevation is shown at O. The gauge point (M) has a wide opening—shown in dotted lines—to allow free play to the needle (K). This balance may be used with weights in the ordinary way, or—and this is very convenient for analysis in which percentages are to be ascertained—by graduating the beam and using a weight (W) carried by a hook (P) made of very thin steel or brass, of which another view is shown at Q. To graduate the beam, a strip of fine note-paper should be fixed along the top with thin glue, and thoroughly dried. The holes for the needles being made, the paper is to be carefully divided into 100 parts from B to A in each direction, marked with fine lines in Indian ink, and then covered with a coating of thin shellac spirit varnish. When not in actual use, the balance should be kept in a glass

case, in which is a small basin containing pieces of pumice-stone soaked with sulphuric acid, to absorb any moisture in the air. This balance will, if carefully made, turn with a quarter of an inch of sewing-cotton in one scale.—F. C.

Cementing Tiles to Wood.—A. E. S. (*Maidstone*) wishes to fix tiles on board for the top of a washstand, there being no overlapping wood to hold them in place. The fact that the two materials will not shrink and expand alike with the changes of temperature renders it difficult to unite them, and the cement must needs be an elastic one. The following has been recommended: To 4 parts good glue (prepared in the usual way for the carpenter) add, and boil in, 1 part Venice turpentine. This, it is said, will also hold stone or metal to wood.—M. M.

The Hot-Air Engine.—J. J. (*Newcastle Emlyn*).—There is no patent on the Seal hot-air engine, nor on a regenerating displacer, though there may be on some particular form of one.—F. A. M.

Piano.—J. K. (*Glasgow*).—Articles on "How to Make a Piano" appeared in WORK, Nos. 29, 32, 36, 41, 43, 46, 50, 51.

Dyeing Grasses—J. K. (*Bolton*).—Grasses for the mounting of stuffed animals are most simply and easily dyed with the *aniline* dyes, which you can get as "Judson's Dyes," or otherwise, in all colours. If, as is sometimes the case, the hard, flinty casing of the stems resists the dye, soak them for some hours, and you will then find them take the colour properly.—S. W.

Covering Hand-Rings with Leather.—E. H. M. (*Birmingham*).—As no seam is permissible lest the hands should be blistered, your plan would seem to be to bind the rings with a long narrow strip, the edges pared thin, so that they may neatly overlap each other. I should first bind dry, to make sure that all was right, and then bind permanently, fixing the edges as I went on with Le Page's glue. I could show you work thus done in which you would find it hard to detect the joinings.—S. W.

Concertina Reeds.—J. O. G. (*Wellington*).—Our correspondent will find spring steel the best for concertina reeds. We are told that old watch springs answer the purpose admirably.—G.

Steel Reeds.—SUFFOLK LAD can procure the steel reeds he requires for his accordion from Messrs. Wallis & Co., Euston Road, London, N.W.—G.

Batteries.—ELDRID.—The thing which has happened to the porous pots of your Bunsen battery is, I am afraid, what comes to pass in most batteries where porous pots are used after a time. Of course, it all depends how much work they have to do, as to that time being longer or shorter in coming. A porous pot is, in fact, like a sponge, all full of little holes: these are, however, so minute that you cannot see them. During the working metallic salts, and in some batteries a metal itself, separate out and bung up all these little holes; when these salts crystallise, the same thing happens as in a lead pipe when the water freezes: the porous pot, in time, can no longer withstand the strain, and so crumbles to pieces. In your case the white and scaly substances you mention are the salts of zinc, which have been formed by the electric current. Now, in asking how to prevent this, you are asking a very hard thing; but I shall try and help you all I can. In the first place, I gather from your letter that you give your battery its full share of work, if you are working it often from the runs you mention; so you must expect it at some time or other to wear out. I am afraid your pots are used up. Get new ones, and then, after working, rinse them *well* in, say, half a gallon of warm water with about a small wine glass of spirits of salts in it; then give them a *good* soaking in clean water before putting them away. If they are to be used again soon—say in two days' time—let them remain in clean water until you want them; by this means you will, I think, lengthen their lives a good deal, but I do not know of any absolute cure.—J. B.

Workbox.—C. T. (*Edinburgh*).—A tenon saw will do nicely to cut open a workbox. Any finely-set sharp plane will do to plane edges of lid and box, giving preference to a trying-plane, and taking care of the corners to avoid injuring them. The tools, of course, may be bought at any tool-shop, but I do not know any Edinburgh maker. For mitring boxes, etc., you should make yourself a "donkey's ear" (see WORK, p. 136, where you will find a sketch of that and several other useful appliances). I will submit to our Editor a list of tools of greatest utility shortly, in answer to you and some others.—B. A. B.

Wood-Carving.—U. K. (*Watford*).—I should leave the wood-carving to tell its own tale without the brass inlay. Being in lime wood, brass would not give much contrast of colour or richness of effect. If the carving had been ebony or rosewood, bright metal does light up the work. However, if you wish to inlay brass into the initials, cut brass exactly to shape, using a jeweller's piercing-saw, which is like a fret-saw, but has a smaller frame and a blade more suited to metal. With a fine drill make holes at suitable places, and use fine pins to fix brass, bedding the brass in thick glue or bicycle cement. All this, however, presumes that the surface of metal is flat, and can be polished *in situ*. The practical way would be to do inlaying first, afterwards the carving.—B. A. B.

Overmantel.—SHOPMAN.—So many designs for overmantels have appeared in WORK that, rather than select a particular one for you, I prefer to advise you to scan the Indexes (1d. each) to Vols. I., II., and III. "Shop" has been devoted to the reception of several designs of a simple and effective character.—J. S.

Incubator.—J. J. (*Walthamstow*).—Articles appeared in WORK, Nos. 89 and 143.

Varnish for Violin.—JOHN.—See No. 108 of WORK.

Coach and Carriage Painting.—VARNISH.—These articles are in hand, and will appear shortly.

Steam-Engine Working Models.—A. W. McC. (*Holywood*).—Many makers of these advertise in WORK. Consult our advertisement pages.

III.—QUESTIONS SUBMITTED TO READERS.

*** *The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Glass Bending.—TAXIDERMIST writes:—"Will some fellow worker kindly tell me the method taken to bend sheet glass; the furnace, if any, used; and also a description of the annealing, if required, of sheets up to 5 ft. by 2 ft.?"

Monograms.—H. T. W. (*Cardiff*) writes:—"I would thank our correspondent R. T. D. (*Marylebone*) for a monogram for the letters, 'S. S. G. C.'; also 'H. T. W.' If he would oblige, I should be very thankful to have a monogram from such a competent hand as his."

Fern-Case Designs.—D. B. (*Glasgow*) would feel obliged for a few designs and descriptions in fern cases.

Inlay Monogram.—M. E. (*Renfrew*) writes:—"Will some kind reader give me a circular monogram of 'M. E.,' to go inside a shield for inlaying?"

Magnesium Lamp.—H. W. (*Smethwick*) will thank any reader to inform him as to the makers of such.

Division Plate.—DRILL writes:—"Will any lathe-worker give me some help in the direction of division plates?"

Violin Tone Lines.—ROYAL COLLEGE writes:—"Will some reader learned in the science of sound waves explain the theory of, and illustrate the travelling currents of tone from stringed instruments—notably the violin?"

Public Clocks.—HOROLOGIST writes:—"I should be glad of the opinion of practical clock makers and experts as to the best form of lettering for dials at a great height."

Black Ink.—W. T. P. (*Bilston*) writes:—"Would a fellow reader kindly inform me how to make good black ink for writing purposes?"

Carriage Whip.—A. H. (*Manchester, Jamaica, B.W.I.*) writes:—"I should be obliged to any reader of WORK for information as to how to finish a carriage whip, with information of white metal mounting; cost of machinery for a full working plant, varnish, brushes, etc. I am sending a choice exhibit of the various kinds of our Jamaica woods to the Imperial Institute shortly, and would solicit an inspection from whip manufacturers and other wood-workers."

Coffins.—W. P. W. A. (*Aylesbury*) writes:—"Will some kind reader give me full instructions how to panel a coffin; how wide and thick the panelling ought to be; and how the lid is done? What is about the right width of the head and feet of a coffin—say, 18 in. at the shoulder? Is it in character to put a bit of flourishing on the breast-plate? If so, kindly give me a design for these and letters."

Picture Restoring.—J. H. (*Edinburgh*) writes:—"I have an oil painting which seems to have been coated with a dark-coloured varnish, making a view in bright sunshine appear as if it were a thunderstorm. Can any reader of WORK inform me how to get off the varnish without injuring the painting?"

Formula.—W. A. C. J. (*Newcastle*) writes:—"Will some of our engineering correspondents supply formula for finding the diameters of cylinders for compound, triple, and quadruple expansion engines?"

Fly-making.—F. E. T. (*Maidstone*) writes:—"Can any reader inform me if there is a book published giving instructions in the above? If so, the price, and where to be obtained; if not, where I should be most likely to get lessons."

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Lessons in Engraving—Tools for Engraving.—N. M. (*Sheffield*) writes to ENGRAVER (*Wales*) (see No. 165, page 142):—"For the former send a letter through the Editor of WORK to N. M.; and for the latter consult the first volume of WORK, which contains a series of articles dealing with engraving in its ordinary form."

Armour.—C. J. F. (*Eastbourne*).—Please write to Wetherilt, 10, West Chapel Street, W.

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—OSTEOLOGIST; H. F. (*New Cross*); S. M. L. (*Goderich, Canada*); FLASHING DYNAMO; J. J. H. (*Cardiff*); SILEX; CARINO; T. W. S. (*Hulme*); BRASS LACQUER; R. M. (*No Address*); F. J. (*West Bromwich*); F. E. (*Kerry, Wales*); AMATEUR; J. M. & Co. (*London, E.C.*); C. S. L. (*Manchester*); R. A. L. (*No Address*); AJAX; FRED; J. McC. (*Lochwinnoch*); J. F. N. (*Dundee*); A. W. E. (*Lynmouth*); C. K. (*Fitzroy Square*); J. A. M. (*Stamford Hill*); E. U. (*Wimbledon*); CYCLIST; B. N. (*North Seaton*); H. S. T. B. (*Godalming*); W. E. (*Herts*); C. S. L. (*Kirkcaldy*); W. P. (*Bermondsey*); N'OUBLIEZ PAS; E. W. L. (*Newcastle-on-Tyne*); J. B. (*St. Helens*); GUMMAN; A. F. (*New Ross*).

NOTICE TO READERS.

Next Week's WORK (*No.* 171) *will contain an illustrated article on* POWER HAMMERS; *and also the first of a series of articles on* SIMPLE UTENSILS FOR THE GARDEN.

"WORK" PRIZE COMPETITIONS.

A general subject has been considered best with which to commence; and as most of the readers of WORK and thousands of the outside public know something of bicycles and tricycles, competition is invited for the best essay upon

"The Cycle: Its Worth to the Nation."

For the three best essays the following prizes will be awarded—

First Prize, £3;
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Third Prize, £1.

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Each Essay to be signed with an original *nom de plume*, and to have the writer's real name and address securely attached to the manuscript in a sealed envelope.

No Essay to exceed more than two pages of WORK in extent, including any diagrams that may be necessary to elucidate the text.

In the work of judging regard will be had to original suggestions of value affecting the improvement of bicycles and tricycles, especially where such improvements are shown by diagrams.

All Prize Essays and Drawings to be published, if desired by the Editor, in WORK, but the copyright thereof to remain with the authors.

Copies of MSS. and Drawings to be retained by the competitors, as in no case can the return of MSS. be undertaken.

The Editor of WORK will supervise the judging of the Essays, and the selection as determined upon is to be final.

All manuscripts intended for the Cycle Essay Competition must be addressed to the Editor of WORK, c/o Cassell & Co., Ld., Ludgate Hill, London, E.C. They must reach him not later than Saturday, June 25, endorsed, "WORK Cycle Essay Competition."

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100 Fretwork Designs (new), 100 Carving, 100 Repoussé, 30 Fret Brackets, 100 Sign Writer's Stencils (all full size), 300 Turning, 400 Small Stencils. Each packet, 1s.; postage free.—F. COULTHARD, Darlington Street, Bath. [1 S

Fretwork Designs.—40, 7d.; 12 brackets, 1s. 1d. Catalogue 300 miniatures, 6d. Lists free.—TAYLOR'S Fretworkeries, Blackpool. [18 R

Hasluck's "Lathe-work," 3s. 6d., new; Copper Boiler, 17 by 7½, 7 flues, new, 35s., worth double.—COOPER, Polegate, Sussex. [20 R

"Screws and Screw Making."—The best book on the subject, 3s.; soiled copies, 2s. The Buyer's Guide to the best Books on Mechanical Subjects, with table of contents, price 6d.; in cloth, 1s. 6d.—Published by BRITANNIA CO., Engineers, Colchester. [21 R

Picture Moulds.—15 to 25 per cent. saved. Send for wholesale list, one stamp.—DENT'S, Importers, Tamworth. [12 R

Wanted.—To Manufacture or Repair for Trade or Amateurs any description of mechanical work. Models for Patentees executed from drawings. Terms moderate.—J. SUMMERS, 17, Regent's Row, Dalston, N.E. [22 R

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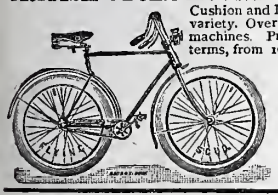

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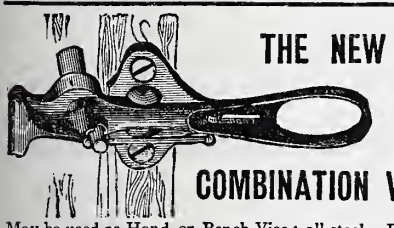

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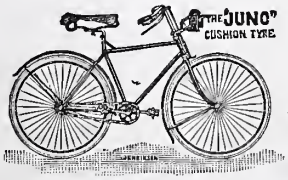

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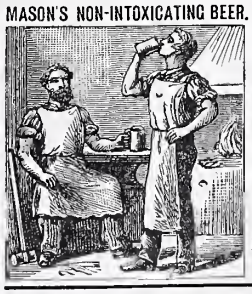

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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Vol. IV.—No. 171.] SATURDAY, JUNE 25, 1892. [Price One Penny.

WORK WORLD.

The Dunlop pneumatic tire has been further improved by the introduction of a pad of cork ⅛ in. thick. Its object is to prevent the inner rubber tube from chafing or cutting at the edges of the steel rim.

* *

An improved tool-heating gas burner has been invented. It consists of a burner somewhat similar to the ordinary kind. To it is attached a lever which works a weight inside the burner. When the tool is placed on the burner it turns the gas full on, and when taken off the weight drops and checks the supply of gas. This should go.

* *

A new photographic dry-plate will shortly be introduced, which will probably cause some stir among photographers generally, and particularly among those whose speciality is the photographing of interiors. It is claimed for it that it is the only plate that renders photography in natural tones a possibility, that halation is annihilated, and that with it the loss of a negative from over-exposure is practically a thing of the past. We wish it every success.

* *

The New Geared Ordinary bicycle takes its name from having its larger wheel in front. This serves for the driving and steering wheel like an ordinary, as distinguished from a "safety," which has the steering wheel in front and the driving wheel behind. By its gear being attached to the hub of the driving wheel, a small wheel, say 36 in., may be geared up equal to a 50 in. or 60 in., or any intermediate size. This form of machine is capable of a speed equal to the best "safety."

* *

Four-wheel carriages, however old, when sold to a user, are taxed £2 2s. a year if with pole fittings on, £1 1s. a year without such fittings. Buyer or maker arranges this payment; usually the buyer pays, but then naturally gives so much less for a vehicle. Two-wheelers pay 15s. a year; all have to pay if not used for trade solely, or for going to church exclusively. By arrangement with the authorities recently, a half-year may be paid for when used a day or two perhaps only in the half-year. The trade of coach-making has been declining for many years, especially in its foreign exports, so that this obnoxious tax should be removed from a home industry to aid it in recovering its healthy vigour as of old. Or, shall this industry, like many others, be driven out of the country?

* *

The Portuguese are considering the comparative merits of the British and French methods of constructing cables. They want a cable to the Azores and North America, and gave a contract for it to a British company. Owing to pressure from the French Government, this contract was withdrawn so as to consider the plans of a French syndicate. Two most prominent experts have sent in separate reports, and a specially appointed committee have also reported. All agree in recommending the adoption of the British plan. This is the more remarkable as, owing to African affairs, the British are not considered favourably just now by the Portuguese.

* *

A non-conducting coat for steam pipes consists of a mixture of sawdust with common starch, used in a state of thick paste. If the surfaces to be covered are well cleaned from all traces of grease, the adherence of the paste is said to be perfect for either cast or wrought iron; and a thickness of 1 in. will produce the same effect as that of the most costly non-conductors. For copper pipes there should be used a priming coat or two of potter's clay, mixed with water and laid on with a brush. The sawdust is sifted to remove too large pieces, and mixed with very thin starch. A mixture of two-thirds of wheat starch with one-third of rye starch is the best for this purpose. It is the common practice to wind string spirally around these pipes, the spirals ½ in. apart, to secure adhesion for the first coat, which is about ⅕ in. thick. When this is all dry, two or three coats of coal tar applied with a brush protect it from the weather.

* *

Information concerning the manufacture of plate-glass in Germany is very carefully guarded by a syndicate of makers, who restrict the quantity produced to certain limits. Nevertheless, some description of the process has been obtained. After leaving the glass-blowers' hands the plates, which are rough, are fixed with plaster-of-Paris on marble or cast-iron beds to be ground; the bed and the upper grinding plate revolve in opposite directions. The grinding is commenced with coarse sand, subsequently replaced by finer qualities, the process occupying from sixteen to twenty-four hours. The plates are next polished to make them transparent. The beds are stationary during this operation, in which square rubbers covered with felt are employed with a ferruginous earth called "potte," which is found in Bavaria. Glass is bevelled by holding it against a slowly revolving iron or stone cylinder 12 in. to 15 in. diameter, and fed with moistened sand. The bevels are polished on felt cylinders.

* *

There has been recently patented an improved system of davit, which will enable ships' boats to be launched outboard, and brought inboard again with the greatest ease, no matter how heavy the seas may be. The davits are so placed on the ship's deck that they take the boat from 3 ft. to 4 ft. from the side of the ship, which will minimise the risk of the boat being dashed against the ship's side. The device consists of two davits placed on the ship's deck in a line with the keel of the boat, and a little farther apart than the length of the boat; and their height is sufficient to accommodate two boats, one above the other, and lowered derrickwise from the ship outboard. Their lower ends are carried in a trunnion piece, the journals of which work in strong bearings secured to the ship's deck, their upper ends having a short bend just sufficient to reach over the stem and stern-posts to the lifting hooks in the boat; the bends retain the same position when in action. A little behind each actuating davit is a strong upright stanchion secured to the ship's deck, and further stiffened by stays. The davit is worked by ordinary tackle falls attached to the upper end of each, and likewise to the upper end of each separate stanchion. When the boat is put overboard, it is lowered down into the water in the ordinary way; when inboard, the lower boat rests on chocks on the deck, and the upper boat hangs clear above in the tackles from the davit arms, and is secured by a lashing spar. When the upper boat is lowered and detached, the davits return to their upright position, and lift out the lower boat.

WRINKLES FOR ALL.

Repairers of clockwork and similar light mechanism should not punch up worn holes to reduce them; the holes should be broached out and new bushes put in, and thus a longer rather than a shorter bearing than before will be obtained. Punching up the hole necessarily thins the plate, reducing the length of bearing, and leading to cutting into the pivot working in it; this causes extra trouble in making subsequent repairs.

Brass may be coloured a deep blue by immersion for three or four minutes in a solution made as follows:—Dissolve $3\frac{1}{2}$ oz. of carbonate of copper in 26 oz. of liquid ammonia, and add 14 oz. of distilled water. The solution must be kept in a vessel closed air-tight; if it becomes weak by keeping, it can be recuperated by adding ammonia. The articles after immersion may be dried in sawdust.

Sometimes tools, plunged when hot into cold water, will not harden properly, and this may be due to the tendency of the water to form a coating of vapour which adheres to the hot metal and, keeping the water off it, prevents its quickly cooling. If the tool be plunged into mercury, it will be cooled and hardened at once, because the mercury is a good conductor of heat, and its density will prevent the vapour coating from forming. For small tools this is a convenient method of hardening, and as it leaves the hardened metal bright, it can have its temper lowered to any colour without repolishing first.

When it is required to divide a circle on a metal plate into an indivisible number of parts—such as twenty-three, for instance—this cannot be done in the lathe, and in working by hand the dividers slip. To get over this difficulty, mark a circle the size of that to be divided on thin paper, divide it in the usual way by trial, with spring dividers, then cut it out and gum it on the metal; its divisions can then be marked by centre-punch or graver on the metal. This marking is to be done while the gum is damp, for as it dries the contraction of the paper will probably split it off the metal. The same method answers for dividing straight and other lines.

Phosphorescent paper may be prepared in the following manner:—Thoroughly mix, in their dry state, 4 parts of bichromate of potass, 45 parts of gelatine, and 50 parts of sulphide of calcium. Mix the resulting powder with hot water until it becomes a thick paste, when it may be used to coat paper or cardboard, which after several coatings becomes phosphorescent.

To mend a puncture in a pneumatic tire, drop a few drops of naphtha into the hole, and saturate a piece of pure rubber, a little larger than the hole, with naphtha, force it into the hole, and tie a bandage over it. Then the tire may be inflated, and the journey continued.

When the hour hand of a watch gives trouble by catching on the minute hand or second hand, through having too much end-shake—a troublesome defect in hunting watches—it may be kept in place by putting around the pipe of the hour hand and beneath the dial a saucer-shaped spring of jewellers' foil. This foil may be obtained from any material shop, a ring the right size punched out, and the edge rubbed up to form the spring.

POWER HAMMERS.

BY FRANCIS CAMPIN, C.E.

Single-Acting Nasmyth Steam Hammer—Double-Acting Steam Hammer—Blade-Spring Mechanical Hammer—Differential Cylinder Pneumatic Hammer — Single Cylinder Pneumatic Hammer.

The steam hammer, although largely used in works in which considerable masses of metal are dealt with, is not of such wide application to purposes of smaller magnitude as to render its adoption sufficiently universal to make it a commonly familiar object; and as several correspondents have evinced a general interest in the subject, I purpose in the present article to give an account of its mode of action, and that of some other power hammers which have come into use during the past few years.

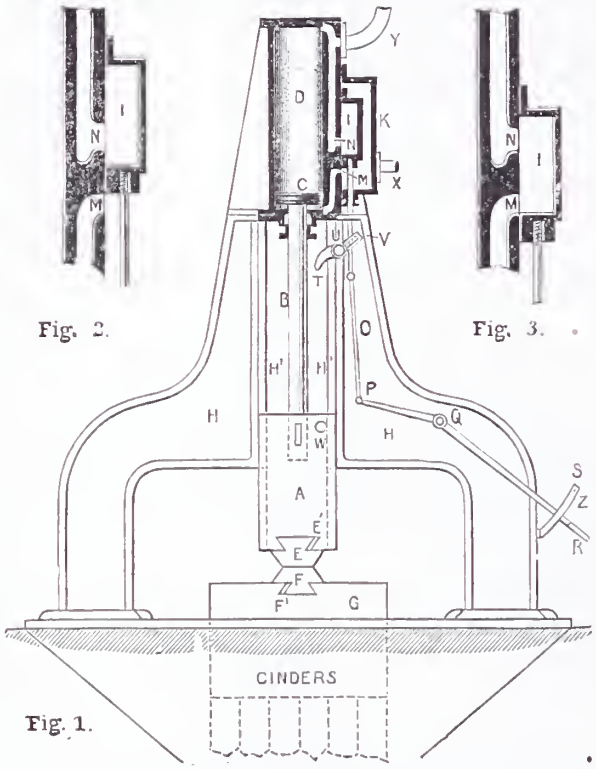


Fig. 2. Fig. 3. Fig. 1.

Fig. 1.—Vertical Section of Single-Acting Nasmyth Steam Hammer. Fig. 2.—Position of Slide-Valve during Upstroke. Fig. 3.—Position of Slide-Valve during Downstroke.

There is not space for anything like a complete detailed description of the various forms of steam and other power hammers, and therefore each kind will be described in reference to a typical illustrative diagram.

Steam hammers may be broadly divided into two classes: First, those that act in their downstroke by weight alone; and second, those in which the weight is aided by steam pressure. The effect of a blow is not practically calculable, and we can only judge from previous experience what work a proposed hammer may be likely to do, and by making the hammer of the second class the advantage is obtained of being able to augment the force of the blow by increasing the pressure of the steam.

In Fig. 1 is shown a diagram of a single-acting steam hammer of the Nasmyth type. In this a heavy hammer-head, A, is secured by a cotter to a piston-rod, B. This piston-rod is fixed in a piston, C, which works in a vertical cylinder, D, secured to and carried by standards, H, H. Upon the faces of the standards are ribs or feathers, H^1, H^1, which form guides for the hammer-head, A, which is made with grooves (indicated by dotted lines) which fit on the guides, H^1, H^1. The hammer-face, E, which is made of steel, with a hard surface at the bottom, is fitted into the hammer-head, A, by a dovetail, which is put in the position shown and secured by a steel key, E^1. A similar face is secured to the hammer-block, G, by a key, F^1. The anvil block requires to be very massive to resist by its inertia the blow of the hammer-head, besides being soundly bedded, if necessary, on piles in beaten ashes or some similar material which will deaden vibration; for it is obvious that the effect of the blow of the hammer will depend very materially upon the resistance offered by the anvil. Steam from the boiler is admitted through a pipe, X, to the valve-jacket, K, and its admission thence to the cylinder, D, is by a port, M, controlled by a slide-valve, I. This slide-valve has a rod passing through a stuffing-box, and connected by a pin to a rod, O, by which it is operated either automatically or by a hand-lever, R, working on a dead centre at Q, and connected to rod, O, by a pin, P. A port, N, communicates with the exhaust-pipe, Y. The slide, I, is of the ordinary box form used in short-stroke engines, and by moving it the cylinder port, M, is made to communicate alternately with the boiler and with the exhaust. When the valve is in its highest position (as shown in Fig. 2) the underside of the piston is in communication with the valve-jacket, K, and the hammer is making its upstroke; and when the valve is in its lower position (as shown in Fig. 3) the steam exhausts into the atmosphere and the hammer falls. The top of the cylinder is always open to the atmosphere, to allow the piston, C, freedom of action in accordance with the distribution of steam. The handle, R, by which the movements of the machine are regulated, is guided by a segment-guard, S, between the arms of which it moves, and in which it may be secured by a pin, Z, to prevent the machine from being accidentally started. To prevent the piston from being carried too high by the action of the steam, a tappet is placed upon a pin or dead centre, U, and its outer end, V, is connected with the valve-rod; its inner end, T, is made of a suitable form to be operated by a pin, W, on the hammer-head, so as to shut off the steam as the piston approaches the upper end of its stroke. By applying a tappet, to be acted at the lower end of the stroke, the hammer is made automatic, and will, when set in action, make a number of blows in succession, until disengaged from the automatic gear. It will be seen that this machine can be handled with the greatest nicety by means of the controlling handle. The blow can be arrested at any point by re-admitting steam below the piston. As a matter of fact, a nut can be cracked without injuring the kernel by the heaviest hammers constructed on this principle.

A small alteration in the construction

will make the hammer double-acting. In this case the steam cylinder is closed at both ends, and the steam passages connected with it are arranged as shown in Fig. 4. A short valve, C, is placed on the cylinder port-faces in a steam-chest, A, and works over the ends of passages, B and T, which lead to the bottom and top of the cylinder respectively. An exhaust-port, N, leads to the exhaust-pipe, E, and a pipe, S, from the boiler keeps the jacket, A, supplied with steam. The valve is actuated in a similar manner to that previously described, through a rod, D. Its top and bottom positions are shown by dotted and full lines respectively; in an intermediate position the margins of the valve will close both top and bottom ports, and the piston will then be held in any desired position. This valve can, of course, be worked by hand or automatically, the same as that for the single-acting hammer. Although I have here described slide-valves as used to regulate the distribution of steam, other forms may be used if desired; but it is unnecessary here to dilate upon them.

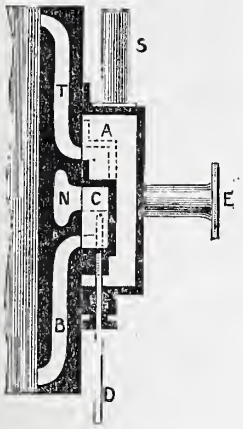


Fig. 4.—Vertical Section of Slide-Valve, Steam-Chest, Passages, and Ports for a Double-acting Nasmyth Steam Hammer.

The power is greatly augmented by making the machine double-acting, and thereby dead weight is saved, and also time; for the speed of the hammer-head will be accelerated by the steam pressure behind it, the amount of the acceleration varying as the square root of the steam pressure. Assume that for a given stroke we have a hammer-head weighing 500 lbs. in one hammer, and in another a head weighing 1,000 lbs. The blow given by the latter will be twice that of the former, but the velocities of fall will be the same in both cases, because the mass of matter is increased in the same proportion as the gravitative force; but if a pressure of 500 lbs. is caused to act upon the lighter hammer-head, its velocity of fall will be increased, for a double quantity of work will be accumulated during the stroke in the same quantity of matter, and as its mass has not increased, its velocity must have done so.

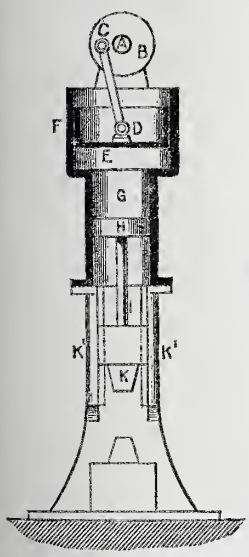


Fig. 6.—Vertical Section of Pneumatic Hammer with Differential Cylinders: Crank-driven.

If it is assumed that a hammer has a head weighing 800 lbs., and that its piston is 10 in. in diameter, the moderate pressure of 60 lbs. per square inch behind it will increase the force about six times, putting an additional pressure of 4,712 lbs. upon it. In hammers of this description it is convenient to make the piston-rods hollow and of large diameter; for only a small portion of steam is required to lift the hammer-head compared to that required to fill the cylinder, and therefore the annulus around the piston-rod may be made as small as is consistent with the convenience of packing the gland through which the piston-rod must pass.

I will now refer briefly to another form of steam hammer, that was first brought out some time after Nasmyth's hammer, and is known as the Condy type. In this arrangement the piston and its rod are fixed and the cylinder moves up and down, and forms, in fact, the hammer-head, the object being to utilise the necessary weight of the cylinder instead of obtaining the whole weight of the head from additional metal. The steam passages in this case must pass through the piston-rod to ports in the piston; the cylinder works between guides: the same as the head in the previous cases. The objection to this construction of steam hammer is that the cylinder is subject to severe shocks, and therefore, if the casting of which it consists is in any way imperfect, its failure will be rapidly brought about; whereas in the hammer with the cylinder fixed there is no shock on the cylinder, and therefore it is likely to be more durable. It is, moreover, more easy of access than is the moving cylinder.

There are many manufacturing operations concerned in the production of comparatively light articles for which separate steam hammers are not suitable, being of too expensive a character for the nature of the work, besides requiring a special attendant. Under these circumstances, various light power hammers, which may be driven from ordinary running shafts, have been put before the public. The object aimed at in the construction of these machines is to produce a hammer that will strike a comparatively light blow with great rapidity, and be all the time under instantaneous control.

One form of light power hammer is shown at Fig. 5. It is, of course, absolutely necessary that the connection between the driving-shaft and the hammer should be elastic, as the stroke of a hammer can never be a fixed quantity, depending as it must upon the extent to which the material struck will yield. In the form shown this elastic connection is supplied by a pair of blade-springs, E, E¹, similar in construction to the bearing-springs of carriages. Fast and loose pulleys are mounted on a driving-shaft, A, and they are connected with a pulley on an ordinary running-shaft by a strap, which can be shifted backwards and forwards on the said pulleys by means of the usual forked shipping-bar, so as to start and stop the hammer at will. On the shaft, A, is fixed a crank or crank disc, B, which, by a link, C D, is connected with the top blade-spring, E; the lower spring, E¹, is secured to an upwardly extending part of the hammer-head, F, which works between guides, F¹, F¹. This hammer will strike a blow harder than that due merely to its own weight, and the intensity of the blow will increase with the speed at which it is driven. During the upstroke a certain momentum is imparted to the hammer-head which, at the instant of the crank-pin reaching the top centre, will cause the springs, E, E¹, to be pressed together; and as the descent of the crank will be far more rapid than the natural fall of the hammer-head, the springs will be further compressed, and by their elasticity urge the hammer-head at a high velocity. This is a very simple form of power hammer for light purposes, and if the springs are made properly and of good material, should be very durable.

Several pneumatic power hammers have also been designed, and very good results have been given by them. The advantage of using an air spring instead of a metal one consists, probably, in its greater sensitiveness, and in the absolute uniformity of its action. One of the earlier forms of light pneumatic hammer, intended for planishing and similar purposes, is shown in Fig. 6. A casting is made, which forms two cylinders, F and G, the former being of considerably larger diameter than the latter. These cylinders are bored out and fitted with pistons, E and H. These pistons may, for small sizes, be made to fit their cylinders with sufficient truth to obviate the necessity of packing-rings: a very important matter when we come to consider the greater friction caused by such appurtenances. If the upper piston is raised, it is evident the lower one will follow it when the air above is sufficiently rarefied to give the required excess of atmospheric pressure below the piston, H, to lift its weight and that of the hammer-head, K, connected to it by a rod, I. The head, K, works in guides, K¹, K¹. On the descent of piston E, piston H will be accelerated in its fall by the compression of the air between the pistons. The piston, E, is connected by a link, C D, to the crank-pin, C, of a crank-disc, B, keyed upon a driving-shaft, A. The crank-disc will only require a small throw, as the stroke of piston E will be less than that of piston H in the ratio of the squares of the diameters of cylinders, G and F. As the crank-pin turns the top centre the piston, H, will continue to rise, and so compress the air between the pistons, which will be further compressed by the downstroke of

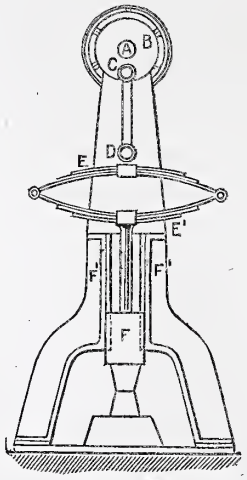


Fig. 5.—Front Elevation of a Blade-Spring, Crank-driven Mechanical Hammer.

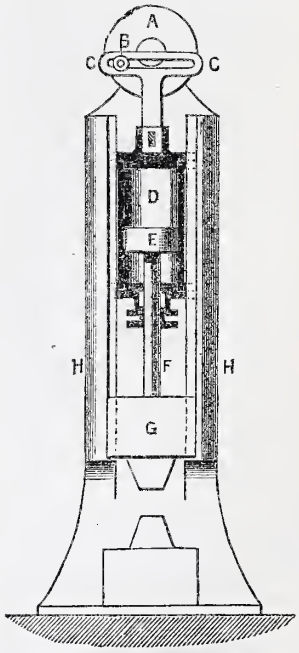


Fig. 7.—Vertical Section of Single Cylinder Pneumatic Hammer: Crank-driven.

piston, E, and thus will impart an increased impetus to the piston, H, and hammer-head, K.

An exceedingly useful form of pneumatic hammer, capable of working at a very high speed, has a cylinder, D (Fig. 7), placed between guides, H, H, and moved vertically by a crank-disc, A, keyed on the driving-shaft. The crank-pin, B, may be connected to the cylinder either by a link or by a transverse slot (as shown at C C). This slot allows for the lateral movement of the crank-pin while receiving vertical motion from it. Between the same guides, H, H, is also placed a hammer-head, G, connected by a piston-rod, F, with a piston, E, working in the cylinder, D. If the cylinder, D, is closed at both ends, then, when it is vertically moved by the rotation of the crank-disc, A, the piston, E, and hammer-head, G, will follow its movements; their motion, however, being modified by the action of the air-cushions above and below piston E, the effect of which will be to add to the intensity of the blow. Hammers on this principle, with heads weighing about half a hundredweight, are very convenient for light work. The cylinder, D, may be fitted with valves, operated by a hand-lever or by a treadle, by opening which the cylinder is allowed to run without moving the hammer-head, thus affording means of stopping the hammer instantaneously without having to stop the cylinder and driving-shaft. From eighty to one hundred blows a minute can easily be made by these pneumatic hammers, the resilience of the air-cushions entirely obviating the evil effects of concussion.

Before closing these remarks it seems desirable to refer to a very powerful rival to the steam hammer, and one which is certainly gaining ground, and that is the hydraulic press in various forms. Although, as stated in the commencement of this article, we cannot calculate the effect of a blow, yet the work expended upon it can easily be ascertained, as we merely have to multiply the weight of the hammer (together with pressure behind it, if any) by its fall to get its value. The work done by a hydraulic press can also be ascertained by multiplying the pressure upon the ram by the distance through which it passes. By producing equal results by a hammer and by a press, the comparative cost of working can therefore be ascertained. Some months since some experiments were made on this subject by Prof. Coleman Sellars, in which he used pig-lead, the resistance of which had been shown by previous experiments to be about equal to that of steel at a bright yellow heat, which is about the highest temperature at which it can be wrought satisfactorily. I have not space here for any details of the experiments, but may sum them up by saying that a given result was produced by the hydraulic press at a little more than one-fourth of the expenditure of work required to give the same result under the hammer. Allowing that the hydraulic machinery will be somewhat more expensive than a steam hammer, and also that steam power is necessary to supply it with water-pressure, there will yet be a wide margin in favour of the press should these experiments be confirmed by practice in connection with the actual working of hot metals.

A CEMENT to resist both heat and acid can be made with quicklime and linseed-oil mixed stiffly.

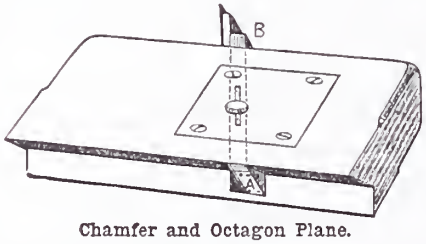
CHAMFER AND OCTAGON PLANE.

BY J. CHARLES KING.

PERFECTION of tools leads to confidence, ease, and simplicity of manual labour.

For working chamfers or octagons accurately a plane that does it truly is a useful addition to a set of planes.

The sketch of the plane shows that the face is a right-angle recess, and the mouth of the plane has a flat metal gauge, A, which fits nearly close to the plane-iron edge. This metal gauge is altered up or down, just as a wide or narrow chamfer may be wanted. If set to ¼ in. chamfer, it will take it exactly and truly, saving gauging edge-marks or using a bevel to test accuracy; so on up to 1½ in. chamfer, as the metal gauge, A, may be brought lower in the wider angle. The screw seen on the side of the plane works up a slot, shown there in the plate. This screw, when tightened, holds the mouth-gauge secure. The casing-up, in which the metal mouth moves (B), is shown in front of the wedge that holds the plane-iron securely, and is ¼ in. wood-casing, let into the usual opening in a plane for the shavings to work out of. The dotted lines show this mouth-opening. For octagon rods or bars, of course, it would serve the purpose of truing them when roughly chopped to the proposed size.



Chamfer and Octagon Plane.

Of course, two truly square edges are essential for the plane-faces to work by to ensure truth of octagon or of chamfer. It is not yet a shop-made tool for general use, but it is not difficult to make.

WHY A NAIL HOLDS.

BY PROF. HENRY ADAMS.

IF one faculty is of more importance than another to the human race, it is the faculty of observation; and the cultivation of this is the true scope of education. Even the simplest every-day surroundings may be made subservient to this purpose; and it is astonishing how much the enjoyment of life is increased by what is generally called "keeping your eyes open." Technical education is merely a particular branch of the general subject; but the advantage of observation applies with tenfold force. For instance: a very simple experiment, which anyone with a hammer and a few nails can make, will throw considerable light on the reason why a nail holds different pieces together. If a piece of straight-grained deal, about 2 in. wide and 1 in. thick, be taken, and a line marked along the centre of one of the narrow sides, various nails may be driven in a row, about 1 in. apart, and the piece may then be split down the centre line, so as to expose the nails throughout their length. The smooth wire nails, called French nails, will be found to have penetrated the wood with very little disturbance of the surrounding fibres; and, as a consequence, they go in easily, and will draw out again with great facility. What hold they have is chiefly by friction from the compressed fibres re-acting against the sides of the nails. On the other hand, a 3 in. floor brad, which has a flat square point, produces great disturbance in the fibres. Immediately under the point they are crushed and pushed downwards, carrying others partly down with them, so that they press against the sides, and at the same time point downwards. It will be observed that every little group of fibres is like a strut pushing against the nail, and preventing its withdrawal. This experiment may be varied indefinitely, and the effect of boring holes before driving the nails can be studied. The difference also between the hole produced by a gimlet, a sharp bradawl, and a blunt bradawl will be instructive. Go and try it.

HOW TO LEARN DRAWING OFFICE WORK.

BY ARTHUR BOWES, A.M.I.C.E.

DRAWING PEN, DESCRIPTION AND CARE OF—POCKET DRAWING PEN — REVERSIBLE PEN — ROAD PEN — DOTTING PEN — SWIVEL PEN—COMPASSES—HAIR DIVIDERS—SPRING BOWS — PUMP PEN.

Choice and Care of Drawing Pen.—In the choice of a drawing pen there are several points which may be looked to with advantage. In the first place it is advisable to choose an instrument which has a strong and rigid bottom blade which will not give with any slight increase of pressure against the edge of the set-square or straight-edge; any flexibility in this direction being naturally to the detriment of the regular thickness of the line which is being drawn. A good shape of handle is the one shown in Fig. 26, where a square portion is formed at the lower part. This is useful in preserving the proper direction of the nibs of the pen when drawing. For cleaning the pen after using, a precaution which should never be neglected, it is convenient, though not absolutely necessary, to have one of the blades hinged so as to lift up and admit of the dried Indian ink being scraped off the inner side of the blades with a penknife. This hinge is shown in the same illustration, Fig. 26. If a small piece of chamois leather be kept at hand, and a corner of it pulled through the nibs of the pen after using, it will generally be found sufficient to keep the pen thoroughly clean. For scraping off any dried Indian ink, either the thin blade of a penknife may be inserted between the blades of the drawing pen, or a steel writing pen with half of the nib broken away may be used. The adjusting screw for setting the pen to various thickness of lines is very often made with too small a head: one of the best arrangements in this direction is that in which the milled head is placed between the blades of the pen, and the latter are adjusted by right and left-hand threads on the screw to which the milled head is attached. The head in this formation of instrument is of a more convenient size, and there is no liability to lose the screw out of the pen. Some drawing pens are made with the ivory handle to unscrew and serve as a pricker or station pointer. This form is not to be recommended: it necessarily weakens the instrument at the screwed joint, and there is little economy in providing in this way a tool which can be made in five minutes by any draughtsman.

Setting the Drawing Pen.—As the pen is more used than any other drawing instrument, it occasionally requires setting or sharpening. This is not a very difficult matter to do

with a little practice, especially after seeing the operation performed, yet many draughtsmen make a practice of sending their pens to the instrument makers to be set. A slip of Arkansas or Turkey stone should be used, or even a piece of common slate, and it will be found better to use water for the lubricant rather than oil, as the latter is difficult to remove from the pen, and prevents the ink being taken up freely. In setting the pen, each nib should be brought to a rounded chisel edge, as shown to an enlarged scale in Fig. 27, and it is imperative that both nibs shall be of exactly the same length, so that when the pen is held upright they shall both bear evenly on the paper. A drawing pen of good hard steel that will keep its edge for many months without being set is a boon to its owner. With a view to securing this durability some pens are made with agate-pointed nibs, but so far as the writer has seen they do not give satisfactory results.

Pocket Drawing Pen.—It is often convenient to be able to carry a drawing pen about with one ready for use, for much can be done with this instrument alone by a mechanical draughtsman who is also a good freehand draughtsman. A pocket drawing pen is shown in Fig. 28, and will be seen to consist of a case or hollow handle in which the nib is carried secure from damage. When required for use the nib is unscrewed, and again screwed into the handle in a reversed position.

Reversible Pen Nibs.—In Fig. 29 is shown a device by which two complete pens are carried in the one handle. The nibs are reversible, and when one set is worn blunt the other can be brought into use in a moment. The milled head which actuates the adjusting screw is placed between the blades as recommended above.

Special Adjusting Pen.—An arrangement by which the drawing pen can be adjusted so as to give a definite thickness of line, and can at any future time be instantly adjusted to the same thickness, is shown in Fig. 30. The milled head of the adjusting screw is larger than in the ordinary pattern of drawing pen, and is graduated to show the varying distance between the nibs. A spring catch engages into the milled head and prevents the adjustment being inadvertently disturbed.

Road Pen.—For drawing parallel lines moderately close together, as in indicating roads, canals, or railways in maps and small scale plans, a double pen, such as is shown in Fig. 31, is a very convenient instrument. It consists essentially of two separate pens connected by a forked spring, with a screw and a milled head for regulating the distance between the pens. It is particularly useful where the lines to be drawn are curved or of irregular form.

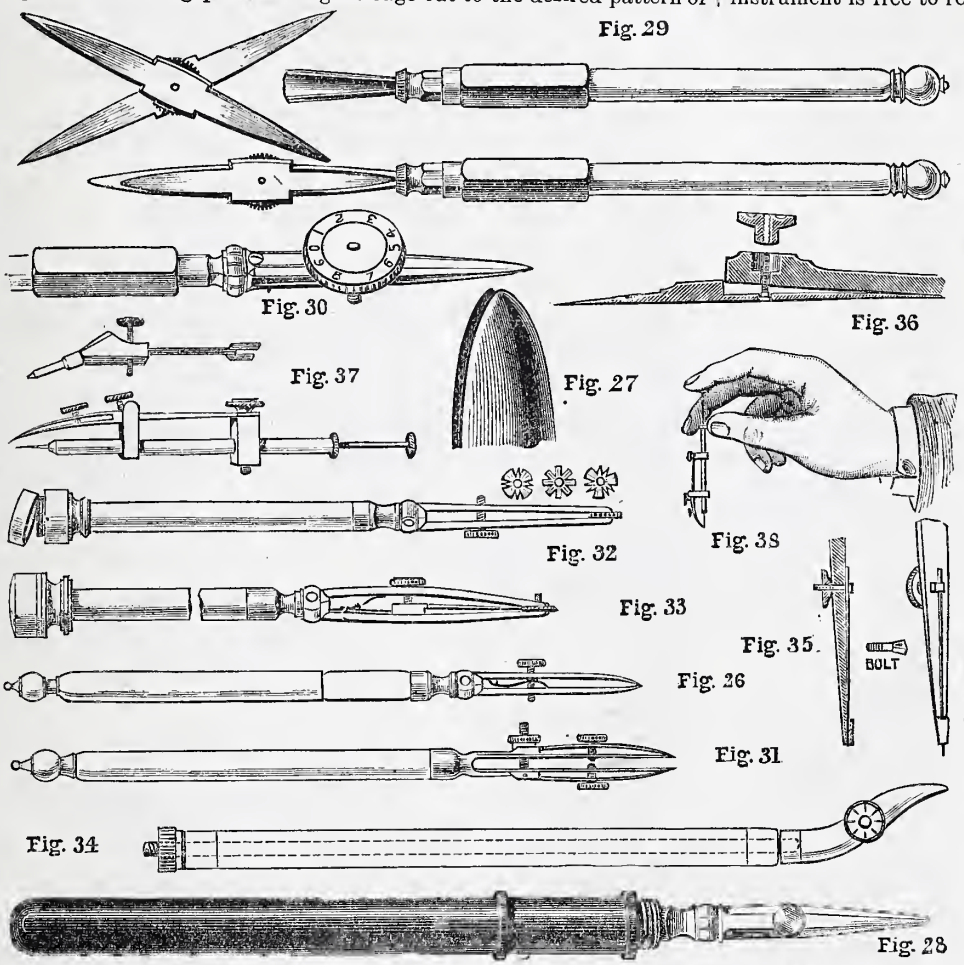
Dotting Pen.—For the purpose of drawing lines composed of dots of various shapes, dotting pens are made, the ordinary pattern being such as is shown in Fig. 32, where a small roller or rowel is fixed between the nibs of the pen. The ink is filled in between the nibs with a small brush, and the roller having its edge cut to the desired pattern of dots, imprints them on the paper as it is rolled along. Several patterns of wheels or rollers are usually supplied with the pen, and are stored in the cavity shown at the top of the handle, covered by a screwed lid. A more recent pattern, introduced by Mr. Stanley, is shown in Fig. 33, and is provided with an internal tongue or midrib coming down almost into contact with the dotting wheel. It is claimed that with this pen sufficient ink can be retained to draw a dotted line 60 ft. in length. Various other descriptions of dotting pen have been produced, some being elaborate pieces of mechanism actuating an ordinary pen by a cam movement which derives its motion from a roller moved by drawing the instrument along the desired line. It will be generally admitted, however, by most experienced draughtsmen, that a dotting pen of any kind is an instrument which can easily be dispensed with, and, indeed, is of little, if any, service to an expert workman.

Swivel Pen.—A pen especially designed for drawing curved lines is shown in Fig. 34. The handle is tubular, and through it there runs loosely a metal shank, to which the pen is attached. At the top is a small nut or milled head, by turning which the pen can be clamped up tight so as to form practically one piece with the handle, and in this fashion can be used in every way the same as an ordinary drawing pen. When the nut is loosened, however, the lower part of the instrument is free to revolve independently of the handle, and follows the direction of a curved line with great freedom. Although rather awkward to handle without considerable practice, it is a convenient instrument for the purpose for which it was designed.

Compasses.—This term is generally used to include dividers and pen and pencil compasses. The ordinary forms and methods of using these instruments are too well known to need more than the shortest reference here. Electrum is the best material for their construction on account of its lightness and freedom from liability to tarnish. The legs should be jointed, and needle points should be chosen as causing less damage to the drawing-paper, and admitting of greater accuracy in their use.

Needle Points.—There are several descriptions of needle points made, perhaps the best being that shown in Fig. 35, and patented by Mr. W. F. Stanley. In this the needle is held by a small bolt, pierced at one end by a hole through which the needle passes. A nut on the outer end of the bolt enables the needle to be firmly clamped against the leg of the instrument. With this arrangement the needle can be adjusted so as to project a very little way beyond the shoulder at the bottom of the leg, which acts as a stop to prevent the needle penetrating too far into the paper.

Hair Dividers.—For comparing or setting off small distances with great accuracy, hair dividers are useful, though with care an equal amount of accuracy can be obtained with the ordinary dividers. The distinguishing feature of the instrument is that one leg of the compasses is fitted with a steel spring, as shown in Fig. 36, with an adjusting screw. In using the instrument it is first set approximately to the desired



Drawing Office Work. Fig. 26.—Drawing Pen, showing Hinged Nib and Square on Handle. Fig. 27.—Enlarged Sketch of Nib of Drawing Pen. Fig. 28.—Pocket Drawing Pen. Fig. 29.—Reversible Drawing Pen. Fig. 30.—Adjusting Pen for exact Thickness of Line. Fig. 31.—Road Pen. Fig. 32.—Dotting Pen with extra Wheels. Fig. 33.—Improved Dotting Pen. Fig. 34.—Swivel Pen for Drawing Curved Lines. Fig. 35.—Stanley's Needle Point. Fig. 36.—Hair Dividers. Fig. 37.—Pump Pen with Loose Pencil Leg. Fig. 38.—Method of using Pump Pen.

measurement by opening the legs in the usual way, and the final adjustment then made by turning the milled head of the adjusting screw.

Spring Bows.—For fine work the small spring bows sold in sets of three, comprising dividers and pen and pencil bows, are indispensable. They are among the best known of all instruments, and as there is nothing that calls for special remark about them, it will not be necessary to describe or illustrate them here.

Pump Pen.—A form of spring bow which is known as the "pump" pen is shown in Fig. 37. In this the centre point consists of a straight steel rod about 4 in. long. The pen or pencil is attached to a tube or sleeve which revolves freely around the steel centre. The method of using is to place the forefinger of the right hand on the top of the centre rod, placing the latter vertically on the paper, then to rotate the pen with the other fingers of the same hand while holding the centre rigid. By this means the sliding of the centre point and consequent tearing of the paper are rendered impossible. The pen and pencil points are interchangeable, and as a much larger circle can be described with this instrument than with the ordinary spring bows, it is a useful article. The method of holding it when in use is illustrated in Fig. 38.

ELECTRO-MOTORS.

SIEMENS' H GIRDER TYPE: THEIR MOTIONS, ETC.

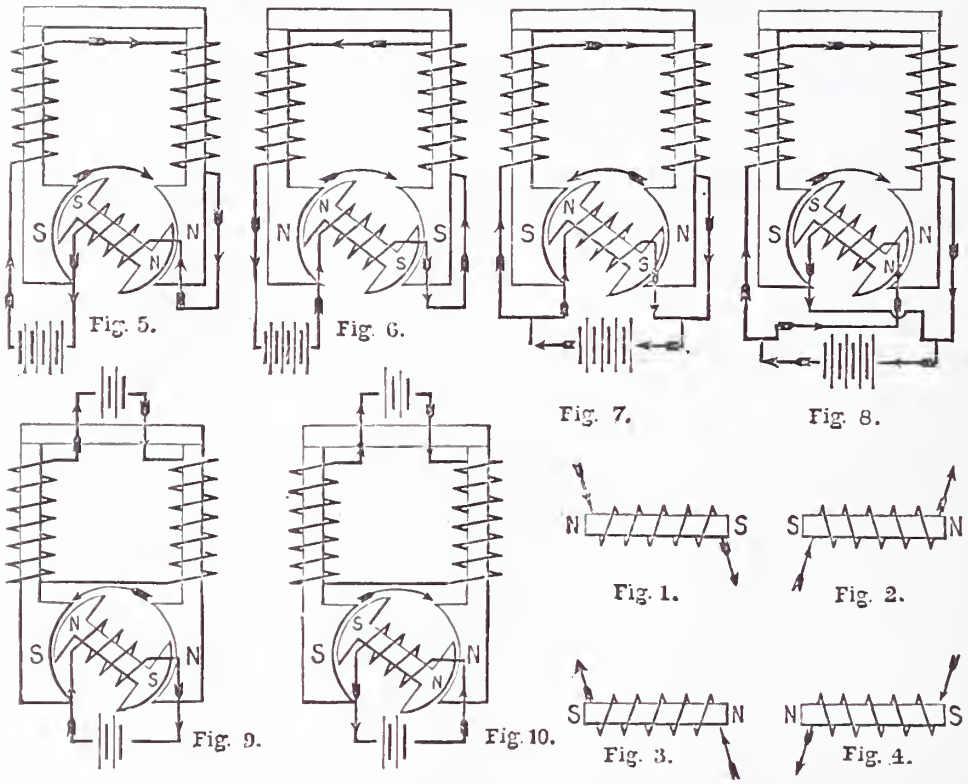
BY J. BROX.

INTRODUCTION—MAGNETS AND COILS—POLE TO POLE — COMMUTATOR — MOTOR IN SERIES — MOTOR IN PARALLEL—WITH TWO BATTERIES —FINAL REMARKS.

Introduction.—This form of motor has been chosen partly because of its simplicity of construction, and partly as it is such a favourite form for small motors with the amateur; also because there are many professional workmen, who have been employed for some time making and putting together such motors as the Griscom, etc., who are still unable to say why they go round, or why they go in a certain direction. I shall endeavour in this paper to make these facts clear to all, by illustrating some of the laws that govern this type of machine, without in any way going into the subject of construction. This task that I have set myself I am going to try and perform with the use of as few technical terms, etc., as I can, so that all may understand.

Magnets and Coils.—The first and principal rule to understand is what happens when a length of covered copper wire is wound round a bar of soft iron, and a current of electricity is passed through the wire. I shall take it for granted that you know the iron becomes a magnet as long as the current flows; but there are other laws to be considered of great importance to us at present.

Take, for instance, a small bar of iron, as in Fig. 1; hold one end in your left hand, and commence winding from your left hand towards the other end as the hands of a clock turn—that is, away from you on top of the iron, and towards you underneath. If you now pass a current of electricity through the wire coil, from the left-hand tag end to the right-hand tag end—that is, the carbon of a battery cell to the left hand, and the zinc to the right—the end of the iron you have in your left hand becomes a north pole of a magnet, and the end that is at your right hand becomes a south pole.



Electro-Motors. Figs. 1, 2, 3, 4.—Coils and Bar Magnets. Figs. 5, 6.—Motors driven in Series. Figs. 7, 8.—Motors driven in Parallel. Figs. 9, 10.—Motors driven with Two Batteries.

Now take the iron bar, but wind it in the reverse way—that is, against the hands of a clock, as in Fig. 2; or pass the wire away from you when under the iron, and towards you when on top; then pass the current, as before, from the left-hand tag end to the right, and the poles will be reversed—that is, the north pole will be nearest your right hand and the south pole in your left.

If you will now look at Fig. 3, you will see that it is wound just the same as Fig. 1, only the current is passed from the right hand to the left; this will cause the poles to be reversed. Also, if you look at Fig. 4, you will see that it is wound the same as Fig. 2; but by reversing the direction of the current the poles again become reversed, as in the other case. This is what happens in an armature when the brushes cross the insulating strips: the poles are reversed by the current being reversed, although the winding remains the same.

A very good way to master this rule is to do as I did—some years ago now. Perhaps I was rather thick, but I was determined to be the master. I got a bit of wood, and marked one end "S" and the other end "N"; then a piece of string. On one end I had a small label, upon which I wrote "+," or positive; on the other end another label with "—," or negative, upon it. With this amusing toy I used to practise at odd times, until I was able, at a glance, to tell what was what.

Pole to Pole.—The next great law to be observed is short and important. If you bring two poles of the same kind near each other, they will repel one another; if you bring two different poles together, they will be attracted—that is, *north to north*, repulsion; *south to south*, repulsion; but *north to south*, attraction.

Commutator.—In the diagrams of motors (Fig. 5 to Fig. 10), the commutators and brushes have been left out, in order to make the drawings as simple as possible; but it must be clearly understood that, when the two poles of the armature are opposite the two poles of the field-magnets, at that moment the two brushes are resting upon the insulating strips of the commutator; immediately after that (the armature being in motion), the current is changed through the armature and its poles reversed. This is not exactly absolutely the fact in practice, but in this case, for theory, we must assume it to be so.

Motor in Series.—Let us now investigate a motor of our type driven in series—that is, the current passing first through the magnets, then through the armature, and so back to the battery—or the reverse: *i.e.*, through the armature first, then the magnets, and so back to the battery, as in Figs. 5 and 6. It may appear a curious fact, but whichever way you send a current through a motor, when in series as shown, it will rotate the same way.

Let us take Fig. 5, and follow the winding, starting from the battery. We will suppose that you wind as the current flows. The first magnet core that you come to is the left-hand one; this, you will observe, is wound as the iron bar in Fig. 4, and, if you have understood the foregoing law, you will see that you leave a south pole behind you. Crossing over to the other core, you wind against the clock, which brings you up to a north pole. After this the current goes to a brush, then through the commutator (which are not shown), and into the armature, which is wound, as you will observe, as the bar in Fig. 3—a north pole to the right hand and a south pole to the left. After this, the current again goes through the commutator and the other brush, and returns to the battery.

If you will now look at the position of the armature in diagram (Fig. 5), you will see

that I have drawn it just a little off the straight, so that the brushes are not on the insulating strips, but are in contact, so the current will flow through the whole machine. Now see what happens. There is a south pole of the armature against, or near to, a south pole of the magnets, and a north pole of the armature near a north pole of the magnets. This means repulsion directly, so that the motion the armature takes is as indicated by the curved arrow above it; which, by the way, shows the motion in all the diagrams. Now, this motion continues until the south pole of the armature nears the north pole of the other magnet; then, as they are of different poles, they will attract each other until the south pole of the armature has arrived exactly opposite the north pole of the magnet. At that moment the brushes cross the insulating strips, and change the poles of the armature, and our south pole, in the armature that was, becomes a north, and then like poles are again together and repulsion commences, causing a continuation of the same motion.

If you now reverse your battery, as in Fig. 6, and follow out the winding, you will find that every pole has been changed, so that again we have like poles to like, which causes the motion to be the same as in Fig. 5. This means that, if a motor is driven in series, the motion will be in the same direction whichever way the current goes.

Motor in Parallel.—We will now consider what happens when we drive our motor in parallel; that is, the current from the battery is divided—part is shunted to the magnets, and part to the armature. After the divided current has passed through the machine they again meet in one wire and return to the battery. If you will follow the windings, and the direction of the current in Fig. 7, you will see what is meant; you will observe that the left-hand magnet is the same as Fig. 5, and will be south; the other must, of course, be north, as the two magnets must always be wound so as to be of different poles. Now follow out the branch of the current which passes through the armature; this will enter on the left-hand side and be wound with a coil, going with the hands of a clock. As in Fig. 1, this will give a north pole to the left, and a south pole to the right; the current then goes through the commutator, etc., and joins the current from the magnets, and so to the battery.

In this case you will see that you have unlike poles near each other; this causes attraction, and the armature rotates in the opposite direction to both Figs. 5 and 6.

Now see what happens when you reverse the shunted part of the current through the armature, and leave the part of the current through the magnets as it was. Fig. 8 will show you this. You have like poles to like, causing repulsion, and the motion of the armature is reversed, turning the same as in Figs. 5 and 6. You would also get a reversal by reversing the current through the magnets, keeping the current in the armature the same as in Fig. 7.

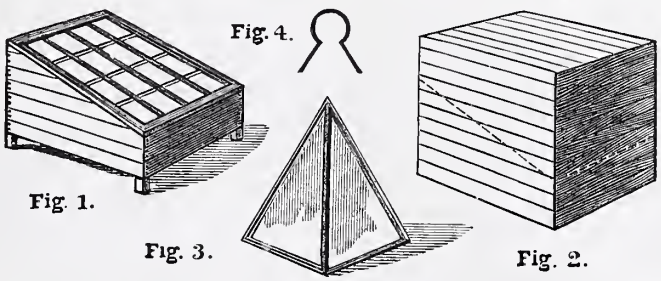
With Two Batteries.—For further explanation, we will suppose that you drive your motor with two batteries instead of one—viz., one to excite the magnets, and the other the armature, as in Figs. 9 and 10. If you now follow out the windings, and the direction of the current, as you have done in all the other cases, you will be able to see what happens and which way the armature will move. Here, as in the case of the motor driven in parallel, if you reverse the current in either the magnets or the armature, you will reverse the motor.

Final Remarks.—You may, perhaps, have noticed that all the diagrams, from Fig. 5 to Fig. 10, are in fact all wound the same way; this has been done to show some of the different ways that one motor can be driven, by making different combinations with the current. If I had drawn all the combinations in windings and all the combinations in currents that were possible, I should very nearly half fill up one whole number of WORK; but as there are many more combinations than those that I have shown, you will find it of use to yourself if you sketch out a few skeleton diagrams, and put the windings and currents in in different ways to these, and work out the motions yourself.

Let us take an example. You are an amateur, and have just bought the castings of a small model H girder motor; but you are very anxious that it should work in the reverse way to Figs. 5 and 6, when driven in series. Now, all you have to do is to wind the magnets as in Figs. 5 and 6, but in winding the armature you must wind it as in Fig. 4; or, on the other hand, wind the armature as it is in Figs. 5 and 6, but reverse the twist in the magnets. Then you will have a motor that, when driven in series, will have a reverse direction to that in Figs. 5 and 6.

All this may seem very complicated, but it is, in fact, very simple—once having mastered the law of winding a simple bar of iron, and always remembering that two like poles repel, and two unlike poles attract each other.

As a final remark, I trust that none of my readers who have good motors will try any of these experiments upon them, as the chances are they will ruin their machines. Always drive your motor with the current for which it was built. If you want to try these sort of experiments, rig up a small motor for yourself, which will do no harm if you do happen to ruin it.



Utensils for the Garden. Fig. 1.—Completed Frame. Fig. 2.—Showing Construction of Two Frames from Packing-Case. Fig. 3.—Hand-Glass. Fig. 4.—Section of Zinc Sash-Bar.

SIMPLE UTENSILS FOR THE GARDEN.

BY C. MAYNARD WALKER.

A Propagating Frame.

One of the most useful articles in connection with gardening is a propagating frame, to be used as a cold frame alone or over a hot bed; and although it is useful at all times of the year, it is especially so in the spring, when one is anxious to get forward seedlings and growing plants; so we will take that first (Fig. 1). It is a very easily constructed piece of work to anyone who is accustomed to the use of the simplest tools; the question of size is one that each must determine for himself, having regard to the position in the garden it is to occupy; and the cost will vary, of course, not only as to the size, but the quality and substance of the material. And here let me say that to anyone living in London or other large town, where a large packing-case can be readily bought for a trifle, a somewhat rough but just as useful a frame can be very cheaply and easily turned out. I have two of this kind in use. I bought a packing-case, which measured 3 ft. 6 in. long by 2 ft. 4 in. wide and deep, and, having marked it off as in Fig. 2, I cut with a rip-saw the two frames from the one box, taking care to nail up securely the top and bottom of the box before sawing it, so as to keep it rigid; afterwards removing them, as, of course, the frame does not require any wood on the underside. But, failing any such opportunity, we must make our frame with new wood. The measurements given above will be found to be convenient for general purposes. Deal, about ¾ in. or 1 in. thick, should be used for the sides, and 1¼ in. for the uprights, which should be a few inches deeper than the frame. If the worker is not accustomed to rough joinery, he will better ensure truthfulness in the completed work if he temporarily battens together the planks which are to form the two longest sides by nailing two strips of wood across them at both ends, then sawing the planks to the required measure and slope, and attaching them to the uprights, leaving a space the thickness of the end planks; then, having cut up the latter, put the whole together with 2 in. French nails. A true and substantially made frame should be the result.

The glass frame for the top should be very strong. The outer frame should be not less than 1 in. thick and 3 in. wide, made on the flat; and if the measurements referred to be adopted, three sash-bars should be fixed lengthwise, and equidistant from the edge of the frame. Sash-bars in lengths can be bought at almost any timber-yard; but if not, can be readily roughed-up by joining, say, a strip of wood, ½ in. thick, upon another, say 1 in. These must be securely fitted to the frame, and should be let in the wood at both ends, as well as nailed. Give the frame a coat of paint before glazing, and for the latter purpose use common window-glass—costing 2d. or under per foot—and ordinary putty. The glazed frame is better adapted to retain warmth when the edges are "lipped," by fitting all round vertical strips of wood, so that the lid of frame laps over the lower part a convenient space—say, 2 in. The earth is usually dug out to form a manure-pit. It is very convenient to have a number of hand-lights (Fig. 3), which can be temporarily covered over newly-planted-out things. These can be made very cheaply. Ready-drawn zinc sash-bar can be bought in 8 ft. lengths at any zinc-worker's. This material has a round bead and a rebate on either side (Fig. 4) about ⅛ in. wide. To make a hand-light, you have to simply cut up the zinc into the required lengths and solder them together, so as to form a triangular or any shaped frame, which, being glazed with common glass, forms a most handy and useful garden appliance.

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ELECTRICAL SURVEYORS.—Judging from the discussion which took place between witnesses, experts, and the jury in connection with the recent fatal fire at a famous London supper room, there would seem to be more danger in connection with electric lighting than the general public suppose. In answer to the question of a juror: "Do you consider that the fire was caused by the electric light?" an expert responded, "I think it is distinctly possible, but I find no definite tangible evidence to that effect"—an answer which admits the fire risks involved in electric lighting and fittings. Far be it from us to discourage the use of the electric light, or to shut our eyes to the fact that the new illuminant will not only eventually succeed gas, but will prove the great propelling and motive power of the future. On this very account, however, and because it is likely to become so generally adopted for social and commercial purposes, we submit that the question of thoroughly qualified and duly accredited inspectors for work carried out becomes a matter of moment—one which the London County Council and Local Government Boards should grapple with without loss of time. When the electric light surrounds us on every side, and wrests the palm from gas in our every apartment, what will be the emergency qualities of the average domestic, or even the *major domo?* After many years' experience with it, the fashion remains of seeking for an escape of gas with a lighted candle, and if this ignorance prevails in respect to gas, what shall we say for the mysteries involved in electric lighting with its systematically concealed wires and fittings? The subject of electrical training and qualification is now of paramount importance, and the powers that be cannot too soon commence to take steps to establish a system of properly qualified practitioners in the science, whose work, when done, shall be subject to being passed by the electrical surveyor or inspector. These latter should be men who have given proof by examination of qualifications as electrical scientists. An electrical college, empowered to grant diplomas, would find ample work before it in the near future, both as regards training classes for electrical students and empowering them to practice as soon as qualified. Certainly these would be the better men to carry out electric lighting with safety to life and property, and with the insurance companies in a contentious mood concerning claims from electric light mishaps, many wise people will defer their installations, preferring the miseries of gas until they can be assured of absolute safety with the new illuminant. Unless this subject of electric lighting be put upon some such basis as this, and the touting tradesman debarred from undertaking work he knows nothing about, the public may one day find itself in a fog in real earnest, for though, curiously enough, all the cunningly devised appliances for effecting capital punishment by electricity seem to fail, it appears ridiculously easy to court a simple and instantaneous death—when not required—by the mere accidental acquaintance with electric currents and wires.

DEVELOPMENT OF INVENTIONS. — Although it is undoubtedly the fact that a majority of the inventions of our times fall into oblivion through inutility or lack of novelty, yet it must be admitted that many inventions genuine and novel, and of real value, are lost by reason of the inventor's want of capital and influence. This is to be regretted not only on account of the inventor himself, but also in the interests of the community at large. The unwritten history of inventors is far from being encouraging—we get glimpses of it at times; the originators of new ideas do not often reap their reward if they have not the sinews of war wherewith to fight the financial battle, without which very few new inventions can reach the market. Inventions in their workable forms must come from practical men, and those who are intelligent enough to improve our methods and machinery should be encouraged in exercising their faculties of originating and improving. Societies and institutes have been founded with this view, but matters at present do not seem to be better in this respect than they were twenty or thirty years since. A new association has now been registered to take up inventions with a view to their development, but it remains to be seen whether its mode of procedure will be beneficial in the way of rescuing useful inventions from neglect. There are some very delicate points to be dealt with in considering the advisability of taking up an invention and spending money on testing its utility. It is, to a great extent, a speculation; there may be a market for a certain machine promising a rich return, and a short time after the completion of such machine a cheaper or better one may be produced to compete with it, or even that which is produced by it may be displaced by other material. On the other hand, by overlooking the possibilities underlying a crude invention, great opportunities of advancement and profit may be lost. New discoveries and startling inventions are almost, if not quite, things of the past, but there is much more to be done in the way of perfecting than ever has been done in inventing, and it is sincerely to be hoped that the new association will prove to be a potent agency in aiding progress. We see no reason why an undertaking of this kind should not succeed, and if conducted upon sound business lines we believe it will be beneficial to inventors all over the country. Their views upon the matter ought to be heard, however, by the promoters of the association. WORK is open to them.

IRCULAR DESIGN FOR REPOUSSÉ, CARVING, MODELLING, ETC.

BY J. EADIE-REID.

HIS design, which is one of several which e hope to give in WORK, has been rawn specially with a view to its being of eneral value to our readers engaged in ifferent pursuits—some repoussé, others rvers, decorators, etc.—modifying the deils in each case to suit the peculiar method material employed. The desire of the esigner has already been enlarged upon a former article—namely, that the degns submitted are intended to form the asis of suggestions to the art workman, assist him in starting a train of thought

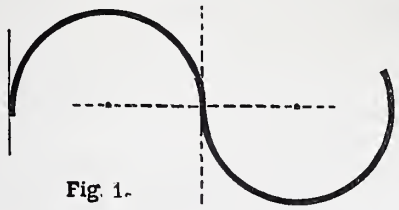


Fig. 1.

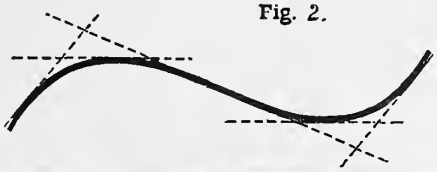
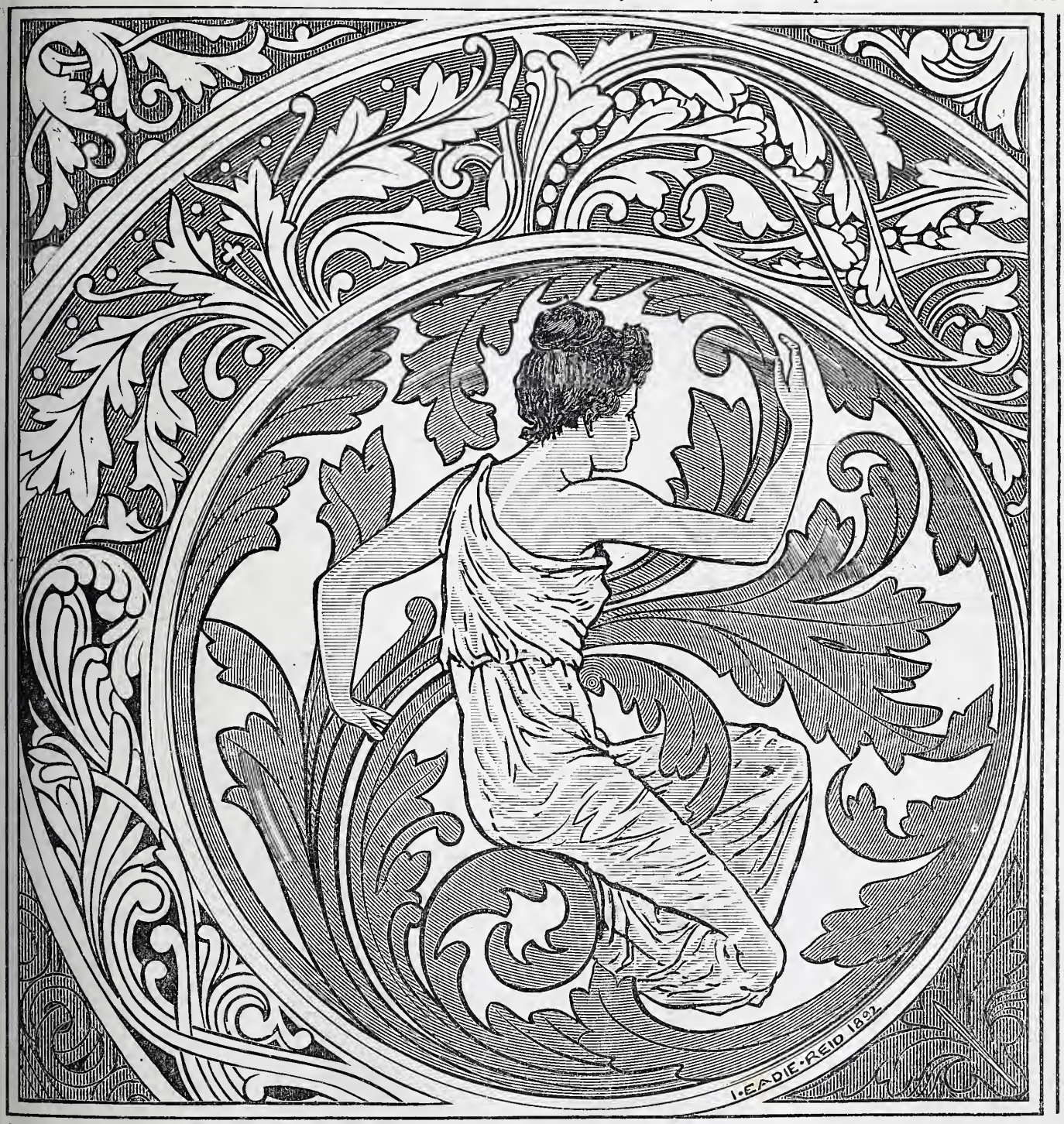


Fig. 2.

of his own. Then, and only then, will he experience the keen pleasure that necessarily accompanies the realisation of our ideas; not merely to trace the lines of our illustration, but diligently striving to reconstruct the designs—to feel, as he works, the meaning and spirit of each detail, while the effect of the whole is preserved.

For instance, in drawing the ornament which fills the circular border, the leading lines form practically the skeleton or framework, and must be defined at the outset; otherwise, the whole will prove a disjointed failure. The circular lines of the plaque itself will suggest the inclination and direction of these lines. Having determined these, and made up our minds as to the manner in



Circular Design for Working in Repoussé, Carved Wood, or Painted Decoration, with Borders varied and cornered for Square, such as Tray. Fig. 1.—Arc, as compared with Fig. 2 (Ellipse).

which the ground-lines are to be clothed, we must draw the details firmly and deliberately. "He who hesitates is lost" is equally true of the ornamentist. Again, in the repetition of the forms we must be careful that the lines flow sweetly into one another; otherwise, we shall have the discordant effect of lines broken at intervals, and having no apparent definite connection with each other. Each line in itself is of vital importance to the whole; take it away, and its absence will be painfully evident.

In analysing the forms, you will find that the curves of the principal forms are elliptical.

We have not far to seek for an explanation of this. The eye is never satisfied with lines the origin of which can be detected without difficulty—as in the case of the arc, the least beautiful of curves—lines which in themselves bear evidence of thought being more pleasing, according to the degree of subtlety displayed. Take, for example, the ellipse, struck from three or more centres. A simpler method, perhaps, is to conceive the curve as formed of straight lines—the longer the better, in proportion to the scale on which you are working. (See Fig. 2, Ellipse.)

The figure forming the principal feature of the centre panel must be carefully drawn, separately, and transferred to its position. The proportions must be religiously preserved; otherwise, you will never succeed in keeping the grace and freedom of the pose.

The lines of the figure have been carefully studied in relation to their harmony with the space occupied. In treatment it must be strictly decorative, carrying the suggestion only as far as your material will allow.

We might say that in the carving greater finish in the details might be expected than would be found in the repoussé work; but the mass will still have the same effect.

The drapery will require careful studying, lest, while preserving the lines of the figure, you fall into the trap of making the drapery too "pipey." It will be seen, on looking at the border, that three different designs have been suggested for this feature. It is intended that one only should be used at a time.

Now as to the purposes our designs might be applied in decoration. The repoussé plaque has already been spoken of; to the china painter it will be found useful. The centre, modelled in terra-cotta, might be used in the carrying out of the design for a fireplace that appeared in No. 146, Vol. III. In painted decoration it would give scope to the decorator—used as a panel in a frieze—and afford a chance for a bit of glowing colour if treated on a gold background.

The fretworker could turn it to account, and the wrought-iron worker might not do amiss with it. Treated in silks and materials, or painted, it could be used for a pianoforte back.

MODEL BOAT-MAKING FOR BOYS.

BY A CRAFTSMAN.

MAST-HOLES — BINNACLE—CLEATS—ARRANGEMENT OF THE RIGGING IN CUTTERS AND SCHOONERS—MASTS.

We must now turn our attention to the mast-holes. These are bored in the deck with a centre-bit, and wooden sockets are fitted into them. One of these sockets is represented by Fig. 14. It is turned out of boxwood, and is fastened into its place with four small screws. The shape of the binnacle is shown in Fig. 15. It is also made of boxwood, and its upper part is hollowed out to contain the compass. It is fitted into the deck in the same way that the capstan is. The compass can be bought at any shop where models are sold, and should be less than 1 in. in diameter. The pieces of brass wire (M, Fig. 9, page 155) are shaped as shown in Fig. 16. The ends are pointed and hammered into the deck, care being taken not to split it. The cleats are made in wood and brass in the shapes shown in Figs. 17, 18, and 19. The kind of cleat represented by Fig. 17 is fastened down by two small screws passed through it, the others having pointed ends, so that they can be hammered into the deck. Fig. 20 shows the manner of mounting cannons with a swivel arrangement. The lower end of the support of the trunnion is pointed, so that it can be fastened on to the deck by simply hammering it in.

These are all the deck fittings which are generally used on model ships. If you do not care for the trouble of making them yourself, you can buy them beautifully made at the Model Dockyard. If you are constructing a one-masted vessel, the only difference in the arrangement of the deck fittings will be that only one mast-hole, two pieces of bent wire, two hatchways, and fewer skylights will be required.

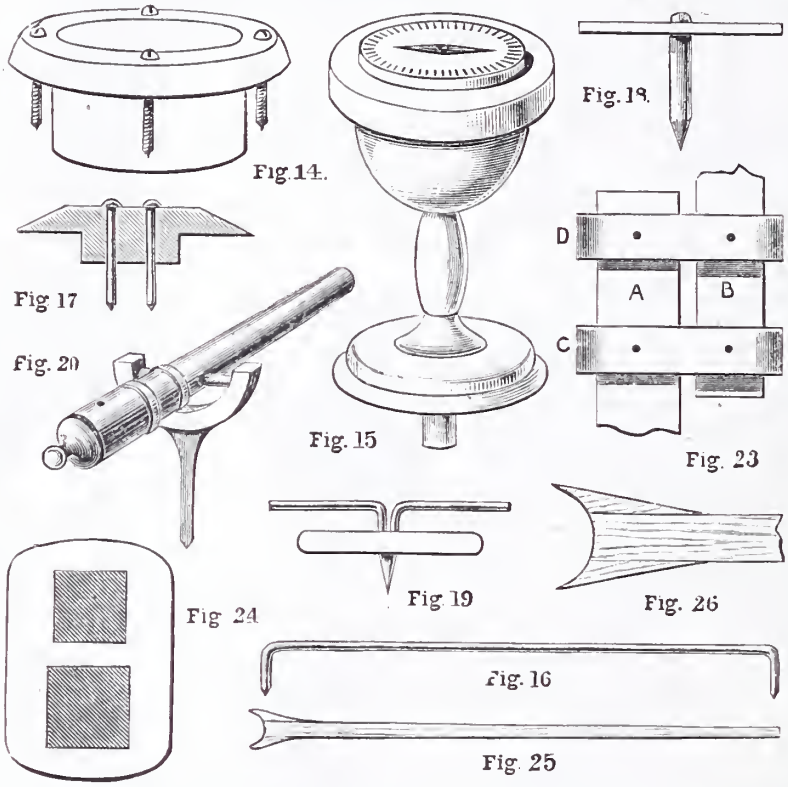
A few touches of paint must now be added to the hull and deck. All iron eyes and heads of screws must be touched up with black paint, and a few touches of red and black paint judiciously added to the skylights will improve their appearance. A figurehead can also, if you wish, be fixed on to the bows.

We must now turn our attention to the masts and rigging. Fig. 21 shows the manner in which a cutter is rigged. There is one mast, F, on the top of which is a topmast, N. It has a mainsail, A, a topsail, B, and jib and foresail, C and D. The mainsail is fastened to a spar, J, called the gaff, and to another spar, I, called the boom. The mast is supported by mainstays, G, and by a forestay, H. The bowsprit is secured by a stay, E, and two sidestays. The mainsail and foresail are fastened to rings which run along the wires, M (see Fig. 9), by pieces of string called "sheets." The sails are let up and down by pieces of string called halyards, which pass over pulleys down to the deck, where they are fastened round cleats. The mast is sometimes provided with two backstays (M, Fig. 21), which pass from the topmast and are fastened on to the outside of the hull, but nearer to the stern than the mainstays.

Fig. 22 is an illustration of the rigging of a fore-and-aft schooner. It has two mainsails, two topsails, a jib, and foresail. The topsail on the foremast, or on both of the masts, may be replaced by one or two square sails, when the ship will be a square-topsail schooner. The square sails add much to the appearance of the ship when she is upon the water, and make her sail with great speed before the wind; but they add greatly to the weight of the topmast, since three yards are required on each mast. In tacking, the yards are moved by halyards, which pass over pulleys fixed on to the opposite mast, and thence down to the deck.

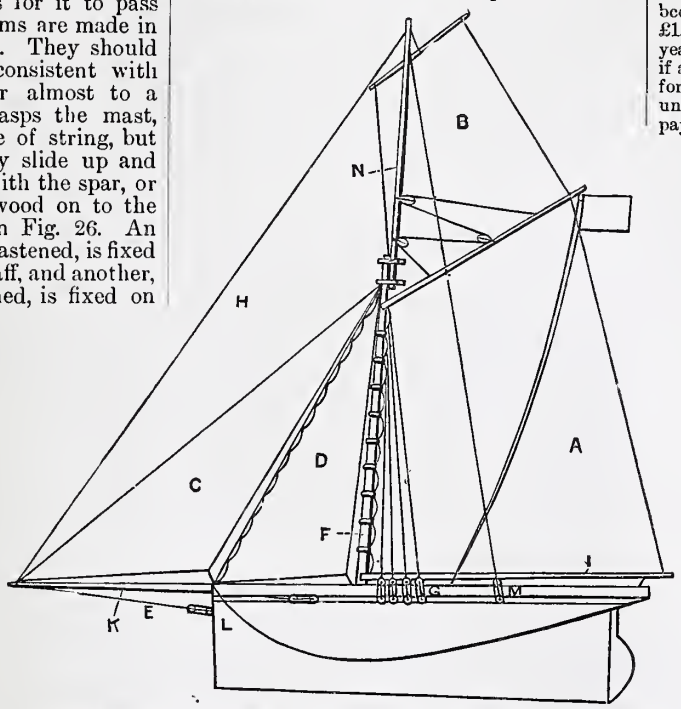
Having settled on the manner in which you are going to rig your ship, proceed to make the masts and spars. Deal is the wood which is generally used for this purpose, but lancewood is greatly to be recommended, because it can be obtained in long strips, is of a good colour, is hard and flexible, and can be made very smooth. The masts are made of such a size that they will fit tightly into the sockets provided for their reception. The topmast is joined to the mainmast by the arrangement shown in Fig. 23, where A is the mainmast, B is the topmast, and C and D are two pieces of boxwood of the shape shown in Fig. 24.

The sharp part of a nail is driven into the lower part of the mainmasts, so that they will not be able to slide in the hold of the vessel. The ends of the topmasts are provided with boxwood or brass caps. Small brass eyes are fixed on to the mast in the



Model Boat-Making. Fig. 14.—Socket for Mast. Fig. 15.—Binnacle. Fig. 16.—Brass Slide for Sheets. Figs. 17, 18, 19.—Cleats. Fig. 20.—Swivel Cannon. Fig. 23.—Arrangement for holding Main and Topmasts together. Fig. 24.—Piece of Boxwood for fastening Masts together. Fig. 25.—Gaff or Boom. Fig. 26.—Part of Gaff or Boom which is next to Mast.

various places where ropes are to be attached. The bowsprit is made to fit into the piece of wood which was fastened on to the deck for its reception, and a ring is rigidly fixed on to the bows for it to pass through. The gaffs and booms are made in the shape shown in Fig. 25. They should be made as light as is consistent with strength, and should taper almost to a point. The curved part clasps the mast, and is tied to it with a piece of string, but so loosely that it will easily slide up and down. It may be cut out with the spar, or made by joining pieces of wood on to the spar, in the manner shown in Fig. 26. An eye, to which the halyard is fastened, is fixed on to the upper side of the gaff, and another, to which the sheet is attached, is fixed on to the lower side of the extremity of the boom.



Model Boat-Making. Fig. 21.—Rigging of a Cutter—A, Mainsail; B, Topsail; C, Jib; D, Foresail; E, Bowsprit Stay; F, Mainmast; G, Mainstays; H, Forestay; I, Boom; J, Gaff; K, Bowsprit; L, Side-stay of Bowsprit; M, Backstays; N, Topmast.

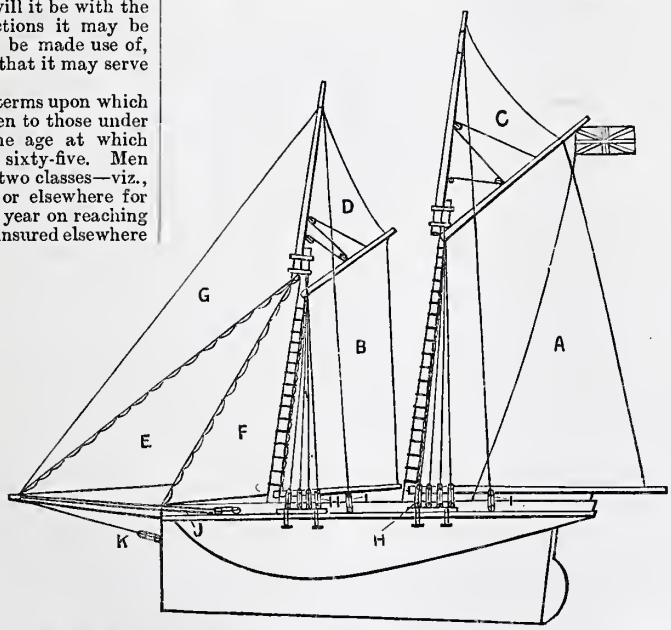
WORKERS' QUESTIONS: OLD AGE PENSIONS.

BY ECONOMICUS.

The scheme furnished by the Parliamentary Committee as a basis for legislation on the question of pensions for the aged will, no doubt, evoke abundant criticism among workmen. Criticism, therefore, we shall dispense with just now, feeling sure that the first question every working man will seek an answer to will be: "What benefits does the scheme offer to me?" If these benefits are deemed sufficient, whether a man may agree in the abstract with pensions or not, he will endeavour to avail himself of them. Many a man objects to underground railways, but few hesitate to use them when their interests are served by doing so. Many of our readers may object to the design of a bridge, but none would refuse to use it any the less on that account if they so required. So will it be with the pension scheme. Whatever objections it may be open to on general grounds, it will be made use of, when legalised, just to the extent that it may serve the interests of individuals.

The easiest—*i.e.*, the cheapest—terms upon which a pension will be procurable are open to those under twenty-five years of age, and the age at which pensions are to become payable is sixty-five. Men under twenty-five are divided into two classes—viz., those insured in a friendly society or elsewhere for a pension of not less than £6 10s. a year on reaching the age of sixty-five, and those not insured elsewhere at all. To the former, an additional pension of £6 10s. a year, making in all £13 a year, or 5s. a week, will be paid by depositing £1 10s. in the Post Office Savings Bank. All a young man in this class has to do to get 2s. 6d. a week after he is sixty-five is to speculate to the extent of 30s. If he die in the meantime the 30s. is lost; if he survive he will, of course, soon realise more than his outlay.

Those under twenty-five and not insured elsewhere pay to the Post Office a deposit of £1 more—viz., £2 10s.—and then, for forty years, an annual deposit of 10s. For this, a total outlay of £22 10s., a pension of £13 a year, or 5s. a week, is payable at sixty-five. This is not a very substantial sum, and there are not many amongst the young who would forego much to struggle on in old age on 5s. a week. Perhaps, however, a pension of £1 a week or more might tempt them, and this may be secured by increasing the deposit or the annual instalments, or a judicious mixture of both. For instance, for every £1 added to the deposit of £2 10s. the pension may be increased 11s. 8d. a year, and for every 5s. added to the annual instalment of 10s. it may be increased £2 16s. 10d. a year. To bring the pension up to £1 a week, the yearly £13, due from the £2 10s. deposit and 10s. instalments, would have to be increased by £39. As every £1 deposited over and above the first £2 10s. brings only an addition of 11s. 8d. a year, and as there are close on sixty-seven times 11s. 8d. in £39, to get £1 a week pension will require an initial deposit of close on £70. This, of course, is impracticable for most young men under twenty-five. By the additional annual instalments of 5s. the pension is raised £2 16s. 10d. a year; to raise it by £39, therefore, would require close on fourteen additional 5s. instalments, or £3 10s. Thus, with a deposit of £2 10s. before the age of twenty-five, and annual deposits thereafter for forty years of £4, a pension of £1 a week is secured. Though a young man may lightly deposit £2 10s. and pay an annual sum of 10s., he may perhaps hesitate before beginning to pay £4 a year to the scheme, especially as, under the foregoing, the money is not returnable in the event of death.



Model Boat-Making. Fig. 22.—Rigging of a Schooner—A, B, Mainsails; C, D, Topsails; E, Jib; F, Foresail; G, Forestay; H, Mainstays; I, Backstays; J, K, Stays to Bowsprit.

When the money is returnable under the scheme, the initial deposit of £2 10s. for a pension of £13 becomes £5, and instalments are raised from 10s. to £1. If death overtake the insurer within three years, the £5 deposit is paid to his widow or heirs; if after three years, then the widow gets 5s. a week for twenty-six weeks and 2s. a week for each child until it reaches the age of twelve. These weekly payments to each family must never exceed 12s. for the first twenty-six weeks and 8s. thereafter. When there is a widow and no children, she receives 5s. a week for twenty-six weeks, and such sum in addition as will together amount to the total of the husband's subscriptions with interest at 2½ per cent. In cases where there is neither widow nor children the heirs receive £5. The rate at which pensions may be increased under this heading is for each additional £1 deposit 5s. 4d. increase to pension, and for each additional 10s. to the annual instalment £3 6s. 8d. increase to pension.

In the case of insurers falling into arrears with their instalments, back contributions may be paid any time within two years with interest at 5 per cent. per annum. In the event of death, however, before an insurer, who has fallen into arrears and who has paid not fewer than three annual instalments, attains the age of sixty-five, his widow or representative shall receive 5s. a week for twenty-six weeks, and such sum besides as shall make up the total amount of his subscriptions without interest. Insurers who fall into arrears, and remain in arrears after paying three annual instalments, receive back on reaching the age of sixty-five the money paid in, but bearing no interest.

Omitting the provisions made for females, which are substantially the same, though for smaller amounts, we give the words of the scheme itself in regard to men over twenty five at the passing of the Act:—

"Every male who, at the passing of the Act, is above the age of twenty-five years, and who, within three years of the passing of the Act, being then under fifty years of age, shall deposit in the Post Office Savings Bank £4 if he is under thirty years of age, £5 if he is under thirty-five years of age, £6 if he is under forty years of age, £8 if he is under forty-five years of age, £10 if he is under fifty years of age, and shall prove that he is insured in the Post Office or elsewhere for a pension of not less than £6 10s. per annum, shall, on reaching sixty-five, and on showing that such pension will be paid to him, be entitled to an additional pension of £6 10s. per annum."

As we said at the beginning, we offer no criticism of the scheme. We simply set forth its leading features, knowing full well that each individual will apply it to his own case, and if he see benefits in it for him and his, he will, if the scheme becomes law, insure; if not, neither favourable nor unfavourable criticism will have any practical effect.

NOTES FOR WORKERS.

If a light be applied to petroleum, the latter is so inflammable that the flame spreads over the whole bulk as a flash. The results are sometimes disastrous, and great care is required in the carriage and use of such an inflammable substance.

Early this year two goods trains on the Transcaucasian Railway came in collision. They were laden with petroleum, which at once took fire; in a moment both trains were in flames from end to end, the employés not even having time to leave their vans, and therefore being burnt to death.

A pin manufacturer in Ansonia (U.S.) is about to make use of some twenty barrels of imperfect pins in laying a sidewalk in front of his residence. There is in that town a small piece of sidewalk built of scraps from the pin factory which, by corrosion, had in a few years become so hard as to require much hard work in drilling, etc., to make a hole large enough to receive the lower end of a telegraph pole, although the layer was only 3 in. or 4 in. thick.

TRADE: PRESENT AND FUTURE.

**** Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

TIMBER TRADE.—The London dock deliveries again show an increase over the corresponding period last year. Now that the differences with the bricklayers have been settled, there is every prospect of recovering ground. Reports from West Hartlepool, Hull, and Grimsby show that there is an improving tendency. Our Liverpool correspondent writes:—Business has been rather more active during the last month, though there are no changes in value to report. Yellow and red pine and oak have been quiet. Elm has been in better request. Ash has been more inquired for. Of pitch pine 6,602 tons have arrived. Mahogany, 1,620 logs have arrived from St. Domingo, 425 from Honduras, 110 from Mexico, 366 from Africa, 72 from Colon, and 17 from Bombay. Cedar, 13 logs from Honduras, 6 from Mexico, 12 from Colon; 1,093 pencil cedar from Pensacola, and 7,971 pieces Californian redwood.

PAINT AND VARNISH TRADES.—Sierra Leone copal, 12 packages have sold at 9d. to 1s. 2¾d., according to quality, and 12 tons Brazilian copal at 45s. per cwt.

BOOT AND SHOE TRADE.—Trade is very brisk in Norwich, Nottingham, Kettering, and Desborough, not forgetting London, where the hand-sewn trade is also better than it has been for a very long time past. This class of trade is seeing a good season, though it may be short.

JEWELLERY TRADE.—London jewellery trade is better than it was, but the shopkeepers are complaining bitterly.

HATTERS' TRADE.—The strike in the hat trade at Stockport has been settled by the withdrawal of the *employés'* demands.

SILVER AND CUTLERY TRADES.—The Sheffield silver and electro-plated trades have fallen, and some cutlery works have been closed, so slack are the home and foreign markets.

IRON AND STEEL TRADES.—There is hope in the condition of the steel trade. Indian markets are opening well for spring steel and octagon sections, and the file industry is looking up. South American trade continues to increase in regard to cutlery and files. Mining tools are in good request, but there is no demand for shipbuilders' tools. Our Rochdale correspondent writes:—Trade is in a very unsatisfactory state, but may be better when the new blast furnaces start "blowing" at Castleton.

COAL TRADE.—With the restarting of the Durham pits, more gas and household coals are thrown on the market, with the result that buyers are able to bid down prices. Steam coals remain steady. Steam small continues to cheapen, the supply being fairly plentiful. Bunker coals are bidding for more orders. Coke is again put forward for shipments at steady values.

CYCLE TRADE.—Trade is still very brisk. The latest firm to commence cycle manufacture is the Salvation Army.

COTTON AND FLANNEL TRADES.—The cotton trade cannot be said to be satisfactory. The flannel trade is better.

CHEMICAL TRADE.—The chemical market retains steady prices. Crystal soda, bleaching powder, soda ash, and sulphur are, however, scarce.

ENGINEERING TRADE.—The general condition of the trade is still decidedly unsatisfactory. So far as can be ascertained, the tone of the pig iron trade is indicative of a hardening tendency. As to manufactured material, the reports from most of the finished iron centres are more hopeful. Business is still generally very slack in Manchester and district.

BUILDING TRADE.—Colne masons and wallers have resolved to give notice to the builders and contractors for an advance from 8d. to 8½d. per hour. Luton bricklayers and carpenters have struck. In Manchester and Salford trade is still steady and firm.

JOINERY TRADE.—The master joiners of Kirkcaldy recently agreed to grant the same increase in wages to their *employés* as the Edinburgh masters. The Edinburgh employers, however, have only given a farthing increase, and this the Kirkcaldy men have refused to accept, having been already some time on strike, especially as in Edinburgh the men have much higher wages than in Kirkcaldy. All the local joiners are expected to leave the town immediately, and a good proportion start work at Leith.

SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

**** In consequence of the great pressure upon the "Shop" columns of WORK, contributors are requested to be brief and concise in all future questions and replies.*

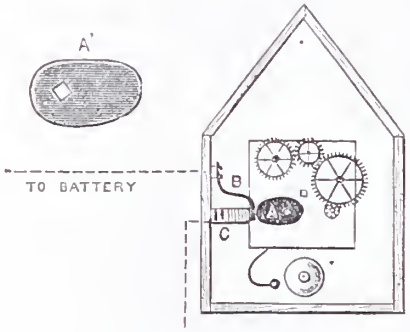
In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of WORK in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given.

I.—LETTERS FROM CORRESPONDENTS.

Hobbyists' Emporium.—J. W. B. (*Huddersfield*) writes:—"I shall be pleased if an Amateur Co-operative Society could be formed with workers of WORK, etc., such as BONA FIDE speaks of in p. 156, No. 166. I keep a small ware and general shop, and would do my best to make ornamental stools and other goods, and exchange them with other correspondents."

Hypnotising Fowls.—G. P. (*Aberdeen*) writes:—"One who for many years has been an unsuccessful breeder of fowls has succeeded in making hens cluck artificially. The power employed is hypnotism, which was first tried on a morose hen by making thirty or forty hypnotic passes over her back. After six or seven passes the wings drooped, and next day the hen appeared in a dazed condition. She then took kindly to the chickens, and so successful was the treatment that chicks from other flocks left them, and watched for an opportunity to get under her wing."

Early Riser.—W. F. P. (*Chalk Farm*) writes:—"Seeing in WORK particulars of an 'Early Riser's Electric Clock,' I send you my arrangement, which I think has an advantage over the one sent by CAWD HUD (see No. 160, page 61). The bell, switch, clock, and battery can be arranged on a similar board (but I prefer to put the battery out of sight), the only difference being in the clock. I got used to the ordinary alarum, and so have devised this plan. I have an ordinary alarm clock in a wooden case, and on the winding square—*i.e.*, the square where the key fits on—I have secured a cam, which is fastened by having a square hole in it, and have so placed it that when the alarm has finished ringing, this cam presses a brass spring on to a terminal, and so forms the circuit. See Figure at A.



Early Riser's Alarm.

The diagram shows the clock with the dial off. A is the cam, B is the spring, C the terminal, from which runs a wire to the bell; and the wire from B goes to the battery. In CAWD HUD'S arrangement the bell ceases to ring when the alarm is run down, whilst mine continues to ring until switched off, which means a thorough wake-up if placed some distance from the sleeper, as several of my shopmates have placed theirs. I have had mine a similar length of time (three years), and it has always answered very satisfactorily; and where the ordinary alarum ceases to ring mine continues, and so I think this is a decided gain. The cost might be a trifle more, but not much, and I think it amply pays for itself."

Hobbyists' Emporiums.—TAYLOR & Co. (*Blackpool*) write:—"With reference to your leaderette upon this subject in WORK, No. 160, we shall be pleased to receive any article in fretwork or carving from readers of WORK for disposal at our *depôt* during the months of June to September, inclusive. We have a large stand in the Royal Palace, where we offer for sale work done by our *employés*; and we have as many as 20,000 visitors in one day." [Taylor & Co. should advertise their terms in WORK.—ED.]

Hobbyists' Emporiums.—B. A. B. (*Hampstead*) writes:—"I will, if agreeable to your readers, expose their productions for sale in a good shop in Hampstead, near station and tramcar terminus, where there is much traffic. Terms shall be mutual."—[We give publicity to this suggestion, as B. A. B. is an old subscriber, but his address and all matters of this business nature must go through the "Sale and Exchange" column.—ED.]

Copying Ink.—G. H. K. (*Bond Street, W.*) writes:—"The formula below is an improvement which I tried the other day, and a good one for copying ink: 1 oz. ordinary ink evaporated down to a quarter of its bulk, and 20 grs. of powdered sugar added and dissolved."

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Dressing Albatross Skin.—G. J. S. (*Arundel*).—If the skin is stiff from having been so long rolled up, it must be softened by wrapping in damp cloths. I should then advise you to stretch it, feathers downwards, and carefully to remove any flesh, fat, etc., that may have been left adhering to it with a knife. Of the extreme oiliness of the skin you may get rid by rubbing it with powdered whiting, which can be removed by scraping, and doing this as many times over as may be found necessary. The skin being what it is, you may perhaps find it desirable to dust in whiting on the feather side also, and afterwards to beat it out. The dirty feathers you can clean by carefully sponging with warm and very strong soapsuds, a very little only being used. This will not injure the feathers if you dry them with clean white sand used warm. This you will sprinkle on the wet part, and beat it out with the hand, striking only in the direction in which the feathers grow. Bird-preservers finish drying with powdered starch to bring up the bloom of the feathers; but, perhaps, with your large skin this may be unnecessary. Before sewing it on the cloth, you should dress the inner side with the arsenical soap used by bird-stuffers (and which may be bought at their shops, or often at those of chemists), or with some other of the preservative compositions in use. This is to be done as a protection against insects.—M. M.

Silk and Cotton.—DROPSALIA.—Messrs. F. & E. Stanton, Silk Mills, Lewisham, S.E., are prepared to supply you with soft unspun silk in any quantity, and will wind it on any kind of reels or bobbins you may require for your purpose. They do not supply soft cotton. This may be obtained from makers of sewing cotton.—G. E. B.

Balance Wheel for Watch.—S. M. H. (*Bootle*).—If you will apply to Morris Cohen, 132, Kirkgate, Leeds, who advertises in WORK, he will probably be able to supply you with a balance wheel for a Geneva watch.—G. E. B.

Battery of Gas-lighter.—S. M. H. (*Bootle*).—If the gas-lighter is worked by a battery, it is most likely to be a chloride of silver battery furnished with zinc and silver plates separated by folds of blotting-paper. To repair this battery, take out the plates and soak them in hot water for an hour; then take off all the blotting-paper, and well wash the plates. Coat the silver plate with chloride of silver paste, and envelop the zinc plate with blotting-paper dipped in a strong solution of chloride of zinc. Replace all in their cells, clean connections, and connect up as before.—G. E. B.

Electric Alarum.—J. H. C. (*Halifax*).—The alarum may be worked as you suggest. J. H. C. uses the spring of an ordinary alarum clock to close the circuit of an electric bell. As the spring unrolls and expands it comes in contact with a pin, and closes the circuit.—G. E. B.

Hot-Air Engine.—APPRENTICE.—The model engine of this kind, shown in No. 149, page 717, can only be considered as a toy, therefore it is not expected that it should be provided with those arrangements which would be needed in a real engine applied to practical use. From the rough sketch given, we cannot supply the details our correspondent asks for, though the action is plain enough to a practical mechanic. There is no doubt an engine of a useful size might be constructed on this plan, but we fear that it would give but little available power in proportion to its size. If such a one is ever made, we shall be pleased to receive particulars and results obtained. In regard to the fan blower, as per sketch sent, we remember the *identical* thing being brought out—we fancy under a high-sounding Greek name—some forty-eight to fifty years ago, and we have had many a grind with it in freshening up a half-dead parlour fire. There is no patent right in existence now which could interfere with our correspondent.—C. E.

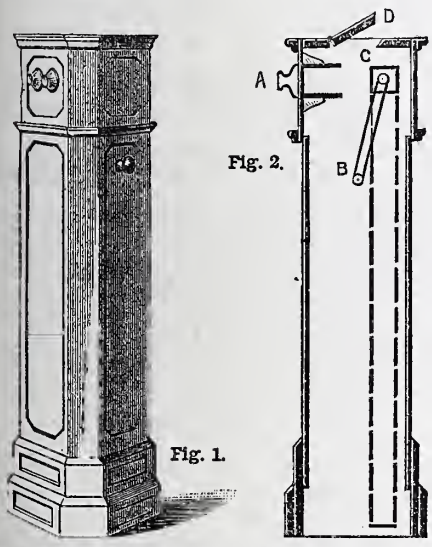
Soap Tray.—H. M. (*Ashfield*).—We have examined the rough model and sketch sent us, and have no doubt it will do all our correspondent expects. We do not think, however, it would be considered in the Law Courts either to have *sufficient invention* in it or to be the *subject matter* of a patent, not being, in the legal sense of the term, a "new manufacture." It is clearly a fit and legitimate subject for registration as a *design*. We have also an idea that it would not hold good under what the law pleases to term an "analogous use," and we fancy we have met with the equivalent of the plan applied to an *analogous use* some five-and-twenty years ago. At any rate, if H. M. likes to take risk, and has not to appear in the Law Courts to maintain his rights, he may make something out of it.—C. E.

Refining Gold and Silver.—H. B. W. (*Cairo*).—I do not know of any easy method for refining gold and silver. If the alloy contains one-third part or less of gold, the latter metal may be separated by boiling the alloy in nitric acid diluted with half its bulk of water. The resulting brown powder must be well washed, dried, and fused with borax in a fire-clay crucible. The silver is thrown down as silver chloride by adding common salt to the acid solution employed in dissolving the gold silver alloy.—G. E. B.

Oak.—Mountain Ash.—You can obtain oak at any hardwood timber merchant's in Cardiff. The price would be from 4d. to 5d. for plain figured wood, and about 10d. for wainscot in the foot super. of 1 in. Your width of 18 in. to 20 in. is excessive, and you will find it difficult to obtain; so you had better get 9 in. or 10 in. and join it. Hungarian—*i.e.*, Trieste—oak is Austrian wood, and Odessa is Russian. The term "Crown" signifies best quality, and of the two ports that which comes from Odessa is the better, and if you get some good, well-figured wood, you would find it equal to British for cabinet work.—A. J. H.

Batteries.—W. E. L. (*Kimberley Road*).—There is a paper at present in hand as to how to make batteries in the easiest and simplest way, which will doubtless appear in due course. If you will look up the index to Vol. II. of Work, you will there find a whole series of papers by Mr. G. E. Bonney, in which he treats in a most able manner the subject of small electric lights. If you would like to order the numbers separately, they are Vol. II. of Work, Nos. 76, 82, 89, 92, 94, 97, 99, 101, and 104.—J. B.

Revolving Stereoscope.—Stereo.—The accompanying diagrams represent a pillar stereoscope which will be capable of holding a hundred or more slides. This instrument takes the form of an upright wooden box or pedestal, which may be a foot square, and of a suitable height to bring the lenses on a level with the eye, but these dimensions can be varied considerably according to requirements. Fig. 2 shows more clearly the interior arrangement, from which it will be seen that the series of pictures are mounted on an endless band of tape, attached to a long horizontal shaft, disposed within the pedestal in such a manner that the pictures are successively brought into position in front of the lenses. A (Fig. 2) is a kind of box or drawer, which is open at the back end, and made to slide in and out of the upper chamber of the



Revolving Stereoscope. Fig. 1.—Exterior Appearance of Stereoscope. Fig. 2.—Interior of Stereoscope, showing internal Arrangement—A, Slide or Drawer carrying Lenses; B, Adjusting Wheel; C, Revolving Drum; D, Adjustable Mirror.

instrument for the adjustment of focus. The wedge-shaped lenses are attached to the front end of the drawer, with the thin edges together, and the centre is divided longitudinally by means of a wood or metal partition. B is a small knob attached to a wooden grooved wheel, which serves to revolve the drum (C) by the aid of a strap stretched between the two. D is a small lid, furnished with an adjustable support and a mirror, by means of which the light may be reflected down on to the face of the drum. The views are stitched together or fastened to a length of tape, the top of one to the bottom of the next, and in this manner they are placed over the top of the drum. It will thus be seen that the simple turning of the knob (B) causes the views to come up one after the other in front of the lenses.—C. A. P.

Gelatine Graphs.—J. W. (*Chorley*).—Read "Graphs, and How to Make Them," in Work, No. 162.

Receipts.—J. G. K. (*Watford*).—Some day your kind suggestion may be carried out by Messrs. Cassell & Co., Limited.

Stopping-off Varnish.—H. B. W. (*Cairo*).—Copal varnish, tinted with an aniline spirit dye, will make a good stopping-off varnish. If intended to be used in a hot gilding bath, the varnish must be allowed to get quite hard in a warm dry place, free from dust, before placing it in the bath. I know of no varnish that will stand the attacks of a hot cyanide solution, as the best soften if exposed long to the action of the bath. Adding a little fine rouge to the copal varnish will aid it in drying quickly and setting hard. The varnish may be dissolved in warm spirits of wine.—G. E. B.

Litho Transposition.—F. J. B. (*Chester*).—I have already given a full description of transposition, or reverse transferring, of lithography in my answer in "Shop" to T. A. J., on page 509, No. 136, Vol. III. of Work; but as you are a new subscriber, perhaps the Editor will kindly allow me to repeat one of the methods which is to protect the drawing or lettering on the stone with resin, and etch it until the letters are raised from the level of the stone to a degree perceptible to the eye. Then wash the stone, first with turpentine to remove the ink, then with clean water, after which paint the stone solid all over with litho ink. When dry, it may be rolled up in the ordinary way in printing ink. The letters being now raised, it is necessary to level them to the stone with snake-stone, and the stone can be easily gummed, rolled up, and printed, the letters standing out white on a black ground. Should any accident occur to the groundwork in using the snake-stone, it can be easily filled in and remedied with litho ink.—A. J. A.

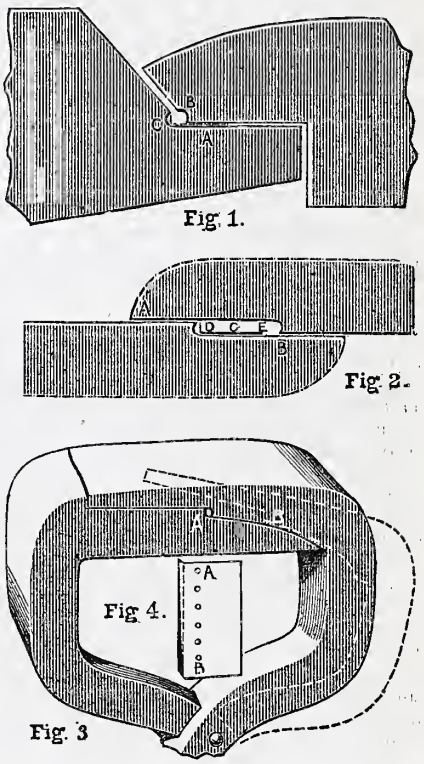
Threefold Screen.—Screen.—If you look through the various indexes (price 1d. for each volume), you will find much dealing with screens. Some time back I gave in "Shop" a small threefold screen; and in another part of "Shop" I speak concerning a peculiar form of joint. Repetitions are, of course, out of all reason; and were not the space required for many other matters at present, I should have been glad to have added something fresh to my previous information. It is our aim to give satisfaction; and if after you have searched the indexes you still remain as you are now—unsatisfied—write again, and perhaps one of our staff may prepare a "Screen" paper for the body of Work. The matter of cost is one which is best decided by simple calculations, and a visit to the woodyard on inquiry.—J. S.

Enamel Bricks.—J. M. (*Leith*).—Enamelled bricks are generally made from fine clay, although at some works the ordinary red bricks are enamelled. They are moulded and dried in the usual way, and baked in a kiln into what is called biscuit; when cool, they are wetted, and the enamel, in a liquid state, is laid on from a sieve, and the brick re-burnt to set the glaze. The enamel is composed of calcined flints and lead ashes pounded fine, and mixed to a paste. For colouring, oxides of iron and manganese are used for black and brown, copper slag for green, smalt for blue, etc. The composition of the enamel is found by experience, and varies according to circumstances, each maker having his own special mixture.—M.

Capacity of Pump.—Walsall.—To find the number of gallons discharged per stroke, multiply the square of the diameter in inches by the length of stroke in feet, and divide the product by 30. For example: let the diameter of bucket or plunger, as the case may be, be 20 in., and the stroke 4 ft., then the number of gallons lifted at each effective stroke will be:— $\frac{20 \times 20 \times 4}{30} = 53\frac{1}{3}$ gallons. In a given time a double-acting piston-pump will lift twice as much water as a plunger-pump working at the same speed and of the same size, consuming, of course, twice the power.—F. C.

Tan Cow-hide.—A. B. (*Oban*).—To give you a full description of all the processes in the tanning of a hide would be impossible in the "Shop" columns, but I will deal with your question sufficiently to enable you to grasp the idea of what is meant, and what a vast field the word "tanning" embraces. I have supposed you to mean by "boot-making," sole leather. The theory of tanning is shortly this:—After the impurities of the skin are removed, it is steeped in an infusion of oak bark, which consists of two distinct substances: viz., the gallic acid (gallic acid is soluble in ten parts of cold water, and also in three parts of boiling water) and the tanning principle. The gallic acid deprives the skin of its oxygen in a gradual manner, and while this is going on the tan combines with the fibrous part, and forms leather. During this process, which is slow and gradual, the skin is found to have increased in weight, and to have acquired a considerable tenacity and impermeability. But before the hide is ready to receive the above two substances, or before it is unhaired (your first question), it is preliminarily prepared. If it is a fresh hide, it will have to be soaked, to develop it to its greatest possible dimensions. A hide that is dry, and has so become hard, should be soaked in the liquors that have soaked softer hides. These are called "old soaks," and are found to contain more softening properties than can be found in clear water. The hide is now unhaired; this is done with lime. It is a process that has never been supplanted by any modern invention. The lime swells the cells of the hair in epidermis (or grain, as it is called when it becomes leather), softens the glutinous portions of the skin ready to receive the tanning agent, and dissolves a substance (the nutrient of the hair) that hovers round the roots of hair. This loosens the hair, which is then scraped off with a blunt knife, which takes other surplus matter with it. The liming is done by laying the hide flat in a pit that has in it sufficient milk of lime to well cover it; each day it is taken from the pit, and the liquor is well stirred, to redistribute the lime, and again make it of an even consistency. After it has gone through this process, it is cleansed through clean water, etc. The liquor is prepared, and the butt suspended by the shoulders, and the time it is there it is kept in motion. Now, this is the first, and is called the "suspender liquor." The skin then, in due course, passes to the "handlers," and is laid flat in liquors that are frequently varied. The length of time it should remain in the various liquors depends not only upon what tanning agent is used, but also on what is to be produced, as the art of tanning consists in impregnating the animal matter with that peculiar principle, taken from the vegetable kingdom, called tan, or tannin. It has next to pass to the "bloomers," through clear liquor, then drain; go through the striking process, and when smoothed by this means it is ready for the finishing touches, which are according to what market they are for. Two of the best books I should say you could get would be, "Text-Book of Tanning," by H. R. Proctor, F.C.S. (1885), and "The Art of Leather Manufacture," by Alexander Watt (1885).—W. G.

Boot-Lace Tagging Machine.—F. B. (*Leek*).—I have kept your letter unanswered longer than I should have done, as I really could not see, according to your diagram, what was the matter with your machine; but now I am in the position to tell the cause of your tags flattening, and also, what will obviate it. Fig. 1 is a reproduction of your diagram. The dotted line at A is to represent a lace tag. Well, the fact is, that when you filed the dies up you made the two circular portions, B and C, too large, and perhaps not quite smooth enough; therefore, I advise you to see to these two particulars. You ask if there are any other kinds of dies.



Boot-Lace Tagging Machine. Fig. 1.—Dies too large for a Tag. Fig. 2.—Dies with Parallel Jaws, showing position of Tag. Fig. 3.—Head of Lace-Tagging Pliers. Fig. 4.—Lace Tag.

Well, Fig. 2 is one. It is similar to your own, only that the top, A, is like the bottom, B; and you will soon see the advantage of this, for as C is the tag, and the lace is placed on to it at D, and pulled at each end, and the dies pressed together, it pushes the tag at E, which rises it in a circular form (the die being that shape), and then (unlike your own) it strikes the top die at D, and each portion of it does the same as the tag rolls round and grips the end of the lace. If you find they are not quite round, keep twisting the tag round and round, at the same time shifting the dies backward and forward, and this, you will find, will greatly improve them. But any dies, when they are closed, should have an aperture no larger than the tag is wanted to be when finished. Fig. 3 is another kind of die; these are in the form of pliers, and are very good generally. The dotted line in this diagram shows that at B, when being closed, they will just catch the end of the tag. Fig. 4 is about two-thirds the size of the tag of the lace, which is a very thin piece of sheet brass, with about six holes punctured in it from A to B, with the rough edges inside to grip the lace.—W. G.

Electric Bell.—Maneo.—You can work a bell by attaching the hammer to the contact breaker of an induction coil, but it would be far better to work it with a simple electro-magnet. The current from your induction coil is no use to excite a magnet to work a bell.—F. C.

S. N. Telegraph Coils.—G. H. (*Sheffield*).—The needle and coils of a S. N. telegraph instrument are precisely the same as that of a galvanometer. A paper on this subject is in the Editor's hands, awaiting publication. Wind each coil with 3 oz. of No. 36 or 2 oz. of No. 38 silk-covered copper wire.—G. E. B.

Six-o'clock Men.—ENGINEER.—Replying to your query, one frequently sees advertisements in the engineering papers for managers, in which, after specifying the qualifications wanted, there is the laconic addition, "Six-o'clock man." Managers advertising for situations will sometimes make use of the same expression. It is only of late years that this peculiarity has become noticeable, and there is good reason for it. There are two classes of men in engineering works—the six-o'clock men and the after-breakfast or office men. The practical work of the factory is done by those who begin work at six o'clock in the morning, the work of the office by those who begin at nine or half-past. Few men like to begin work at six. Many entrusted with the work of supervision who have been supposed to begin at six in the morning with the men, but who, because of their superior position, have not been booked in with the men, have gradually become lax, and their first appearance on the works has approximated more nearly to nine than to six. This has frequently become a sore point, and has caused much friction between employers and their responsible servants, especially when—as has been the case with some firms in recent years—the employers have resorted to the practice of checking the time of their foremen and managers. However, it is certain that, whether popular or unpopular, there is a strong sentiment among employers growing up in favour of six-o'clock men. So that, other qualifications being equal, a manager or foreman who can be trusted to be at his post at six o'clock prompt will invariably stand a better chance of securing a good position than a man who cannot rise early. Of course, this presupposes good physical health; for the lack of this no amount of mere technical education will compensate. Not many years ago the masters of the old school were for the most part in their workshops between six and seven o'clock in the morning. The practice is not so common among their successors, who were born with the proverbial silver spoon in their mouths; and this is one reason—perhaps the chief one—why they are disposed to insist on early rising on the part of those to whom they delegate the supervision of the works.—J.

Horse-Shoeing.—FARRIER.—The foot should have only so much horn removed from it at each shoeing as is necessary for the proper fitting of the shoe, and no more. The frog should take a bearing on the ground, but no other part of the hoof should be weakened to give this healthy action. Shoes cannot be too light if they give sufficient wear. The width of a shoe need be no more than is necessary to cover the bearing surface. Nails are the most secure and simple fastening for horse-shoes, and a properly driven nail never does any harm. The most important requisite in horse-shoeing is the adoption of a correct system, not the use of any special form of shoe. All shoes should have a level bearing on the foot, extending from the toe to the heel. The ground surface of a shoe should follow the form of the ground surface of an unshod foot which has travelled on a level road. No better form of shoe exists than a narrow one made rather thicker at the quarters than at the heel and toe. The recent proposal to affix shoes on feet (without nails) by broad projections into the hoof, and by pressure round the wall, is impracticable and injurious. No advantage follows the retention of shoes on a foot for more than four weeks, as the growth of the horn in that time produces a disproportionate hoof. If in this time a shoe is not worn out, it should be removed.—A.

Fixing Glass to Honey Boxes.—W. S. (*Inverness*).—Gummed paper could scarcely be strong enough for your purpose. I should prefer to use Le Page's liquid glue, or the patent fluid water-resisting glue of the Waterproof Glue Co., 62, Dale Street, Liverpool, who claim for their cement the power of holding well to glass; 4d. or 6d. will put W. S. in possession of a bottle of the first, or a tin of the second.—S. W.

Tailors' Cutting and Fitting.—SHEARS.—These articles are being arranged.

Mahogany Mouldings.—G. B. (*Accrington*) will have some difficulty in getting a small quantity of mahogany mouldings, as very few mills keep this in stock. He does not state whether he wants any special pattern or one of the regular stock patterns. As it is only a small quantity he requires, he had better get it out himself, or ask one in the trade to do it for him.—A. J. H.

Amber-Tipped Paper.—F. A. (*Leicester*).—To give an amber-tipped quality to cigarette papers, many manufacturers use pure white ozokerite. This treatment is not very objectionable to the smoker, as ozokerite is insoluble in water. If the amber-tipped portion of the paper, however, is allowed to burn, its highly inflammable nature is very noteworthy. It is no uncommon thing to use paraffin. A composition introduced to give an amber-tipped quality to cigarette papers is three ounces of shellac dissolved in a gill of spirits of wine or methylated spirit, and the consistency of thickness may be regulated by adding more or less shellac, as found desirable. Another method is the following: 48 parts by weight of shellac (to be melted at a gentle heat), 12 parts of Venice turpentine, and 1 part of balsam of Peru. Incorporate the ingredients together with one addition of, say, about 36 parts of the best vermilion, or an equivalent proportion of other suitable colouring matter.—F. G.

III.—QUESTIONS SUBMITTED TO READERS.

*** *The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Carving.—C. M. S. (*Aldington*) writes:—"Can any correspondent tell me how to clean carving in white wood which has got dirty during the process? It does not do to use water, which raises the grain."

Loco. Work.—CORKSCREW writes:—"Will any reader of WORK kindly describe, with sketch, a ringing punch? It is used in loco. work about and behind the smoke-box end. Please state its object and use."

Wood Filling.—A. P. M. A. (*Streatham*) writes:—"Could any reader tell me of some putty or cement for filling cracks in wood, as I find the putty cracks and falls off?"

Ambulance Station.—ST. JOHN writes:—"Will some reader kindly give me a design for ambulance station and head-quarters, also superintendent's house? The head-quarters and station are intended for a corps consisting of fifty members. They must comprise lecture-room, to accommodate an audience of one hundred persons, ambulance-room, small committee-room, ambulance instruction room, to accommodate thirty pupils, library, cloak-room, w. c., and extra room. The superintendent's house must have kitchen, sitting-room, two bed-rooms, bath-room, and w. c."

Pitch.—J. J. (*Barrow-in-Furness*) writes:—"I should be glad if some kind reader could give me the recipe for making the pitch used by repoussé workers."

Gun Models.—ANXIOUS GUNNER writes:—"At the Naval Exhibition last year at London, I saw two guns which visitors were firing from at some moving ships in Armstrong and Mitchell's shed. I should like to make a model of the largest gun. Could any kind reader give me the sizes, or information as to where I could get any paper or book with them in?"

Wood.—WALNUT asks for an address where American walnut, suitable for making furniture, can be obtained.

Oleographs.—WALNUT writes:—"Will any reader tell me where oleographs of the Ramsgate lifeboat (the *Bradford*) could be obtained?"

Guitar.—A. T. (*Bollington*) writes:—"Will J. G. W., or any other kind person, give me the rough outlines of a guitar, the stringing of the same, the dimensions, etc.; and also please say whether it can be made best in a mould, as recommended for the zither?"

Refreshment-Room Sideboard.—A. B. D. (*South Shields*) writes:—"Can any reader of WORK oblige me with a good design for a sideboard for refreshment room; either in pitch-pine or to stain and varnish would do—about 8 ft. high, and about 10 or 12 ft. long? Also some idea of cost of same."

Soft Soap.—D. A. L. (*Bacup*) writes:—"Will any reader kindly inform me, through WORK, how to make common soft soap for cleaning purposes?"

Hoop Staves.—HOOPMAKER writes:—"Will any reader kindly inform me where *cast steel hoop* staves are *manufactured*, as used by hoopmakers?"

Fretwork Market.—W. P. (*Dartford*).—Advertise your articles, with prices, in WORK.

Towel-Horse Rails.—ANXIOUS writes:—"Will someone kindly tell me how hardwood towel-horse rails are most easily and quickly turned—some quick and cheap method?"

Cricket Bats.—L. M. (*Roscrea*) writes:—"I should be very glad of any information about making cricket bats, kind of wood, method of splicing, and where the materials can be obtained."—[A comprehensive article upon this subject would also be entertained.—ED.]

Sash Beads.—H. F. (*Ramsbury*) writes:—"Can anyone give me rules for cutting beads round pivot sash to enable same to work properly, but still to fit close when sash is closed? At present I have to keep cutting each joint until satisfactory results are obtained."

IV.—QUESTION ANSWERED BY A CORRESPONDENT.

Pinhole Photography.—ST. MUNGO writes, in reply to H. A. H. (*Tunbridge*) (see No. 164, page 126):—"Any camera will do, provided it is light-tight. The exposure is longer than with a lens. With an aperture of $\frac{1}{70}$ of an inch the exposure should be 5, 7, 10, 13, 16, 20 seconds at 2, $2\frac{1}{4}$, $2\frac{1}{2}$, $3\frac{1}{2}$, $3\frac{1}{2}$, and 4 in. focal distance respectively; but the best result will be got when the pinhole is about $\frac{1}{100}$ of the focal distance. No image is seen on the screen, and the shorter the focal distance the wider the angle of view."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—F. S. (*Exeter*); H. O. (*Thurso*); T. D. (*Newcastle-on-Tyne*); F. C. B. (*Glasgow*); NATURALIST; G. H. S. (*Stockton*); AMATEUR; W. R. (*Sturminster-Newton*); F. S. (*Old Swindon*); T. W. S. (*Hyde*); J. E. (*Aberdeenshire*); D. R. (*Dennistown*); NOVICE; M. E. F. (*Stockton-on-Tees*); W. C. (*Rawdon*); THE UNIVERSAL AMATEUR; W. S. (*Appleby*); T. P. (*Bristol*); F. J. K. (*Tufnell Park*); D. J. G. (*Holyhead*); W. E. W. (*Wimbledon*); S. R. (*Welworth*).

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No Essay to exceed more than two pages of WORK in extent, including any diagrams that may be necessary to elucidate the text.

In the work of judging regard will be had to original suggestions of value affecting the improvement of bicycles and tricycles, especially where such improvements are shown by diagrams.

All Prize Essays and Drawings to be published, if desired by the Editor, in WORK, but the copyright thereof to remain with the authors.

Copies of MSS. and Drawings to be retained by the competitors, as in no case can the return of MSS. be undertaken.

The Editor of WORK will supervise the judging of the Essays, and the selection as determined upon is to be final.

All manuscripts intended for the Cycle Essay Competition must be addressed to the Editor of WORK, c/o Cassell & Co., Ld., Ludgate Hill, London, E.C. They must reach him not later than Saturday, June 25, endorsed, "WORK Cycle Essay Competition."

NOTICE TO READERS.

Next Week's issue (No. 172) will contain the announcement of the SECOND "WORK" PRIZE COMPETITION *subject; also, among others, the following important papers:* HOW TO MAKE A CHEAP ICE CHEST; IDEAS IN GREENHOUSE BLINDS; HOW TO COPY GLASS POSITIVES; THE WAY TO MAKE CHEAP BLOWPIPES.

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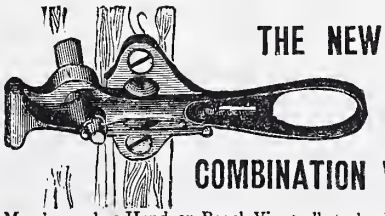

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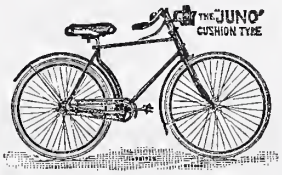

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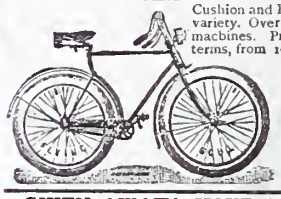

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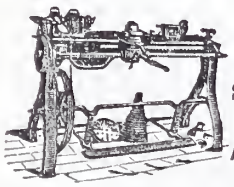

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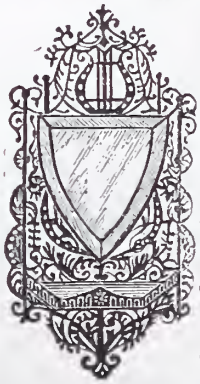

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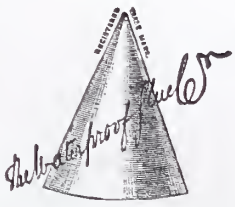

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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VOL. IV.—No. 172.] SATURDAY, JULY 2, 1892. [PRICE ONE PENNY.

WORK WORLD.

THE French postal authorities are adopting the bicycle for collecting late-fee letters and conveying them to the stations. Where are the British authorities?

* *

An alloy of gold and aluminium has recently been made. Its colour is a most beautiful purple, and it will be valuable in making jewellery.

* *

A tricycle, driven solely by electricity, has also an electric lamp and bell. The inventor travels with it at the rate of four miles an hour, but says it will travel much faster.

* *

It is fairly well known that German husbands wear a wedding ring as well as their wives. Now a London jeweller has introduced a wedding ring for husbands. Whether Englishmen will be content to go about labelled in this way remains to be seen!

* *

Electricity is being used in tempering springs of coiled steel wire. A current of 23 ampères at 45 volts' tension is passed through the spring, and when its temperature has reached the required degree, the current is broken and the spring falls into a trough of water. One man can temper 2,400 springs per day by this method.

* *

An illuminating gas made by mixing carburetted hydrogen or other gas with atmospheric air is thought of. Some private demonstrations of the utility of this mixture have given satisfaction. This mixed gas is stated to admit of being stored for distribution, and to be cheaper than ordinary coal gas.

* *

A new rail coupling-bolt lock-nut is simply a thin metal nut of an escutcheon form. Now, suppose it screws home to the bolt-nut, in a position so that its gravity would unlock it. Take it off and reverse it, and the thread is so cut in relation to the face-bearing as to make it stand out horizontally—so as to gravitate by any jar—to lock the bolt-nut. The English waggon builders used it a century ago.

* *

As a step towards the abatement of the smoke nuisance, a process is nearly in working order which consists in conveying smoke into a chamber where it is well washed with water spray. This causes every particle of soot to be deposited, and at the same time condenses and recovers the ammonia and sulphurous fumes as sulphate of ammonia. The extra cost of this process is more than counterbalanced by the price obtained for the sulphate of ammonia. Londoners, note!

* *

A turner when turning a job that has to be tapered, may be called upon to take out that job for a short time, and bore out a bearing to be parallel. In order that he may save time, he can do this without shifting his headstock, by turning out the front part of the hole to the finished size. Then placing his lathe tool upside down and cutting from the further side of the lathe, he can get a parallel hole. When this is done he returns to his tapered job as before.

* *

A new use for fibre is found in applying it to the manufacture of steam pipes. The texture of the finished pipe is hardened by very heavy hydraulic pressure, and it is claimed that this treatment renders it practically as strong as steel, while it remains comparatively light. It will neither swell nor shrink, rot, or rust. It is a non-conductor of heat, and in its compressed state sufficiently incombustible to render it safe as a material for steam pipes.

* *

Glass-lined tubing can now be obtained in all forms: straight, bends, elbows, and crosses. The internal glass tubing is protected by either cast or wrought iron external tubing, with cement run in to bed the glass solidly. These pipes are made with butt, flanged, and socket joints. Washers of gutta-percha or other suitable material are used to seal the joints. The great advantage of using these pipes for chemicals and other liquids which attack metal is obvious.

Very often engineers wish to fill up unsightly blow-holes in castings in places where these holes do not affect the strength. If lead is poured into them, the lead, when cooling, contracts, and is, therefore, smaller than the hole when cold, and will shake about. What is required is a metal that will expand when cooling, and fill up the cavity tightly. If 9 parts of lead, 1 part of bismuth, and 1 of antimony are used, this alloy will have the desired effect.

* *

A considerable amount of economy is claimed for solidified petroleum. Some recent experiments have proved that 80 gallons of water in a six horse-power tubular boiler can be heated, and steam raised, to 60 lb. pressure per square inch, by 62 lb. of the fuel, in 36¼ minutes, whereas it required 106 lb. of coal and wood to raise steam to the same pressure in one hour. If more extended trials bear out the results now recorded, petroleum fuel should have a prosperous future before it. The property of raising steam rapidly will give it a high value for steam fire engines.

* *

A new lubricator — fibre-graphite — is coming into general use for journal bearings. It is composed of hardwood fibre and graphite. The fibre is reduced to a pulp, graphite is added in a powdered state, and the mixture is subjected to hydraulic pressure in an iron box with several very small holes in the bottom. Water is added before pressure is applied, and, being forced through the holes, in its escape causes the wood fibre to take a perpendicular position. As the fibre prevents the graphite from escaping, the latter is compressed between the fibres which are thus coated with plumbago, and the result is a dense mass of fibre-graphite. When taken from the mould the material is in a finished condition, and has a very smooth, satiny appearance. It is then dried in the air, thoroughly saturated with purified linseed oil, and baked in an oven. It is then ready for use. The wood-fibre, in taking a perpendicular position, presents the ends of the fibres to the shaft, thus reducing the wear on the journal. In the form of a journal bearing, fibre-graphite is a solid lubricant, plumbago being one of the best lubricators known. The first few turns of the shaft in a fibre-graphite journal fill the pores of the steel, and also give the shaft a very thin coating of the new material.

AN EVERY-HOME ICE CHEST OR REFRIGERATOR.

BY ONE WHO HAS MADE IT.

Introduction.—The object of this article is to describe a very easily made and inexpensive refrigerator, which embraces nearly all the latest and best principles of preservation of perishable goods, with a minimum of outlay for ice.

The air of a good refrigerator must be *dry* and *pure*, as well as *cold;* for dampness and varying temperature are principally the causes of decay in meats and fruits.

The objection there is to be found in the so-called "ventilated refrigerators"—where fresh, warm air is admitted from the outside and discharged again just when it has become cold — is that it is this *warm* air that contains the moisture and germs that are so detrimental to the preservation of food, and the process of continually cooling *fresh* warm air consumes a much larger amount of ice than simply cooling the air originally confined in the refrigerator when the door is closed from time to time.

Description.—Fig. 1 is a front elevation. Fig. 2, sectional plan through A A, showing the method of construction, with the ice basket, A, gutters, B, and the zinc-lined shelf on which the ice basket stands. Fig. 3, sectional elevation through C C, showing the circulation of the air in the direction of the arrows. The air in the ice chamber in contact with the cold zinc and ice falls to the bottom, as shown by the arrows, condensing in the ice chamber, which condensation is caught by the drip, shelf, and gutters, and so conducted to the trap, D, and then falls into a receptacle placed for it on the floor under the trap. The cold air, in passing down the trough or space between the false back and the outside, is kept cold by the ice water and condensation continually running along the gutters, and enters the food cupboard at the bottom, passes through the cupboard and around all its contents, and rises to take the place of colder air in the ice chamber; and so on continually, as long as the door of the refrigerator is shut and the ice lasts, it being a well-known fact that cold descends and warmth ascends. Fig. 4, sectional plan, showing slatted shelving and method of constructing door. Fig. 5, perspective view of framework, on which matchlining is nailed. Fig. 6, sectional elevation, through D D, of inside of back, showing direction of gutters.

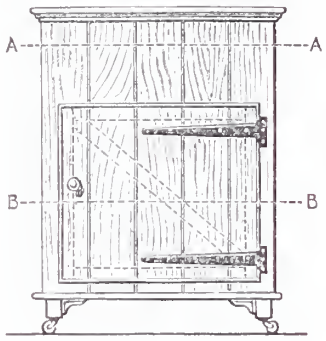


Fig. 1.

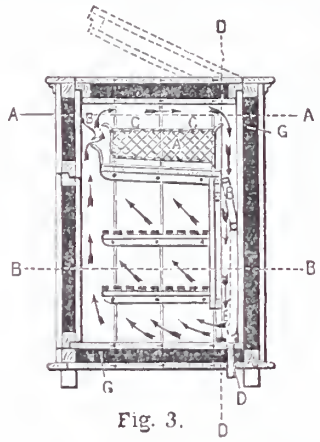


Fig. 3.

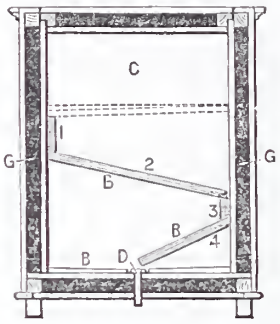


Fig. 6.

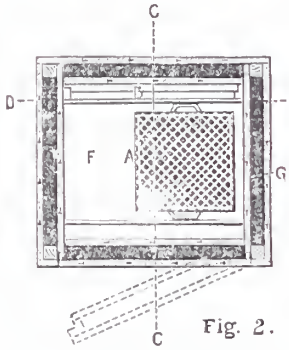


Fig. 2.

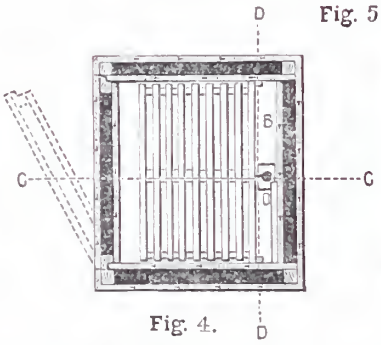
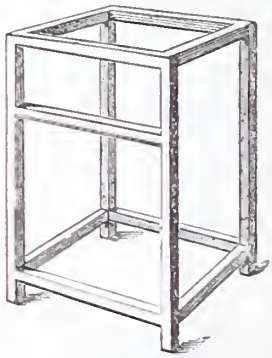


Fig. 4.

Fig. 5.



Ice Chest or Refrigerator. Fig. 1.—Elevation. Fig. 2.—Plan, A A. Fig. 3.—Section, C C. Fig. 4.—Plan, B B. Fig. 5.—Framework. Fig. 6.—Section, D D. A, Ice Basket; B, Gutters, Drips, etc.; C, Ice or Condensing Chamber; D, Trap to prevent Air getting into Cold Air Trough or Flue and so spoiling Circulation; E, Galvanised Iron Grating to prevent Plates being pushed into Cold Air Flue; F, Space for Water-Cooler, etc.; G, Slag Wool, Charcoal, or other non-conducting Packing.

In order to make the refrigerator as cheap and simple in construction as possible, I do not cover the inside with zinc at all, except the shelf on which the ice cage, A (Figs. 2 and 3), stands, and the little gutters and drips, B B (Figs. 2, 3, 4, and 6). It would certainly be better to cover the underside of the lid—in fact, the whole of the condensing or ice chamber—with zinc; but if the woodwork is well varnished and the gutters and drips screwed tightly to it with brass screws, it is hardly necessary; but on no account should the food cupboard be lined with zinc, because of the condensation of the warm air on the cold metallic surface of zinc rendering the cupboard damp, etc., and this is what it is so necessary to avoid. In a great many refrigerators this zinc lining is simply nailed on to the battens, with very little, if any, space between the outside and the zinc, and with no non-conducting packing between, and, like charity, covers a multitude of imperfections.

Making.—First make the framework as shown (Fig. 5), with 2 in. by 2 in. yellow; this need not be planed, and, as the construction of all these and other various joints have been described so often, I will not stop to describe them. They, of course, would be better properly framed, or mortised and tenoned, but if they are *halved* they will serve every purpose, as the matchlining holds everything together. The inside should next be lined with $\frac{3}{4}$ in. yellow matchlining, letting the end boards of the sides run by the uprights, and nailed to them, cutting the boards that form the door-stops to the centre of the front uprights. The tops of the boards for the sides should be cut nice and square, and finish exactly in the centre of the top rail of the frame (Figs. 3 and 6).

The bottom should be nailed to the bottom rails first, keeping the front to the centre of the front rail to form stop to door (Fig. 3). On the bottom, between the uprights, battens should be nailed to receive the ends of sides.

Now screw the bearers on to receive the solid shelf (Fig. 3), and the battens to receive the false back. Fit in the solid shelf, allowing it 3 in. narrow, back and front, for circulation of air. This shelf can also be made of $\frac{3}{4}$ in. yellow matchlining. Make the false back, with battens behind, and fit it into its place, allowing about $3\frac{1}{2}$ in. space at the bottom for galvanised iron grating. By keeping the bottom batten $\frac{1}{2}$ in. below the bottom edge of the matchlined false back, it will form a rebate for the grating later on.

The false back should now be stood on one side, and if it is intended to line the back and sides of air-shaft with zinc, you should now do so. Put sloping pieces of wood on the bottom to form drip to lead water into the trap at D (Figs. 3, 4, and 6); these sloping pieces should be lined with zinc and connected to trap (an ordinary small brass bell trap will do), and turned up 3 in. at the back and two ends (the front need only be turned up about $\frac{1}{2}$ in.), and the thickness of these drips form the bottom rebate for the iron grating. Next line the shelf with zinc, and secure a small piece of zinc guttering on the back edge of the shelf, giving it a slight fall from right to left for the shelf to drain into; turn the zinc of the shelf up 3 in. all round, except the back edge that drains into the gutter. The two sides of the ice chamber, if decided to be covered with zinc, should have the zinc closely screwed to them along the top edge; if you decide not to line the chamber with zinc, closely screw the turned-up edges of the shelf lining to the sides. The drip, B (Fig. 3), should be screwed along the top edge, and then bent so as to deliver over the back turned-up edge of the shelf, but about 3 in. above it. The small guttering—which, by the way, can be bought at any zinc-worker's—should now be screwed or soldered on to the ends and back as shown at Fig. 6—the short piece, marked 1, arranged with a stop-end on the right-hand end to take the water from the gutter running along the edge of shelf, and delivering into the stopped end of that marked 2, which in its turn delivers into the stopped end of No. 3, and No. 3 into No. 4, and No. 4 into the trap. It might be advantageous, and pay in the long run, to take the carcase in its present state—that is, when it is ready for the zinc—to a zinc-worker's, and get him to do the lining and fixing of the

gutters. Very thin zinc will do. He could cut you the piece of zinc for lining the underside of the lid, which could be readily screwed on when the lid was made.

Now procure some charcoal or slag wool, and tightly pack the spaces between the framework and proceed to nail the sides on, one side at a time.

The sides would look and be much better if a staff bead were worked up the four external corners, and the angles tongued and grooved together. The sides and door could also be framed with panels and moulded, if desired; but this, of course, must be decided by the maker. What I am endeavouring to explain is how to make the thing easily and cheaply.

The doors are simply made of the same material as the frame, but rebated on the outside to form stops, and the matchlining nailed on inside and out and packed with the non-conducting material. If the rebating presents any difficulty, make the edges perfectly square, less the thickness of the inside matchlining all round, and nail fillets or beads around to form stops.

To hang the door and lid, put them into position, seeing there is sufficient space all round, and keep them away from the body of the case with small wedges driven lightly into the joints, and screw on ordinary cross-garnets; take out the wedges, and the doors are hung.

Next screw the false back into its place; and, as there is very little chance of any drippings or condensation getting on to this, it need not be lined with zinc, even if the rest of the air-flue is.

The galvanised iron grating, or a piece of perforated zinc, may now be secured under the false back, as shown at E (Fig. 3). Now screw on the bearers for the slatted shelves; these shelves are so simple that I shall not attempt to describe them.

The next thing is to nail the nosings round the top and bottom and put the fastenings on the doors (a simple knob and button will do for this), and screw on the castors, if required. The only thing that now remains is the ice basket, and this, I think, I should buy. Any wire basket will do that will go into the space. The whole of the inside, except that portion covered with zinc, should have two coats of hard oak varnish. The outside can be either stained or grained, or left in plain colour; but, whichever way you finish it, it should be varnished.

Cost.

	£	s.	d.
Say, 60 ft. 2 in. by 2 in. yellow, at 1d. per foot	0	5	0
1 square of ¾ in. yellow matchlining	0	11	0
Zinc guttering and lining—1 sheet..	0	5	0
2 pairs cross-garnets at 1s.	0	2	0
Non-conducting packing	0	5	0
Wire basket	0	2	6
1 bell trap	0	1	4
Fastenings for doors	0	0	9
Jury-grating (galvanised)	0	1	6
4 strong castors	0	3	0
Nails, screws, etc., and paint and varnish	0	5	6
	2	2	7

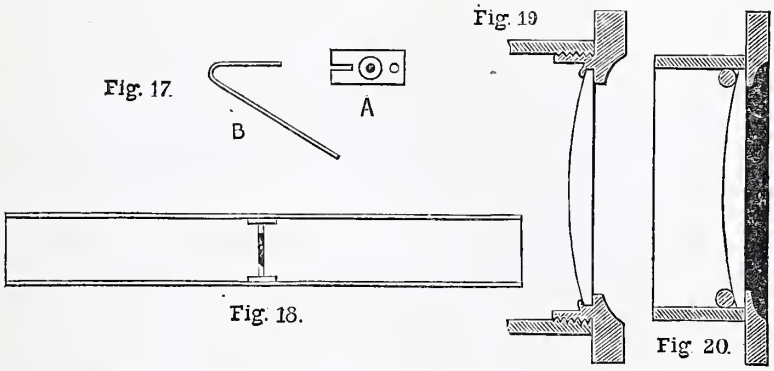
This cost is the most you would have to give for the materials in any part of the country; in most places I think they could be got for less. Food should be kept fresh and wholesome, and such a chest as described would often repay itself in warm weather by saving a doctor's bill.

HOW TO MAKE AND WORK THE SPECTROSCOPE.

BY CHARLES A. PARKER.

Fitting Springs and Regulating Screw to Hood—Adaptation of Clock-spring Barrel for Collimator Hood—Preparation of Collimator Body Tube—Attaching Collimator Hood to Body Tube by Bayonet Catch—Preparation of Cell for Object Lens.

Having already shown the mode of attaching the jaws to the cover of the collimator hood, it behoves us to turn our attention to the preparation of the two springs and milled screw by which the width of the slit is regulated. These springs, which are intended to act upon the extreme corners of the jaws and force them into close contact when shut, have already been illustrated in Fig. 12 (page 151), but the component parts are again shown at A and B in Fig. 17. For each of these springs file up a small block of brass to the size and form of A, Fig. 17, which measures ⅜ in. long and ¼ in. wide by ⅛ in. thick, and when ready drill a hole through the middle of the block and afterwards slit one end of the brass nearly through to the central hole in order to receive a 1 in. length of steel watch spring, B, Fig. 17.



The Spectroscope. Fig. 17.—Spring for Jaws of Slit. Fig. 18.—Section of Collimator Tube. Fig. 19.—Section of Cell for Object Lens. Fig. 20.—Simple Form of Cell for Object Lens.

The spring should be made quite soft in a gas or spirit flame, and then bent to the required form whilst at a red heat, after which it is hammered tightly into the slit portion of the brass block previously made. Thus prepared, the two springs are attached to the discs in the position indicated in Fig. 12 by means of small screws driven into suitable holes drilled and tapped for their reception in the brass disc. As an additional precaution against the possibility of the springs shifting at any time, it will be found advisable to drill a hole close to the screw and fit a small steady pin to each spring.

Before going further it will be necessary to turn to the collimator hood and provide this with a milled screw by which the width of the slit may be adjusted. For this purpose we shall require a milled screw and nut similar to the one shown in Fig. 13 (to be obtained from Messrs. Platt and Witte).

To attach it to the collimator hood, remove the nut from the screw, and then soft-solder this over a hole of suitable size drilled through the side of the collimator hood quite close against the open end of the latter, as will be seen by reference to the illustrations, after which the screw may be screwed into position in order to be certain that it acts with perfect freedom.

In order to complete the collimator hood, a 1⅜ in. hole should be cut through the bottom of it, into which a ½ in. ring of drawn brass tubing (previously trued up in a lathe) is fitted, and then soft-soldered, any solder escaping outside being afterwards cleaned off by an old file, followed up with a piece of emery-cloth wrapped round a strip of wood.

As before stated, the collimator hood can be made from the spring barrel of a disused musical box or clock, which would be found to answer admirably for the purpose without any alteration. A barrel of this description can generally be had for a few pence from a watch and clock maker in any large town.

In the event of a barrel of this class being employed, it should not measure less than 2¼ in. in diameter by 1¼ in. in thickness. If it is a musical-box barrel, it must be mounted in a lathe for all the teeth to be cleared off, and it will also be necessary to soft-solder a ½ in. ring of 1⅜ in. drawn brass tubing into a hole cut for its reception in the bottom of the barrel, in order to form the collar by which it is fitted to the collimator tube, not forgetting the attachment of the regulating screw. The remaining operation of attaching the jaws to the outer cover or cap is also executed in precisely the same manner as I have previously described, and therefore calls for nothing more than a passing mention here.

The collimator hood being by this time completed, may now be placed aside for a short time while the collimator tube is being prepared. This is shown in section in Fig. 18. For this we shall require a 10¾ in. length of moderately stout drawn brass tubing 1½ in. in diameter, which should be trued up at both ends in a lathe, and then provided with a suitable stop. To make this, prepare a ½ in. ring of tubing which will just fit into the tube, and then cut a ¾ in. hole in a small disc of brass, and afterwards reduce this in size to a suitable diameter to allow it to be tightly fitted into the ring just prepared, thus forming a suitable stop which may be pushed into the collimator tube, and fixed in the centre of the latter by means of a small quantity of soft solder run round the ring. The next proceeding will be to make suitable provision for the attachment of the collimator hood to one end of the tubing, and afterwards provide a cell to contain the lens which fits on to the other end of the tube. The former can be readily fitted into the tube by means of a bayonet joint made in the following manner:—At one end of the 10¾ in. tube just trued up, drill a couple of small holes on opposite sides to each other and ¼ in. distant from the outer edge of the metal, and then fit the collimator box on to the end of the tube by means of the projecting collar. Now insert a sharp point through the holes just drilled, and make a couple of marks on opposite sides of the collar while it is in the tube in order to indicate the position of the two holes. This done, remove the collimator hood, and by means of a small square file proceed to cut a couple of L-shaped slots through the sides of the collar, the punch marks serving to indicate the position of the short arm of the slot, which, by the way, should be of

sufficient width to take a pin of stout brass wire (about No. 10, B. W. G.).

Now insert a pin of the above wire in each hole of the tube with about $\frac{1}{8}$ in. projecting inside, and then cut it off flush with the surface on the outside, and rivet securely. If necessary, the wire may be fixed to the tube by means of a touch of soft solder, but in the ordinary way this will not be needed. It will obviate any annoying mistake if only one bayonet slot is filed first and then filled with its respective pin, as it will then be an easy matter to fit the remaining pin with the greatest degree of accuracy.

If preferred, a screw thread may be chased on the collar of the collimator hood, and a corresponding thread on the inside of the tube, but at the same time it must be said that the above plan of a bayonet catch is much more simple to make and quite as satisfactory in use. When it is desired to attach the hood to the tube, it is simply necessary to insert it in the body tube with the pin passing through the longer arm of the L-shaped slot, when a slight turn will cause the pin to pass into the shorter arm and thus secure it in position.

Next in order comes the cell to contain the collimating lens, which, by the way, should be a $1\frac{1}{4}$ in. plano-convex lens of 12 in. focus. The cell, which is shown in section in Figs. 19 and 20, should have a $1\frac{1}{8}$ in. clear aperture, and may be cast from a suitable pattern, and then turned up quite true in a lathe with a seat of just sufficient diameter to take the lens. In preparing the bed to receive the lens, it will be necessary to turn the upper edges of the seating as thin as possible, with only just $\frac{1}{32}$ in. projecting above the lens, so that it will be a simple matter to burnish the edge of the metal over the lens, and thus secure it in position.

It will require some amount of skill to accurately prepare the seating for the lens in the manner above described, and as it is a rather difficult undertaking for an inexperienced amateur, it may be advisable to describe a more simple plan of making this cell, which is shown in Fig. 20, and will doubtless be preferred by some of our readers.

From a piece of stout sheet brass cut a circular disc $1\frac{3}{4}$ in. diameter; then find the exact centre by means of a pair of compasses, and strike out a $1\frac{1}{8}$ in. circle, which is afterwards cut in a lathe with a countersunk edge. Now procure a bit of tubing which will tightly fit into the end of the collimator tube, and having cut off a $\frac{1}{2}$ in. ring of this, true up both ends in a lathe, and then soft-solder the ring on to the disc just prepared, being particular to see that it is correctly centred.

In order to ensure this, it will be found advisable to mark a circle on the disc just a trifle larger than the diameter of the collimator tube before cutting the central opening. It is almost needless to say the countersunk side of the disc should be on the outside. If any difficulty should be experienced in obtaining a piece of tubing which will tightly fit into the collimator tube, it will be necessary to obtain the next size larger, and then slightly reduce the diameter of the tube by turning it in a lathe or by the judicious use of a file. When the cell is ready, the lens may be dropped in it plane side downwards, being retained in position by means of a ring of brass wire which is sprung into the cell and pushed firmly against the lens. Assuming that the cell has been properly fitted to the collimator tube it will remain in position quite secure without requiring the additional aid of a bayonet joint. The observing telescope will receive description and illustrations in the next article.

BENT IRON WORK, AND HOW TO DO IT.

BY J. H.

Candlesticks.

Bracket Candlestick—Back of Ditto—Candle-Holder—Table Candlestick—Details—Candle-Holder—Table Candlesticks—Bedroom Candlestick.

Candlesticks are not used so much nowadays as formerly; but they are retained for bedroom service; and as they can be made very prettily in bent iron, I propose to illustrate a few forms.

Bracket Candlestick.—Fig. 22 illustrates a bracket candlestick, suitable for screwing-up against the bed's head for reading by. The main framework, A and B, is made of iron rod, $\frac{1}{4}$ in. square in section; the remainder is of thin strips, $\frac{1}{4}$ in. wide. After having drawn out the entire bracket to the size selected as being most suitable and convenient, measure round the curves of A with a bit of string or wire, in order to get the length of rod required. Cut it off and heat one of the portions marked *a a′* to a white heat. Hold the bar at *b* or *b′* with tongs or pincers, and with another pair of tongs turn the bar round and round, and so form the twist, *a*. Repeat this operation at the other section, *a′*. Heat the parts *c*, *c*, for about 1 in. or $1\frac{1}{2}$ in. of length, one at a time, and upset them by striking the end of the bar upon a lump of iron, which will, of course, thicken or dump the metal up at the heated section. Flatten out the metal with the hammer in the width-way of the bar, thus giving it the appearance of Fig. 23, A. Now heat it again, and punch a hole in the centre (Fig. 23, B). The bar will next be bent to the scroll forms shown—*c′*, *c′*, in Fig. 22. It will be raised to a moderate red-heat and hammered gently around the beak of the anvil, or round any suitably curved surface of metal, or even bent with tongs. The bar will be tried from time to time upon the full-sized drawing, and its curves set and corrected with the hammer, until all flats and angularities are removed, and good flowing scrolls obtained.

Back of Candlestick.—The cross, B, is made thus:—Two strips are taken, each, say, 1 in. longer than the total distance, *d*, over the bosses, *e*, *e*. The ends of each are heated in succession to a white heat, and upset by hammering or by dumping down upon the face of a block of iron. They are then spread out sideways with the hammer, and thinned down until they are rudely of the form of the bosses, *e*, *e*, *e*, *e*. But the neat outlines of the latter will have to be imparted with the file. The screw-holes in the centres of *e* will be drilled and countersunk. The bars, B, will be welded at the centre, where they cross each other. They should be upset slightly, and then raised to the welding heat, and struck smartly while laid across each other at right angles, until their faces are flush on both sides. The metal spread out about the centre will be filed off neatly to form a little boss, in the centre of which a rivet-hole, *f*, will be punched or drilled. Through this the rivet, *g*, which unites the scroll, A, to the back, B, will be put. To prevent risk of the scroll turning round on the rivet, the latter must be made very fast, or the hole and the shank of the rivet be filed square, or a little solder run round it.

The bent iron work on the back, B, is made in four similar portions. The separate parts which compose one of the quatrefoils are shown distinctly separated in Fig. 24. There is, first, the central finial, *h*, bent round upon itself, and turned backwards at the ends, to be soldered or clamped to B. To *h* the flanking scrolls, *i*, *i*, and *k*, *k*, are pinched with clips; *k* and *k* are also secured to B adjacent with solder or with clips; *l*, *l*, are fastened to *k*, *k*, with clips, and they may also be further secured to B with solder or with clips.

On the scroll, A, midway between the twisted portions, *a* and *a′*, the ornament, *m*, is fastened. There may be four, six, or eight of these small scrolls arranged equidistantly around the bar, A. They relieve the otherwise naked appearance of the bar.

Candle-Holder.—Lastly, the actual candle-holder is made and fitted into the hole made at *c*. Fig. 25 shows this fitting enlarged in section and in plan. A pillaret, *n*, turned in brass, is fitted by riveting below to A at *c*, and above to the dish, *o*, also by riveting. This dish is made of thin sheet-iron, cut into a conventional floral dentition at the edges and beaten up into a dished or concave form. Upon this the actual holder, *p*, of tin or brass tubing, is secured by means of soft solder.

Table Candlestick.—Fig. 26 shows a candlestick suitable for standing upon a reading-table. There is a centre-pillar, *a*, of rod $\frac{1}{4}$ in. square, and four sets of scroll-work standing at right angles with each other. Three sets also will serve as well, and give less labour. The height of the candlestick may be from 10 in. to 14 in. It should be drawn out to any full size decided on, and the figure can be measured by scale for the purpose. The details of the work are as follows:—

Details.—Beginning at the base, two double scrolls, *b*, *c*, either of thin iron, $\frac{3}{8}$ in. or $\frac{1}{2}$ in. wide, or of that of stouter section, say $\frac{1}{16}$ in. thick—preferably the latter—are turned, and crossed at right angles. A hole $\frac{1}{8}$ in. or $\frac{3}{16}$ in. diameter is punched in the centre of each, and the bottom end of the pillar, *a*, is shouldered into it and riveted over (as at Fig. 27, A). All the rest of the work is of thin iron. There are three main scrolls, *d*, *e*, *f*, in each series. There are also the minor scrolls, *g*, *h*, *j*, *k*, and also the tendril, *l*. These parts separated are seen distinctly in Fig. 27, B; and the positions of the clips are indicated by single crosses. The locations where the curves are mutually clamped to the central rod and base are indicated by double crosses. The tendrils, *l*, are fastened only at *m*, being clamped between *d* and *e*. Beyond that, they simply lie around the curves of *d*.

Candle-Holder.—The dish, *n*, is cut from thin sheet-iron, and is fastened to *a* by riveting *a* through a hole in the centre of *n*. The candle-socket, *o*, made of tin or brass tube, is soldered upon *n*.

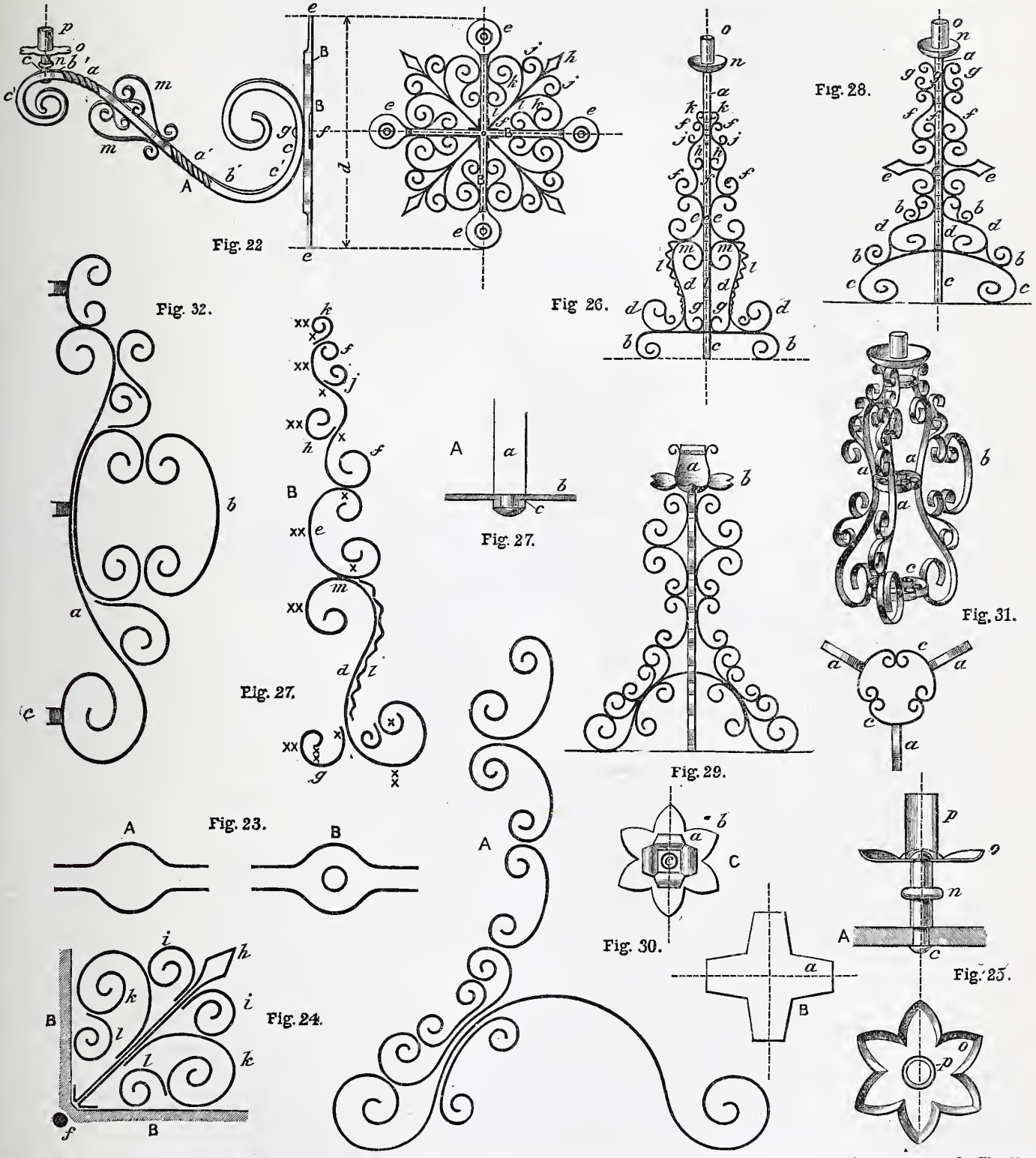
Table Candlestick.—Fig. 28 illustrates a candlestick of an alternative design, but of the same general type as the last. As before, there is a central bar, *a*, riveted at bottom to the scrolled feet, *c*, and at the top to the dish, *n*, which holds the candle-socket, *o*. The feet, *c*, should be of stout section, the remainder of thin strips. The scrolls, *d*, *e*, *f*, *g*, are clipped at their points of contact with each other, and also to the central pillar, *a*; and *b*, *b*, are minor scrolls.

Table Candlestick.—Fig. 29 shows another

alternative design, constructed similarly to the previous ones, but with different dispositions of the scroll-work. The various scrolls in a single series are shown separated

the shape shown at B; *a* is the sheet, shown again at C, and seen also in Fig. 29, *a*, to be bent upwards on the four sides, and curled back again slightly at the top. This is

handle, *b*. In this there is no central pillar: three legs, *a*, provide the necessary support. The legs should be made of iron strips, $\frac{1}{16}$ in. thick; the remaining curves of



Bent Iron Work. Fig. 22.—Bracket Candlestick. Fig. 23.—Formation of Bosses. Fig. 24.—Detail of Scroll-work with Parts shown separated. Fig. 25.—Detail of Candle-Holder. Fig. 26.—Table Candlestick. Fig. 27.—A, Fastening of Base to Pillar; B, Detail of Scrolls. Fig. 28.—Table Candlestick. Fig. 29.—Table Candlestick. Fig. 30.—Details of Scroll-work with Parts separated. Fig. 31.—Bedroom Candlestick. Fig. 32.—Detail showing Parts separated.

in Fig. 30, A, and the remarks already offered in reference to fastenings will also apply to this example, so that I need not repeat them. The socket of the candlestick is formed differently from those in the previous examples. It is shown in detail in Fig. 30, B, C. It is cut from a bit of sheet-metal to

soldered on to the rosette, *b*, also formed of sheet-metal, and riveted to the central pillar of the candlestick. The head of the rivet is shown at *c* in Fig. 30.

Bedroom Candlestick.—One more example (Fig. 31), and I have done. It is that of a bedroom candlestick, provided with a

the thin strips. The disposition of the scroll-work is quite clear from the figures. There is only one handle, *b*. The legs are prevented from spreading, and kept steady by means of a top ring, and two rings of double curves. The lower series, *c*, is shown in plan below. These curves are united to

each other with clips, and to the legs with crossing wire. Fig. 32 shows the detail of one leg—the one which carries the handle, *b*.

HOW TO COPY GLASS POSITIVES.

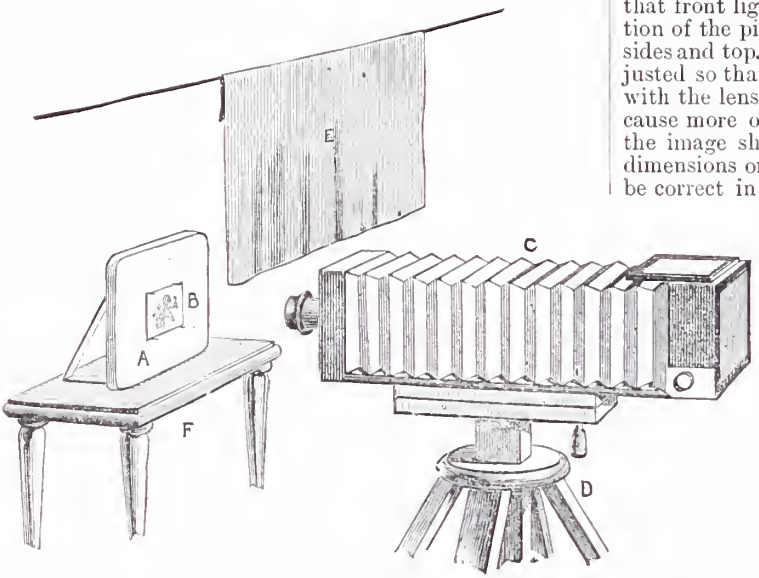
BY AN OLD HAND.

When the amateur has occasion to copy a glass positive he would probably like to know the best manner of doing it, and as the method differs in many particulars from that adopted in copying an engraving or picture of any other description, we purpose to point out where the differences lie, and the precautions to be adopted to secure a successful result.

Let us suppose the positive is in our hands, and we desire to make a copy the same size. Prior to setting to work, we must examine it carefully before deciding on our method of procedure, which will have to be varied according to circumstances. We first notice the state of preservation of the positive picture, and remedy defects as well as we can. The principal defects will probably consist of dirt and scratches, or it may be the portrait is broken in pieces; or, on the contrary, it may be a perfect example of positive work. Good glass positives are usually sent out unvarnished, backed with black velvet, a gilt mat and a piece of glass laid on them, and the whole bound together with a metal binding, technically called a "preserver." They are also frequently met with, especially in second-class work, varnished on the film side with white spirit varnish, and on the reverse with Bates' or some other black varnish, in lieu of black velvet. The metal mat will often be found to have damaged the film where its edges have come into contact with it; in such cases it is *generally* best to limit the amount of subject of the copy to the space exposed by the opening of the mat.

In the case of a good unvarnished picture, our first care is to remove it from its case, mat, and preserver, carefully removing any dust and dirt with a soft camel's-hair brush. Little else can be done or be found necessary to do to it previous to copying. If it happens that the varnish on the face is dirty, a moist rag may be used to remove the dirt; if black varnish has been applied to the back, and has become scratched, the best plan is to scrape it all off with a knife and re-black it, as patching up is apt to show on the face; but if applied on the film side, we must let it remain as it is, for any attempt to remove the black would inevitably spoil the picture. Turpentine or benzole would dissolve the asphaltum, but at the risk of staining lights of the image—probably somewhat yellow, from the varnish that has already been applied. When we examine a glass positive by *transmitted* light, as we do negatives, it has the appearance of a very under-exposed negative, little more than the high lights being visible. It is, in fact, an exceedingly *thin negative*, but with this difference: in an under-exposed one the details in the shadows are not absent, although almost invisible, by reason of their extreme tenuity. *Reflected* light, on the contrary, shows up every detail even in the darkest parts, and in the early days of photography beautifully made out detail was taken advantage of to convert a positive into a negative in order to multiply proofs. In ordinary collodion negative work, the image before drying frequently shows as a good positive on the back, although, after being dried, it loses its positive appearance, not again to be restored by remoistening, and becomes invisible, or nearly so, by reflected light. It is necessary to caution those who have only had experience with the tough leathery gelatine films that all collodion surfaces are *most easily* injured, and no greater friction than that of a soft brush, delicately applied, is permissible; unless, as before said, they have been varnished.

In the majority of cases very light plain backgrounds have been used, and it is almost impossible to touch out defects on them in the ordinary way that will not show objectionably in the copy. An excellent plan is to paint all over the defective background with a suitable tint of grey opaque water-colour. An excellent one is composed of Chinese or zinc white and lamp-black, a little hatching with a deeper colour grey near the lower part of the figure being often an advantage.



How to Copy Glass Positives. A, Bath Cork; B, Glass Positives kept in place by Four Pins; C, Camera with Shutter of Dark Slide drawn out; D, Stand; E, Black Cloth hung in Front to prevent Reflected Light; F, Table on which the Bath Cork is placed, supported with a strut at back, or heavy books may be utilised for this purpose.

Covering the background with opaque colour is very useful if the positive has been broken in pieces, as it perfectly hides the junction of the fractures, even if the film is broken away; of course, the damaged picture must have been previously cemented to another piece of glass—with Canada balsam by preference—and allowed to harden; the edges of the broken parts having been accurately adjusted to each other. When positives are mounted face outwards to the case, the portrait will be reversed; in the same manner, a face is seen in a mirror which, although conveying a better impression to the individual represented, does not do so to others. Some concession must be made to this method of mounting by reproducing the copy in the same position, looking to the right or left, as the case may be. This is important if the original of the portrait is dead, as the friends are so used to the appearance of the reversed picture that they would probably disapprove of any alteration. Therefore, when a picture is removed from its case it must be remembered in which position it was mounted in order to restore its original appearance.

Having done all we can to remedy defects, we proceed to make our copy by fixing the positive to an upright board—of a dark colour by preference—by means of four pins, one at each corner (a slab of Bath cork is one of the most useful appliances in existence to use in place of board for this and similar purposes), in a convenient position for copying. Glass being prone to cause ugly reflections, care must be taken that no light falls on it—that is, reflected into the lens—than that required to form the image. If the film side has to be copied, there is less chance of defects from this cause than with the bright surface of the glass; at any rate, front light is best wholly excluded by hanging up dark cloths in such a position that front light is cut off, and the illumination of the picture limited to light from the sides and top. The camera is now to be adjusted so that the positive is exactly *central* with the lens; any deviation from this will cause more or less distortion. As soon as the image shows squarely and of the right dimensions on the focussing screen, it will be correct in this respect, and all that remains is the focussing, which can be best effected by the aid of a magnifier, so that the image is seen absolutely sharp, a small stop being always used for the exposure, even if the focussing is done with a larger opening for the sake of more easily seeing the image. All being ready, a plate is inserted and the exposure made. With regard to the length of exposure, it is impossible to say anything definite, as it depends on the amount and colour of the light at the time, and the lens used. Slow or, at any rate, not very rapid plates are best for the purpose; those containing iodide, known by the yellowness of the film when examined by daylight, are to be preferred. Some operators prefer wet collodion plates for this work, but I believe their advantage is simply owing to the iodide and the comparative slowness with which they work when compared with the very rapid gelatine plates so often used, and that I have always found unsuitable for this kind of photography. "Ilford ordinary" plates give very good results, as also do Wratten's, London. Now comes the development. By preference, I use the pyro-ammonia, according to the formula issued by the Ilford Company, as subjoined:—

Pyrogallic acid, 2 grains; bromide of ammonium, 2½ grains; liquor ammonia, ·880°, 4½ minims; water, 1 ounce.

As a matter of convenience, it is best to keep 10 per cent. solutions made up, and use a proportionate quantity of each. The ammonia should be added gradually, as sometimes less than the normal quantity will be found sufficient, too large a proportion producing a flat image. The most usual defect in the copy of a positive is flatness, which may be the fault of the positive itself, or may be caused by improper development. The shadows in a copy should be clear and the lights not too dense,

but rather more so than in a portrait negative. A very little re-touching will be necessary, but a slight strengthening of the high lights may be an improvement. The printing of the negative differs in no way from that ordinarily adopted. To enlarge the positive, the process is precisely the same as far as precautions go; the difference is the distance between the lens and the picture and the lens and the plate, the first being less and the latter more than in reproducing the same size. The negative also should be a trifle thinner in the enlargement than in the same size copy, but in reductions the density of the negative is maintained. The diagram shows the arrangement for copying.

CARTON-PIERRE OR STONE PAPER.

BY GEORGE PARLAND.

Carton-pierre or paper stone is used for a great variety of decorative purpose—gallery fronts, sunlights, etc.—where strength and toughness are required. Thousands of hobbyists will be glad to learn how it is made.

Fill an ordinary washing boiler or copper half full of clean water, and into it put as much paper cuttings or scraps of old newspaper torn up as can be pressed under the water; then set the water boiling, and add two pounds of the best joiners' glue; keep it now well stirred up, and the paper will become a pulp and the glue dissolve.

Have ready two pounds of the best flour made into a paste with a quart of water; also, in a separate vessel, pour a quart of water, and sprinkle into it a handful of fine plaster-of-Paris. Let it stand ten minutes before mixing it.

When the paper in the copper has become a fine pulp (which can be seen by lifting some out on the end of a stick) add the flour paste, keeping the whole well stirred. Fifteen minutes after add the plaster, and a few minutes later rake out the fire from under the copper. Have ready three pailfuls of fine ground whiting; pour in one pail of whiting, and stir up well, adding more whiting till the stick used to stir it will stand of itself in the mixture. Let it cool, and it is ready for use.

Some firms add powdered alum in the boiling process, others add one pint of boiled linseed oil; but if made according to the above directions an excellent carton-pierre will be secured, and one that will give very fine impressions from the moulds.

If the mould from which a cast is wanted be a plaster piece, the pieces of the mould must be well dried, and have two or three coats of shellac varnish till the varnish shines out on the surface when dry. The mould must be oiled with sweet oil, and it is ready for the carton.

If it be a gelatine mould, oil the same with sweet oil, and slit with a sharp knife those portions that are deeply undercut. If the mould be in the form of a pinnacle or circular pendant undercut, slit one side only from top to bottom, and the casts will easily be got out.

In using the carton, sprinkle some fine plaster-of-Paris on a bench, and, taking a lump of the newly-made carton, mix it well with dry plaster, adding more plaster as bakers would add flour to their dough. Having worked it up well in this way until it will not stick to the fingers, with clean hands roll pieces very smooth in the palms or on a smooth level board, and press each roll into the cavities and hollows of the mould, often wetting the edges of the carton in the mould before adding a fresh piece to it. The casts must not be more than from $\frac{1}{8}$ in. to $\frac{1}{4}$ in. in thickness, except at the outside edges of the mould.

Large casts with perforations and casts with delicate points are strengthened with wire embedded in the carton. The places where the screw-holes are to be are protected by having wire twisted once or twice round a sprig-bit—just sufficient to allow the screw to pass through, but not the head.

If the mould has a flat top, fill the mould level with sawdust, well pressed down; place a board on the top, turn over the mould board as well, and remove the mould.

Should the top of the mould be concave or convex, a plaster case must be made, by first putting a thick layer of sawdust over the cast and covering it with paper, then a coating of plaster-of-Paris, making it strong enough to support the cast when the mould is removed.

The casts must stand about twenty-four hours, and then be baked in not more than 100 degrees of heat. They are then trimmed, sand-papered, and any crack or disfigurement made good with a little putty made of whiting and glue size. The whole is then finished by painting with two coats of clear whiting and size. In fixing them up they are screwed to the joists or woodwork, and puttied up.

Detached portions of carton can be quickly and firmly cemented together by notching the parts to be joined and coating them with hot glue. Put a layer of gilders' compo between, and squeeze the parts firmly together. Remove the superfluous compo, and brush it clean with hot water.

WORKERS' QUESTIONS: TRADES UNIONISM AND WAGES.

BY ECONOMICUS.

It is a vexed question whether trades unionism is or is not efficacious in raising workmen's wages. The more sober-minded amongst us consider that it is not, and that the sole extent to which it operates upon wages is to stave off for a while an inevitable fall of wages, and to secure more quickly a rise when wages are rising otherwise. Those that hold this view reason thus: When wages are falling an employer of union men hesitates to reduce his men's wages. There is the danger of a strike, as the reduction will affect all his men simultaneously, and so he puts off the unpleasant duty as long as he can, in the hope that perhaps the rate of wages may rally, and, at any rate, until the decline has become a well-established fact by others having put it into force. It is different when he can treat with his men as so many units when they are still in the non-union stage. He can give notice to one to-day, to another to-morrow, and so on, of his intentions as regards them alone. If these individual workmen do not like it, and prefer to lay down their tools, he is little, if any, incommoded.

It is thus very clear that unionism tends to keep up wages in a falling market. The converse of this is equally clear—viz., that unionists will secure the rise in wages sooner in a rising market. A workman may know that wages in his particular industry are rising, and he may make representations to this effect to his employer. The employer, however, dealing with only one man, can easily, if he be so minded, put him off. It is different again, however, when the representations come from a whole body of workmen. The employer is likely to hesitate again ere he puts them off. Thus, besides staving off the fall in wages in a falling market, unionism also secures a speedier rise in a rising market.

Does it do any more? Does it actually raise wages? There are those that hold that it does. There are no clear and satisfactory explanations given as to the way in which it does this. Those that believe in this view have, to all appearance, a good case to cite as an example. That case is the Bar, the members of which are formed into a very close union, and one of the most rigid rules of the union is that no barrister shall accept a smaller fee than one guinea. But for this rule, barristers will tell you that their fees would fall almost to nothing. There are so many members of this profession without briefs, who never have had a brief, and who never will have a brief, that they would accept employment on almost any terms. If the barrier prohibiting them from pleading for any fee they can get were withdrawn, there can be no doubt that the average fee for professional representation in a court of law would be nearer 5s. or 2s. 6d. than 21s. Here, then, we are told, is a clear case of unionism keeping up wages in the face of competition; and if unionism acts this way in one sphere of employment, why not in others?

In the first place, we question whether this rule of the barristers' union keeps fees up to the extent it is credited. No barrister was ever *known* to accept a smaller fee than 21s. But then, "there are more things," etc. A young Scotsman, now a thriving barrister and member of Parliament, after graduating at one of his native universities, came up to London, and was, in due course, called to the Bar at the Middle Temple. He used at first to attend the Old Bailey in his gown, so as to familiarise himself with court procedure. On one of these visits a stranger slipped half-a-guinea into his hand, and asked him to appear in some case. He could not accept the half-guinea, he said—a statement that astonished the stranger, who explained, "I know you took half-a-guinea from X, for he told me so!" It then transpired that the stranger had mistaken the young Scot for some other barrister, well enough known to-day, and whose services would be hard to get at a guinea now.

This story, which we have direct from the lips of one of the parties, shows that though barristers are not *known* to plead for less than a guinea, they nevertheless do so. Thus this very close union and this very rigid rule are not able to withstand the pressure of competition. It would, however, be obliterated altogether, but for one fact: that fact is that the unemployed barristers get food and other necessaries without briefs. In many cases they have private means, and can afford to wait until the guinea comes, and in other cases they flow over into other callings. They become journalists, coaches, something in the City, or whatever else they are able to become. If it were essential for the unemployed amongst barristers to get briefs ere they could get food, then the rule prescribing the *minimum* fee at a guinea would be as operative as Canute's command to the waves to retire. Moreover, they would not take low fees on the quiet, as illustrated by the foregoing story; on the contrary, each would underbid the other, and the one that offered the best bargain would get the most patronage.

It comes clearly to this, then—that though unionism delays a fall of wages, forces them up to their highest possible point, and accelerates a rise, there is yet some other force that determines them—a force that both employers and employed are subject to. This should be apparent to everyone; for if unions could fix wages, why do they not make demands for something substantial when they are about it? Why do they not pass resolutions that the lowest union rate of wages shall be £300 a year? No one would object to this or any larger sum being the lowest income in the country. Everyone, on the contrary, would rejoice that the reward of toil was sufficient to enable the toilers to live in comfort, and to make provision for their declining years.

As to the cause that really does fix wages, that has been often enough pointed out, though it seems to have little hold on the minds of those that write about strikes and offer advice to workmen. It must be easy enough for anyone to understand that if half a dozen men are after the same job, that a similar job will be done at a much lower wage than if half a dozen masters were each after one man to do it. When an employer has a great many men to pick and choose from, he naturally takes the one that he can get the most out of—that is, the one that will do the most work for the least wages. When, on the other hand, a workman has several masters after him, he naturally accepts the one that will give him the most wages. If, then, the demand for employment be keen—that is, if there are a great many men eagerly seeking work—wages will fall, in spite of union rules; and if the demand for workmen be keen, if employers are competing with one another to get men to work for them, then wages will rise. This is how wages are determined; we say nothing upon the point as to whether this is the best way to have them determined.

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NOTICE.

"WORK" COMPETITION COUPON

will be found on page 255.

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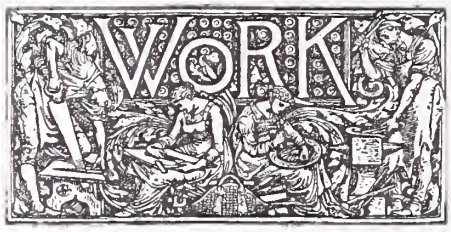

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PATENTS REVENUES.—It seems impossible that any enlightened community would descend to the extent to put money into the national pocket at the cost of the brains of its best life. Yet this is what England does through one of its most profitable departments—that dealing with Patents, Designs, and Trade Marks. Why struggling genius should be hampered in this way we fail to see. It would be far more creditable to the State if, instead of boasting a surplus of £122,000 on its Patent revenues of £203,000, it were to cut down tens of thousands of its useless and ornamental expenditure and hold out premiums to the genius of its sons, giving them free and easier processes to test their inventions, and clearing the road of impedimenta in the shape of interested officials when an invention—should it be a Government matter—is perfected and ripe for adoption. Where would the greatness of England be but for its industrial inventions? And we tax this knowledge!

ARTS AND CRAFTS EDUCATION.—The recent Annual Exhibition of the Home Arts and Industries Association has fully justified the Society's Report for 1892, which shows that the useful work of the association is still carried on with the old enthusiasm. In many places the County Councils have used the funds at their disposal for technical education in helping on the work of the association, and the wisdom of this step is amply proved when the results are compared between aiding classes already started and in the hands of experienced teachers, and giving the money to start fresh teaching under the superintendence of inexperienced persons. Wood-carving, metal-working, embroidery, hand-spun wool and linen, hand-woven fabrics, bent iron work, embossed leather, carpentry, baskets, and specimens from more branches of industrial art, were shown, and everyone interested in such work, either from the artistic or philanthropic point of view, must rejoice at the work shown, which, with the exception of a very few pieces, was the labour of people—chiefly lads and girls—of the working class.

TECHNICAL EDUCATION.—Amongst the many projects in vogue at the present day for increasing practical knowledge and rendering the rising generation of more utility to themselves, and also to the State, that of technical education is by no means of the least value, but unless it be confined to its legitimate use and position, is more likely to raise up a generation of "smatterers," "amateurs," and "dabblers" than produce properly skilled and capable mechanics. As a preparatory system for enabling youths of twelve to fourteen to become acquainted with the principles of a given industry, and acquire a certain amount of preliminary knowledge of the tools, apparatus, and processes employed in the industry he is destined or desires to follow, there can be no doubt of its benefits and utility; but the great and serious danger is, lest what is really the initial step for aiding a youth to practically become acquainted with the preliminaries of a given industry before he enters into the business of acquiring the proper practical knowledge of it, be taken as equivalent to a thorough practical training in that business. We allude here especially to what are called "schools of engineering," in most of which the pupils are "amused" with making models—say from 10 to 5 daily—and learning in a "gentlemanly" way—as they think—to become practical engineers. A more erroneous and injurious notion can hardly be conceived, and it is quite time that people should be put on their guard respecting it, so as to prevent disappointment and discredit being thrown upon what does not deserve it. There is no royal road by means of which a boy may be made into a skilled and capable mechanic or engineer. The ability, experience, and skill required for this purpose can only be obtained by apprenticeship in a works or factory where *reality* is dealt with, such as repairs, breaks-down, conversions, etc., as well as new work—conditions that never come in the way of technical schools. For a boy to become an engineer or mechanic, and be qualified as a master man, requires a five to seven years' apprenticeship in actual works—the more varied their work the better—in order that he may become practically acquainted with the varied conditions of the business, and gain that experience which is not, and cannot be, furnished by technical schools. Such institutions, though admirable for preparatory purposes, cannot by any means be treated as substitutes for a regular apprenticeship to any business. Parents will do well to keep these facts in mind, and not waste time or money in imagining that sending a youth to such places qualifies him to come out in the world as a skilled mechanic, with the needed knowledge and experience required to enable him to take, or even hold, his position in the battle of life, with any chance of success. Such a course is most prejudicial to the interests of the youth who may be so treated, and is quite enough to damp his energies and aspirations, and probably have an unfavourable influence on his future life. A proper consideration and understanding of what we have said may, it is to be hoped, lead parents and guardians to look before they leap in this matter of finding employment for boys.

GREENHOUSE BLINDS.

BY P. B. H.

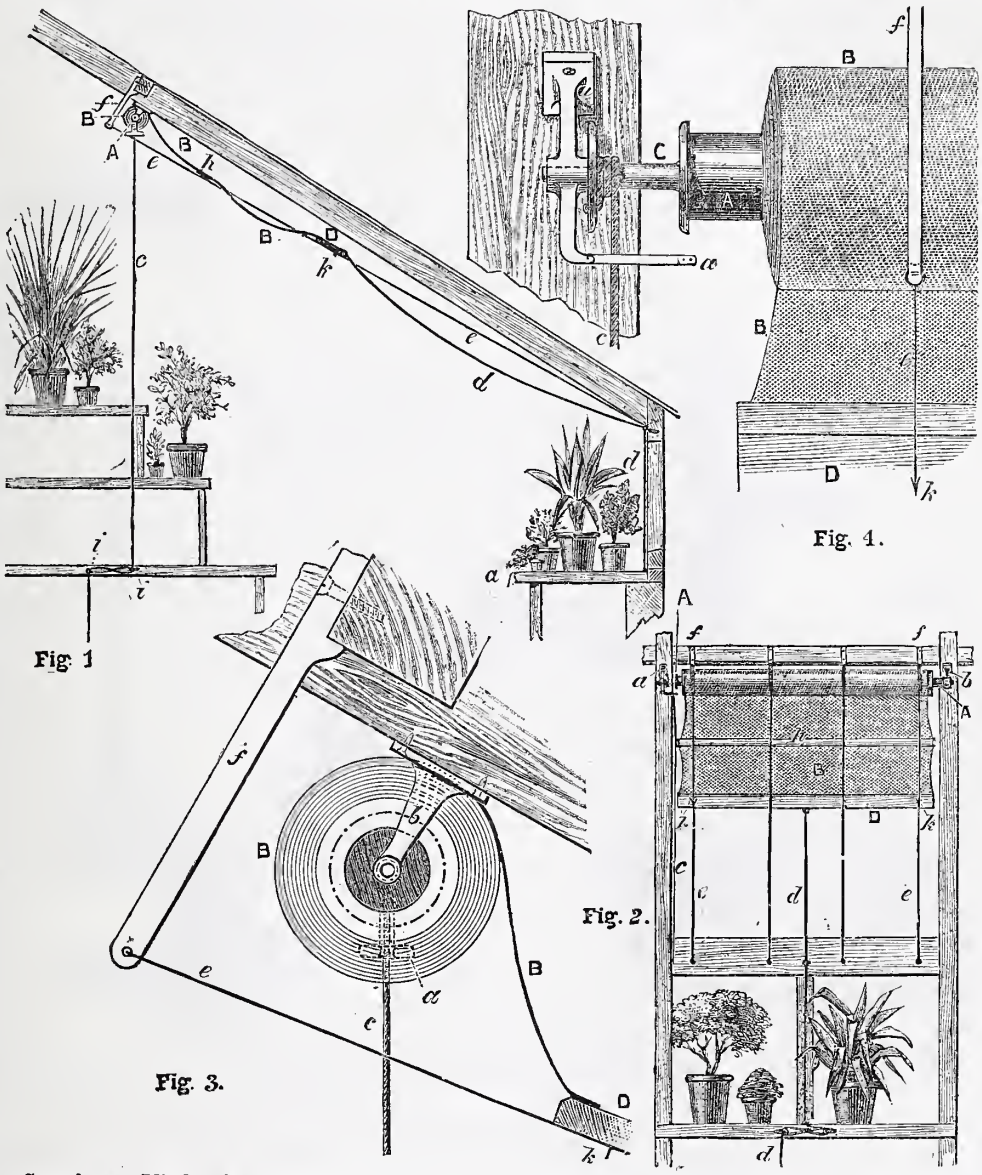
Readers of Work belong to all classes, and I have no doubt a quantity of them employ their spare time in gardening and the cultivation of flowers. The following simple arrangement of greenhouse blinds will prove useful to such. The blinds were inclined as shown on the drawings.

Fig. 1 is a sectional elevation of the greenhouse, showing a blind for one bay; Fig. 2 is an end view of blind fixed in a bay. These two figures are drawn to the scale of ½ in. to a foot, thus making the blinds about 3½ yds. long by 54 in. wide. Figs. 3 and 4 are views of one end of roller, showing the pulley and cord by which the blinds are wound up. A is a light wooden roller about 1½ in. diameter, and slightly longer than the width of the blind, B, which is first nailed accurately across its length. The best way of accomplishing this satisfactorily is by following one of the cross threads during the operation of nailing. If you do this the blind will roll up straight. C is a metal pulley round which the cord, *c*, is wound when the blind is drawn down by the cord, *d*. The two ends of the blind roller are carried by the two fixings (*a* and *b*) screwed to the underside of the beam, the former having a slotted arrangement cast to it, through which the winding cord, *c*, passes to prevent it running off the pulley, C, when being wound on. At the extreme end of the blind a piece of wood, D, ½ in. by 1½ in., is nailed, the material being slightly stretched during the nailing; this should also be done on the roller.

Now, a blind of such coarse material as greenhouse netting, and 3½ yds. long by 54 in. wide, will need some support; so just below the roller, A, making allowance for clearing when the blind is rolled up, stretch four thin wires, *e*, held at top end by small metal fixings, *f*, attached to cross beam, and at the lower end by eyes, *g*, screwed into woodwork. These wires should be tightly drawn, and spaced as shown plainly in Fig. 2.

These wires alone, however, will not prevent the blind falling through, so in a blind of the above length it will be needful to have four cross-pieces, *h*, spaced equi-distant between D and roller A. These cross-pieces should be of light wood, $\frac{3}{16}$ in. thick by ¾ in. wide, and slightly longer than the width of the blind; they should be tied in four places to the underside of the blind; this latter, while tying the string, should be slightly stretched. These laths, *h*, form a good support for the blind, and keep it well stretched. In order that the blind may run straight during the winding and unwinding, two small U-shaped pieces of wire, *k*, are driven into bottom cross-piece, D, encircling the wire.

The cord used both for winding and lowering is the ordinary window cord. In the winding the cord is passed through a hole in the flange of the pulley, and a knot tied thereon, and when the blind is fully wound up two or three turns of the cord should remain wound on the pulley. It should be long enough to fix the blind in any position by wrapping it round the hooks. The cord for drawing the blind down is tied to an eye screwed into cross-piece D, then passed through two eyes in the front frame of the greenhouse, and brought to the front of flower stand, where it can be fastened by means of hooks, as shown plainly in Fig. 2. Suppose the blind be drawn to its extreme height (Figs. 3 and 4), the cord, *c*, as already mentioned, must still encircle the pulley, C, about three times. To lower the blind, the cord, *d*, must be drawn down when the blind unwinds, at the same time winding the cord, *c*, on pulley, C, ready for the rewinding, which is accomplished by pulling the cord, *c*. The blind can be held in any position by fastening *c* below, and then drawing *d* tight, and fastening it also.



Greenhouse Blinds. Fig. 1.—Sectional Elevation of Greenhouse. Fig. 2.—End View of Blind fixed in a Bay. Fig. 3.—End Elevation of Blind Roller. Fig. 4.—Showing Roller and Blind.

VARNISH.

Select the palest lumps of copal gum, and crush them into small pieces; tie in a bag of fine muslin, and suspend in a bottle of sulphuric ether, when the copal gum will gradually ooze out into the ether. When the gum has been digested, let the bag drain off and be thrown into another bottle of the ether, which will remove all the available gum. It is a good plan to have plenty of the gum, so that the liquid will form a varnish sufficiently thick. Then add oil of caraway, or any slow-drying essential oil, as oil of anise, poppy, or sweet almonds, which are as colourless as possible in such small quantities; this will make the varnish dry more slowly, and render it more elastic. If it dries too thickly, add oil of rosemary, or some colourless essential oil, that it may dry as fast as may be required. Should it dry too slowly, add more ether and mix thoroughly.

MAGNETISING.

It is found that by heating magnets in an atmosphere of steam they will lose from thirty to sixty per cent. of their strength; but if re-magnetised they will stand exposure to steam with very little loss of magnetism; and, in addition to this, the magnetised bars will also withstand the deteriorating effects of mechanical vibration. A magnet was boiled for four hours, then having been re-magnetised and placed in steam for two hours, it was found to have lost only $\frac{1}{900}$ of its magnetic moment, and after being hammered for some time with a wooden bar it only lost $\frac{1}{400}$ of its strength.

HOW TO PREPARE CHEAP BLOWPIPES.

BY H. B. STOCKS.

"Mouth" and "Foot" Blowpipes—Blowpipe to Hold in the Hand—Blowpipe on Stand—Materials Required for Blowpipe to Hold in the Hand—Method of Making—Adjustment of Air Supply for Large or Small Flame—Blowpipe on Stand: Materials Required—Method of Making—Probable Cost of Blowpipes.

I wish to give a few practical details on the construction of blowpipes. Readers may look up pp. 92, 354, 831, Vol. II., and p. 356, Vol. III., etc., where they will find figures of blowpipes by various makers, showing the uses to which they are applied. Most of these blowpipes are exceedingly good. We do not wish to compete with them; our humble task is to describe how one may make a blowpipe for himself to suit his own individual requirements. I do not wish anyone to adhere exactly to my measurements, someone may require a larger or they may require a smaller blowpipe than mine: if so, increase or diminish the sizes.

For our purpose we may divide blowpipes into two kinds: "mouth" and "foot" blowpipes; also into two classes: (1) To hold in the hand; (2) on stand. The simplest form of blowpipe to hold in the hand is the mouth blowpipe; this requires no description, as its construction is apparent to everyone. Fig. 1 shows a blowpipe to hold in the hand applicable to autogenous soldering, etc. The materials required to make this blowpipe are a three-way tube; a piece of $\frac{3}{8}$ in. brass tube 4 in. long, with thread cut at one end; one piece of $\frac{3}{8}$ in. tube $5\frac{1}{2}$ in. long, and curved, with thread on one end; one piece of $\frac{3}{8}$ in. tube $3\frac{1}{2}$ in. long, also with one thread; one piece of brass tube $5\frac{1}{2}$ in. long, about $\frac{1}{8}$ in. diameter; a small piece of thin sheet brass.

The construction of the blowpipe will be seen at Fig. 2, where A is the outer tube, B the air supply, and C the gas supply.

Commence by cutting out a piece of sheet brass full $\frac{3}{4}$ in., and $\frac{1}{2}$ in. wide; turn it up into the form of a ring; solder this on one end of the $\frac{1}{8}$ in. tube, file the brass strip down until it will push into the tube which is $3\frac{1}{2}$ in. long, solder it inside of the thread end, screw this into one end of the three-way tube, screw on the outer tube, and see that the $\frac{1}{8}$ in. tube is exactly in the centre of it; then into the side tube screw the 5 in. curved tube (see Fig. 1), and the blowpipe is complete.

The inner tube of the blowpipe should come within one-eighth of an inch of the end of the outer tube. If during blowing there is a white patch in the flame, either the inner tube is not directly in the centre of the outer one or the inner tube is too long; in that case, file it down a little until correct.

If a fine-pointed flame only is required, do not cut the inner tube so long, say 2 in. shorter, and solder into the end of it a piece of tube tapering to a fine point, and with a very fine hole (the tube of an old oil can would do); allow the inner tube to come almost to the mouth of the outer tube. Turn down the gas a little and blow gently; a fine-pointed but very hot flame will result. (See Fig. 3.)

Fig. 4 shows the blowpipe on stand: this is useful when both hands are required for the work. The materials required are a brass elbow-joint, with tap and boss attached, similar to those used for gas brackets; a piece of brass tube 4 in. by $\frac{1}{2}$ in.; one piece of tube $2\frac{1}{4}$ in. by $\frac{3}{8}$ in., with thread on one end; brass nozzle $1\frac{1}{2}$ in. long, with $\frac{3}{8}$ in. thread cut inside one end; one bit of tube $\frac{3}{4}$ in. long, $\frac{3}{8}$ in. diameter; another piece $\frac{1}{2}$ in. long, $\frac{3}{8}$ in. diameter, with thread cut on each; one piece of tube $3\frac{5}{8}$ in. long, $\frac{1}{4}$ in. diameter; a small piece of sheet brass, and a block of wood for the blowpipe to stand upon.

Commence by drilling a hole in the brass boss, between the boss and the cock, and at right angles to the cock; tap it for a $\frac{3}{8}$ in. tube, cut a circle of brass $\frac{1}{2}$ in. in diameter, and solder it over the hole at back of boss, as we wish to close the gas supply there, but let it in by the side tube, E. Screw in the bit of tube $\frac{3}{4}$ in. long at B (Fig. 5), cut out a piece of sheet brass $1\frac{3}{8}$ in. long, $\frac{1}{2}$ in. wide, coil it up in the form of the ring, and solder it over B; at the same time solder inside the $\frac{1}{4}$ in. tube, C, and file down the portion B until tube D will slip on with a push.

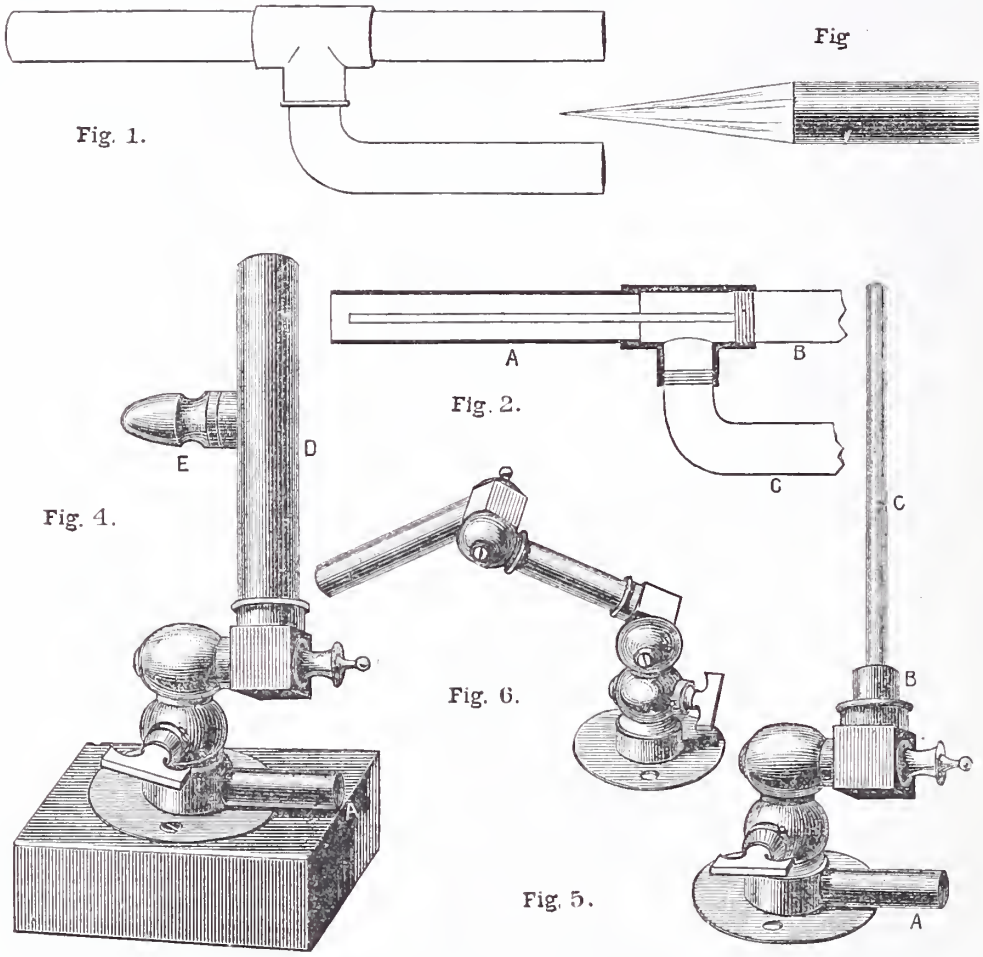
Now take tube D in the side, and at the middle of the tube bore a hole $\frac{3}{8}$ in. in diameter; file the nozzle, E, to a rounded-out shape at end, so as to fit close against the tube, D. Screw in the bit of $\frac{1}{2}$ in. tube, and file it out in the same way until about one-sixteenth of an inch is showing; knock it into the hole in tube D, and solder. Push the tube on to B, and see that the inner tube comes within about $\frac{3}{8}$ in. of the outer tube. In the wooden block bore out sufficient to allow of the brass circle entering the wood, and thus leaving the boss flush, then screw to the block; also screw in the side tube.

The gas is let in at E; there will always be a tap on the gas supply to regulate it by, and the air is regulated by the tap on the blowpipe. But if the gas supply is some distance off, and you require alternating heats, then put a tap on E. If a fine flame is required, proceed as in the hand blowpipe.

With this blowpipe we get one movement vertical of the elbow-piece; but if another tube and elbow-piece are inserted between the burner and the stand, a double vertical motion will be got, which will be very useful. This will higher the blowpipe, and allow also to blow down upon anything which it is required to heat. (See Fig. 6.)

I am sure the cost of these blowpipes must be comparatively small. Most people have odd pieces of tube lying about, as I had, which will come in handy; the others may be got of a plumber or second-hand. I gave 3d., second-hand, for the brass boss, and $2\frac{1}{2}$d. per ft. for the $\frac{1}{4}$ in. tube. The total cost of the hand blowpipe will be about 1s., and of the one on stand, 2s.

I have said nothing about blowing arrangements, preferring to leave them till some future time. In the meantime, look up back numbers of Work for articles upon bellows and fans, where you, or indeed any student interested in chemical matters, will get many ideas.



Cheap Blowpipe. Fig. 1.—Hand Blowpipe. Fig. 2.—Section of Hand Blowpipe. Fig. 3.—Small-pointed Flame. Fig. 4.—Stand Blowpipe. Fig. 5.—Stand Blowpipe showing inner Tube for Air. Fig. 6.—Blowpipe with Double Joint.

AIDS IN AILMENTS.

External Application.—Alcohol for external application for strained muscles was a remedy sometimes adopted by the celebrated bone-setter, Hutton. A linen bandage was bound round the injured part, after it had been soaked in brandy or whisky, loose enough to allow movement, if such were permitted; if in a sling bandage, to prevent movement—never tight enough to stop circulation. Relief from pain was mostly quick and lasting. For sore throats, flannel dipped in brandy and bound two or three times round the throat, and the bandage covered with oil-silk or waterproof cloth, acts rapidly on the nerves and tissues of the throat, so that relief is soon felt. Two or three applications of a soaked bandage, aided by slightly aperient medicine, effect a cure and prevent more serious complications of the delicate structure of the throat.

Sore Throat—Wounds.—An elixir known to be an excellent preventive of sore throats and colds, to be gargled and swallowed:—2 oz. of camphor; ¾ oz. of spirits of nindererus; ¼ oz. of ipecacuanha wine; 1 oz. of any simple syrup. A teaspoonful occasionally. For wounds and ulcers, pour two pints of boiling water over two drachms of dried hemlock; add crushed linseed (not linseed meal) to make into a poultice. Its efficacy has been extolled. For sloughing wounds, a little powdered alum added is good.

Embrocation.—Of the many embrocations now offered to the world, the one which is pre-eminent for efficacy for strains, rheumatism, enlarged joints, and muscular injuries generally is now given to the readers of Work by a gentleman whose long experience as a veterinary surgeon and stock-keeper gave him extensive opportunities of testing its sterling worth for man and animals (with animals it may be saturated on a bandage and applied). Mix 2 quarts of white wine vinegar; 1 pint of spirits of wine; ½ pint of turpentine; 3 drachms of camphor; 4 yolks of fresh eggs. The spirits of wine mixed previously with the camphor; lastly, the turpentine. To be well rubbed into part affected (always rubbing upwards), and cover up parts with soft flannel.

TIPS.

When young draughtsmen experience the difficulty of getting colour to wash properly over the rough side of tracing cloth, the difficulty can be got over by grating a piece of common washing soda, about the size of a pea, to a fine powder, and mixing it with the colour in the palette. The soda kills the grease in the tracing cloth, and therefore the colour can be more rapidly and correctly spread over the surface.

A good lacquer for oven pipes is made by dissolving yellow ozokerite in heavy crude naphtha. It is brushed over the iron and then burnt off, and a polish put on by rubbing it with a greasy woollen cloth. The operation may require to be repeated to obtain a perfect coating.

Avoid the risk of blinding or severely burning yourself when pouring melted lead, in the various uses to which it is put, by placing a small piece of resin in the ladle. This will effectually prevent the metal "sluttering."

SCIENCE TO DATE.

Ozonine.—This is a new bleaching material. It is said to be prepared as follows: 125 parts of resin are dissolved in 200 parts of oil of terebenthine; a solution of from 22 to 25 parts of caustic potash in 40 parts of water is added, together with 90 parts of peroxide of hydrogen. The jelly obtained, exposed to the light, changes in two or three days to a clear fluid, to which the name of ozonine is given. In the proportion of 15 grains to a pint and a half of water it bleaches fibres, wood, straw, paper, etc., energetically, and equally well in acid or alkaline solutions.

Mammoth in London.—During recent excavations in St. Pancras, in connection with the deepening of the main sewer, the remains of a mammoth and other prehistoric animals were found at a depth of about 22 ft. from the surface. Two mammoth tusks were discovered, and a portion of one, on being brought to the surface, was found to measure nearly 2 ft. in circumference at its thickest part. The length of the tusks would be from 9 ft. to 10 ft. Other bones were found, as well as vegetable remains, chiefly the seeds of marshy plants. Deposits usually classed with the high level gravel and brick earth of the Thames Valley were found overlying the animal remains, and hence they are considered to belong to the glacial period.

Coal in Kent.—Further information has been communicated by Professor Boyd Dawkin as regards the progress of the Dover boring. 762 ft. of coal measures have now been pierced, which include an aggregate thickness of more than 7 ft. of coal in nine separate seams, mostly workable. Seam No. 1, 2 ft. 6 in. in thickness, occurs at a depth of 1,140 ft., and Seam No. 9 (1 ft. 8 in.), at a depth of 1,875 ft. Arrangements for the sinking of a shaft are in progress.

Iron Rust.—It is generally supposed that iron rust consists chiefly of the hydrated sesquioxide of iron. Professor Liversidge, of Sydney University, has had occasion to examine a large number of specimens of rust from different places and formed under different conditions, and finds that in almost every instance the rust contains more or less magnetic oxide. In some cases the rust, although presenting the usual appearance, was, when powdered, practically wholly attracted by the magnet.

Depth of the Mediterranean.—Recent soundings executed by the *Pola*, of the Austrian marine, in the Mediterranean have shown the existence of greater depths than one would have supposed. Fifty sea miles south-west of Cape Matapan, a depth of 14,300 ft. was found. Between Candia and Alexandria another sounding gave 10,700 ft.

Temperature of the Sun.—Several attempts have been made at various times to determine the temperature of the sun, and the results obtained vary very widely—namely, from 1,500° C. to 5,000,000° C. The reason of this great variation in the different estimates lies in the fact that different laws have been assumed to represent the rate of radiation. Recent experiments made by M. le Chatelier on the intensity of the radiations emitted by an incandescent body at temperatures ranging from 680° C. to 1,770° C. have afforded fresh data on which to base a new calculation, and the result has been arrived at that the sun's temperature is about 7,600° C., that of the photosphere being probably a little higher.

Electricity and Vegetation.—Experiments lately made on wheat, maize, tobacco, and beans, show that whilst atmospheric electricity exercises a beneficial action on vegetation, so also electricity in the soil has an analogous influence on germination. The less luxuriant vegetation of plants growing in the neighbourhood of trees is due in great measure to the lowering of temperature. Again, according to experiments in North Italy during recent seismic disturbances, as to the effect of earthquakes on vegetation, it is found that the latter induce a more rapid germination and quicker growth, by bringing into play secondary causes, one of which is the increased production of electricity, others being the increase in the carbonic acid produced and the diffusion of nutritive fluid through the soil.

Occlusion of Hydrogen by Nickel.—When water is electrolysed in a voltameter with nickel wires for electrodes, the negative electrode is found to occlude hydrogen. According to experiments by Bellati and Lussarra, after a current had been passed through the voltameter for 200 hours, the wire had absorbed about 100 volumes of hydrogen. The occluded hydrogen is not given off easily, but rather oxidation takes place on exposure to the air.

NOTES FOR WORKERS.

Natural coke has been discovered at the Brelli Pass Mines, in New South Wales. The seam occurs in a coal measure covering 550 acres, and is composed partly of ordinary Australian coal and this coke, the junction of the two being clearly defined. It is a little heavier than the manufactured article, contains less fixed carbon, and a much smaller percentage of ash and sulphur. It burns without smoke, and can be mined cheaper than the cost of manufactured coke.

A reproduction of the *Santa Maria*, the little vessel of 100 tons in which Columbus made his famous voyage, and from which he landed at San Salvador on October 12th, 1492, will be exhibited at the Chicago Exhibition.

A saturated solution of corrosive sublimate in water is a good hardening reagent for animal tissues before cutting sections for the microscope. The object is soaked in it for half an hour or more, washed with water or weak alcohol, and then transferred to 70 per cent. alcohol before staining.

A new fire-extinguisher is composed of a mixture of water and liquid carbonic acid gas, which, upon being discharged through pipes at high pressure, causes the rapid expansion of the gas, converting the mixture into a spray more or less frozen.

Celluloid is now being used in the manufacture of rules, set-squares, angles, and other mathematical and drawing instruments.

Mount Washington is to be capped by the largest electric search light ever made—one that can be easily seen from Portland, Me., and, under favourable conditions, from Boston.

The effect of passing electric currents through wines is to mellow and preserve the healthy ones and to arrest deterioration in those about to turn sour.

BOOKS.

Technical Education.—"Technical Education in the Counties: What is It? How may It be Carried Out?" By G. J. Mitchell, B.A.Lond., and E. H. Smith, Assoc.R.C.Sci.Lond. (George Philip & Son.)—A revised reprint of a series of articles contributed to *The County Council Times*. It is intended to be a guide to teachers and others who are desirous of utilising to the best advantage the facilities afforded by the Technical Instruction Act for the practical education of the young. No writers could possess better qualifications for the task they have accomplished, and no one who feels an interest in this subject can afford to neglect the perusal of their pages. The requirements of agricultural, mining, manufacturing, art trades, and commercial interests, are discussed in detail, and the education of girls is not forgotten. A very useful appendix closes this most comprehensive little volume of 144 pages.

Bent Iron.—"Bent Iron Work: A Practical Manual of Instruction for Amateurs." By F. J. Erskine. (L. Upcott Gill.)—A little book of 52 pages and 27 illustrations, reprinted from the *Bazaar*. It is, of course, impossible to treat this interesting subject exhaustively in so small a compass, but the elementary part of the work is made sufficiently clear. The methods of making the heavier framings should not, however, have been omitted, and a little more detail, both of illustration and description, would have been advantageous to the amateur.

Watches and Timekeepers.—"A History of Watches and other Timekeepers," by J. F. Kendal. (Crosby Lockwood & Son.) A history of watches by J. F. Kendal should be an interesting volume. This little book of 247 pages gives us some interesting watch and clock lore, nicely illustrated. "Time, and cycles of time," show how time is and has been reckoned in all parts of the world in all ages. Dials, clepsydra, and other curious and mysterious timekeepers are noticed. Some useful information relating to clocks and watches is given. This history is incomplete in omitting even a bare mention of the Waltham, Waterbury, and other American timekeepers.

TRADE: PRESENT AND FUTURE.

*** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

Iron and Steel Trades.—An improved tone is noticeable in the Sheffield district. Crucible steel maintains its price, and competition is not so keen as it has been. Rolling mills and tilt forges are better off for orders, and the demand for bicycle tires, octagons, etc., has again increased. Hammer makers are busy, one firm having taken an order for 50,000. The demand for cutlery steel is limited. The Indian markets are opening well for spring steel and octagon sections. Makers of Bessemer steel material have commenced work again.

Silver Trade.—In the silver trade there has been a considerable falling-off, as is usual in June, and trade will probably be dull until next September.

Ivory Trade.—From Tripoli we hear that last year there were exported from that country 46 tons of ivory, valued at £30,000. Most of this came from the Soudan, and is of a softer and inferior quality than that of Zanzibar and the West Coast; yet it would not seem that there has been any great falling-off, either in quantity or price. It has been noticed and remarked that the London market, which is the great selling-place for ivory, has for a long time been in a bad condition.

Cutlery Trade.—The Sheffield spring-knife trade is slack, and competition from Germany is having a bad effect. Workmen are feeling the pinch, and many grinders of pen- and pocket-knife blades are earning barely sufficient to pay for steam power. Competition from Germany is also affecting the razor trade. Manufacturers are attempting to accommodate themselves to the requirements of foreign markets, and one firm has sent 500 gross of handle scales to Sweden, where the cutlery trade is developing. In small scissors, which as yet the American cutlers have not touched, there is a great struggle for the market between the English and German makers, the English article being superior to the German for wear, while the Germans beat us in the finish of the goods. The ivory- and bone-cutting trades are both dull, owing, probably, to the exceptional employment of xylonite for table cutlery.

Engineering Trade.—Most of the large engineering establishments of the Lancashire district are now in operation, and it is gratifying to be able to report even a slight improvement in the machine tool making branch. Several important orders, chiefly for special tools for abroad, have lately been secured, and one of the largest firms in the locality has obtained a good order for a foreign Government in connection with ordnance work. In the other branches of the trade, however, there is but little new work coming forward, locomotive builders being specially slack just now. The shipbuilding industry of the Mersey district remains in the same depressed condition which has now characterised this branch for many months. In the Barrow district, however, both shipbuilders and engineers continue to report trade as being brisk, and new orders continue to come to hand. Business in the iron market is still exceedingly slow, for it is the general opinion that the present prices cannot be maintained for any length of time, and buyers are holding back from placing orders in the hope of securing better terms than at present offered. Only a moderate business is being done in the steel market, both as regards raw and manufactured material. Steel boiler plates of local make are still quoted at £8 per ton. There is little change to report in the metal market, business being, if anything, quieter than of late.

Building Trade.—The strike still continues in Birmingham. Steps are being taken to form a co-operative society of builders, floated with 2,000 £1 shares offered to the workmen. This ought to be an initial step in the solution of difficulties between men and masters. At Colne the stonemasons and wallers, after giving the master builders and contractors of the town seven days' notice, have struck for an advance of wages from 8d. to 8½d. per hour. In Rochdale and district the building trades continue in a prosperous state. The Kirkcaldy joiners and their employers have settled their differences. Recently the Edinburgh slaters intimated to the masters that they wanted an increase of ½d. per hour on their wages, the rise to take effect at the beginning of August. The masters' action has been by no means unanimous.

Jewellery Trade.—The London jewellery trade would be in a flourishing condition if the result were only to be judged by the new shops opened; but if what the manufacturers are doing is to be taken into consideration, then the judgment will be reversed, for there is much less work at most firms than there ought to be in the middle of the season.

Cycle Trade.—A reaction has set in at Coventry and the neighbourhood, the factories not working so late as formerly, it being considered that there are sufficient machines in stock and in hand to meet this season's demands. The question at issue now is: "What will be the machine of the future?" Pneumatic and cushion tires are in some quarters regarded as a passing fad, the idea being that 1 in. solid tires will carry the sway. Experiments are being made with a view to improve geared machines. Our Glasgow correspondent writes:—There is good business being done, especially in pneumatics, and the dealers are troubled to find room to store solids and cushions returned and given in part payment for pneumatics. Great numbers of these returned machines are resold to cycle hirers at prices ranging from £3 10s. to £7 for cushions. Numbers also find their way to the auction rooms, so that working lads with but little cash can in these rooms buy a machine for a very small sum. The Howe Company are busy; their light pneumatic tire machines are taking well with racing men.

SHOP:

A Corner for Those who Want to Talk It.

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of Work *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given.*

I.—Letters from Correspondents.

Alarm.—D. B. (*Glasgow*) writes:—"Should any reader require an alarm which can be absolutely depended upon, I can recommend the following, which I adopted, as my electric bells often went wrong without any warning, and I repeatedly found customers in my shop when we were all engaged in the back premises. I fixed gas-pipe from the meter to the top of my shop door, at which

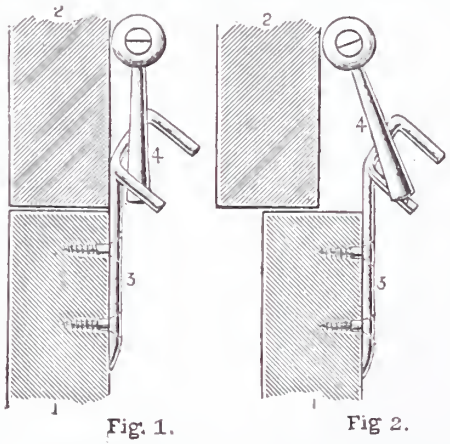


Fig. 1. Fig 2.

Reversible Gas Alarm. Fig. 1.—Door closed and Gas full on. Fig. 2.—Door partly open.—1, Section of Door; 2, Section of Woodwork over Door; 3, Brass Wire with Fork to turn Gas on and off; 4, Gas Cock made to work rather stiffly.

point I fitted a cock, which is turned off and on by the opening and shutting of the door. The pipe is then continued to the back premises, and terminates in a branch, which I light, and, at the same time, pull down the blind, or close the shutters to exclude daylight. The cock is so adjusted that when the door is opened the gas is turned down very low, but immediately goes up again on the door being shut."

Evening Class Instructor.—W. A. G. (*Gutter Lane*) writes, expressing his willingness to take "a small class in Carpentry, providing that out-of-pocket expenses are defrayed."—[Our correspondent had better advertise his full name and address in our cheap "Sale and Exchange" column.—Ed.]

II.—Questions Answered by Editor and Staff.

Cottage and Garden Wall.—Vita.—If the ground is fairly good and sound, an average depth of 1 ft. would be sufficient, calculating it thus: The wall, one brick, or 9 in., thick, would contain 6,900 bricks, calculating the bricks 9 in. long and 4 in. in height to set twelve in; if the bricks are larger a less number will be required. I would not advise you to make the wall less than one brick thick. If you do not fix coping on the top, you could finish it with a brick on edge, pointed with Portland cement. You would require about 2½ tons of lime and 7 or 8 tons of clean sharp sand for mortar; and if under favourable circumstances, a man would do it in nine or ten days. You will also have to calculate for digging the foundation and filling in, and clearing away all rubbish. These items are, of course, approximate, as it is impossible, without being on the spot, to give them exact. Your best plan would be to get an estimate of the cost from a local builder. If the ground is soft, and deeper foundations are required, you could lay them with concrete, formed of five parts of broken stones, and one part of best Portland cement.—M.

Water Motor.—J. R. (*New Brompton*).—The illustrated article is in the printer's hands, and will appear shortly.—Ed.

Spectacles for Rear and Front Sight.—T. C. B. (*Cork*).—Will you please write again, sending a rough sketch, if possible; or, failing that, a description of such a pair of spectacles? I am informed there is no doubt they can be made, but in the absence of any indication of their manufacture, all steps in that direction would take the form of experimental work. It would also greatly aid the maker if you were able to say for what purpose you required to use them; not necessarily for publication, but as an aid to the maker. We should be glad to hear more on this subject, as there are, no doubt, many who would like to be the possessors of such a pair of spectacles.—N. M.

Type for Printing.—F. T. (*Rochdale*).—There are many difficulties in the way of your carrying out your laudable desire to make type for yourself. You are, doubtless, aware that types are cast from matrices, each matrix being the work of a skilled artist, who has had to spend many years of labour and study before he is able to produce work such as is required in these days of modern printing. The casting of type is a large undertaking, even for the type-founders themselves, and who possess every mechanical appliance for producing type clean and sharp. If, after reading the above, you are content to try your luck, you may proceed as follows: Procure some type-high type metal, and saw into blocks of the required size, and trim up the sides and edges; and then slightly warm the blocks, and cover the surface intended to be cut with a film of white wax. Next, procure some ordinary writing or foolscap paper, and with a lead pencil draw the letter to be cut—one drawing for each block. Now lay the drawing on the face of the block, and gently rub on the back of the paper; remove paper, and the result ought to be a black-lined letter in *reverse*. The letter is now ready for cutting; take a *sharp* and acute-angled lozenge graver and outline, going over the outline several times until the proper depth is acquired; always cutting towards the left hand for outside outlines, and towards the right for inner outlines, regulating the bias or "side" of the graver *from the outline*, both outside and inside outlines. By observing this last rule you will get nice sharp letters—that is, supposing you handle your graver with ordinary skill. The next thing is to cut away the outside edges; you will find a threaded flat graver, about $\frac{1}{16}$ in. wide, a good tool for this purpose. You may cut in any direction you find most convenient, the main object being to get the reversed letter or figure into high relief. As you are an old subscriber, kindly turn to the first volume of Work, and study an excellent article on "Lettering," etc. This series of papers has been of great use to many inquirers, and is most valuable to those who desire to be able to form letters correctly, either for painting or engraving. In the first volume of Work, and running concurrently with the papers on "Lettering," you will also find papers on "Engraving on Metal," which you are recommended to look through.—N. M.

Battery.—B. (*Wirksworth*).—I cannot make out what kind of battery yours is. All you say is that it is a single fluid, with carbon and zinc, and that it is for plating. Are you sure there are no porous pots? If there are none, I suppose it must be a potash bichromate, the charge for which is: 3 oz. of potash bichromate, 3 oz. sulphuric acid to every pint of water, to be used quite cold. If you had only given the name of the cell I should have been certain as to the charge. You say you have taken Work in for about two years, and yet have not seen a very interesting paper by Mr. Bonney on the subject of Plating in Vol. III., No. 107, page 35, which appeared a year ago last April; also, since then there have been many little tips in "Shop" about battery cells, etc.—J. B.

Dynamo.—W. N. (*Oldham*).—As to where to obtain the information for making a small Manchester dynamo of about the power you mention, you will find the very thing in Work, Vol. II., No. 99, page 756. Please note that the diagram showing the winding (Fig. 59) was corrected in another number of Work. A very useful little book on the subject is "The Dynamo; How Made, and How Used," by Mr. S. R. Bottone. Another good book, a little more expensive, is "Electricity in the Service of Man," published by Messrs. Cassell & Company, price 7s. 6d. You have Mr. Croft's book; if you get the information and books I have named, and, as you say, have made a gramme ring dynamo, with an output of 360 watts, I should say you would be able to make any type of machine you please.—J. B.

Work Bench.—J. N. B. (*Raddington*).—An article is in preparation, which the Editor shall have as soon as possible.—B. A. B.

Paint.—C. J. (*Chester*).—There *was* a paint called Balmain's luminous paint, but I cannot trace it. Perhaps some of our readers may know.—E. D.

Plumber's Joint.—J. J. (*Shadwell*).—Joint-making is the principal thing in plumbing; a man who could make a "wipe joint" properly could soon get his living as a plumber. There is an excellent substitute for a plumber's joint (Fig. 1), sold by Tyler of Newgate Street, that can be fixed single-handed without skilled labour; it forms a perfectly sound, solid, unbreakable, imperishable joint. If the joint is to be made in light lead pipes, place the diminishing linings (Fig. 2) in the pieces, A, B (Fig. 1). If strong lead pipe is used they will not

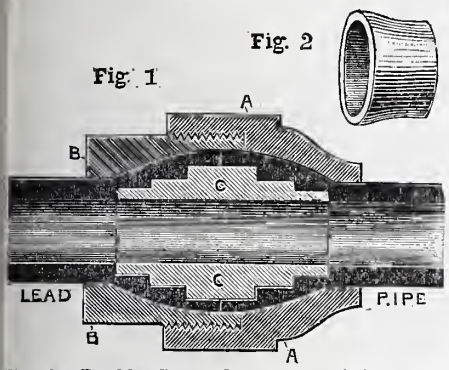
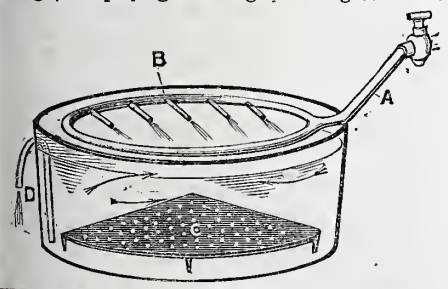


Fig. 1.—Double Grooved Joint for fixing Lead Pipe without Solder. Fig. 2.—Diminishing Lining.

be required. Unscrew the brass nut, A, and slip it and the part B over the ends of the lead pipe. Swell out the ends of the lead pipe by driving into them a taper of hard wood—the same taper as the piece C. Trim off the ends of the lead pipes square, and having well greased the outside ends of pipe, to prevent them twisting, slip the pieces A and B on to the swelled ends. Place the brass piece, C, between the two lead pipes, and screw A and B together with a pair of wrenches, and the grooves of the piece C immediately embed themselves into the lead pipe, each groove making a perfectly sound joint, which will stand a pressure greatly in excess of that which the pipe itself will stand.—E. D.

Casement Windows.—Bookcase.—It is impossible in "Shop" to give directions for making casement windows that shall also include the modes and methods of mortising and the other operations involved, together with tools needed. Our querist gives a large order for "Shop," but an article shall be written and sent to the Editor, and he will, if he approves of the article, insert it as soon as possible.—B. A. B.

Wetting-Trough.—A. W. (*No Address*).—If the position of the jets is altered, so that the water plays at a different angle, the prints will revolve. The better plan would be to fix the jets in a ring just over the surface of the water, and playing down into it. In the present form of machine there would be a stoppage of the current on the side opposite to the jets. Even the straight row of jets as shown in diagram, fixed at one end of the trough, and playing at an angle of 45 degrees to the



Wetting-Trough—A, Water Supply; B, Jets; C, False Bottom; D, Syphon.

bottom, would in all probability cause a satisfactory revolving motion, but there is no doubt but that a *circular* washing-trough with the jets above keep the prints better apart, and wash them better than any rectangular vessel with a circular current can possibly do, as the angles of the vessel offer sufficient resistance to the free movement of the prints, so that they are apt to stick together. The above is a good design.—D.

Bicycle Chains.—E. C. M. (*Ipswich*).—E. C. M.'s idea is an impracticable one in its application to cycle driving. Assuming that *in an air-tight* case the force applied to A would make B revolve with sufficient power to drive the machine, the case could not be made air-tight, neither could it be made oil-tight. The shafts must pass through one side of the case in order to carry the wheels on their ends. They could not be fitted by any mechanical means perfectly air-tight, therefore the principle of the pump acting in an air-tight casing is wanting. The joints referred to might be fitted, at first, very nearly air- and oil-tight, and might remain so for a time if applied on a stationary and strongly got up piece of machinery, but in a cycle the case is entirely different. It is at best a fragile machine, liable to twists and strains which at once affect all nicely fitted bearings, and necessitate their frequent adjustment. Even were all the conditions of the vacuum pump present, I am not prepared to say that the arrangement shown by E. C. M. would have the power necessary to drive the machine.—A. S. P.

Silvering Copper Tubes.—Eldred writes:—"I want a simple method of doing the above kind of work. The tubes are 22 in. long and $\frac{3}{16}$ in. in diameter." He further says: "Give me an idea of the kind of vessel to do it in." It seems to me that Eldred has in his mind, at least, in the last sentence, some idea of electro-plating; if so, my advice is, "Don't." If the number of tubes which he has to silver are very few, then I can assure Eldred it would be a most expensive process, and would not be a commercial success. I venture to say that at any one of the manufacturers of plated goods in Birmingham he could get his work done for a fraction of the cost he could do it at, and a great deal better. Electro-plating in its simplest form as a mere experiment is easy, but to produce finished work requires a somewhat expensive plant. I would repeat that my advice is, "Don't." But, supposing by his "simple method" he does not refer to electro-plating, but some other: then I think there is a possibility of his doing the work himself—that is, providing the said tubes are not to be subjected to hard wear. I can give Eldred the method used by one of the largest manufacturers of scientific instruments in Birmingham for the kind of work I have indicated, which may suit Eldred, seeing it is a simple and also an inexpensive method. It is used for silvering scales, dials, and such kind of work as is not liable to rough usage. First make the tubes perfectly clean, and polish with emery-paper; they should then be washed, so as to remove any adherent dust. See that they are perfectly free from grease. In a glass bottle make a strong solution of nitrate of silver, in the proportion of 60 grains to an ounce of distilled water. When dissolved, add table salt—chloride of sodium—in small quantities and slowly; a precipitate of chloride of silver will be formed. Continue to add the salt until no further precipitation takes place. This must be allowed to settle, and the chloride of silver separates by filtering. Now add three times by weight of cream of tartar; wet the tube and put a little of the mixture on it, and rub with a piece of cork, when a thin film of pure silver will be deposited on the tube. When the tube is covered, wash it in water, and dry in sawdust. As the film of silver is exceedingly thin, it will be necessary to protect it by a colourless lacquer or mastic varnish. This is a simple method, and one, I trust, that will answer Eldred's purpose; but if the work must be electro-plated, I will give a further answer, if requested.—O. B.

Sharpening Plane-Irons.—J. McC. (*Lochwinnoch*).—Your machine is an ingenious one; but I do not think the round-edged wheel would sharpen so truly as the hone held in the hand. A revolving wheel, though suitable for grinding, is hardly good enough for sharpening.—J.

Water Motor.—A Reader of "Work."—This is rather vague, because you might mean a water wheel, or a turbine, or a pressure engine. In either case several drawings would be necessary. You should state the nature of the water power available, the conditions under which it must be used, and so forth.—J.

Iron Shedding—Roofing.—"Iron Roofs and Bridges," by Prof. Rittor (Spon), is a high-class work. Elementary works are "Designing Wrought and Cast Iron Work," by Prof. Adams (Spon). Anyone can master these books by Prof. Adams.—J.

Property in Chancery.—A Labourer.—Various lists are published of the names of those entitled to such property. Perhaps that most suited to your purpose is issued (price 1s.) by Messrs. Harrison, St. Martin's Lane. This is stated to contain names collected from the *London Gazette*, and is published at intervals of, I believe, ten years. There are plenty of offices at which information is professedly given on this subject on payment of an inquiry fee, such as Culmer's, Southampton Buildings; Preston's, Great College Street, Westminster; Read's, Fleet Street; Bernardi Brothers, John Street, Bedford Row; and Dougall's, of which I have not the address, but it is well-known, and "Dougall's Next of Kin Office, London," will find it. Lists are published at most of these offices; but before Labourer spends his money and time on making research, he should be warned that of those who believe themselves entitled to property through unknown ancestors, there are few indeed who ever succeed in establishing their claims; whilst the majority, seduced by delusive dreams, neglect their business, which would have brought them certain prosperity, and sacrifice their happiness in life for that "hope deferred which maketh the heart sick."—S. W.

Emigration.—Female Emigrant.—There is a "School for Household Management, with Special Facilities for Training for Colonial Life," at Miss Mitchell's, Fryerne, Caterham.

Glockenspiel.—W. J. P. (*Birkenhead*).—The glockenspiel proper consists of a set of eight or more clock bells, mounted on a central spindle, which is inserted in a wooden handle. They are held in one hand, and played by being struck with a small metallic beater held in the other (Fig. 1). They may be of any size or number, so long as they are in tune. The instrument to which you most probably refer is the "metallaphon," or metal harmonica, which, in its simplest form, consists of a wooden box without a lid, on the top edges of which are laid on a woollen cord flat bars of metal (Fig. 2). These bars are kept in position by means of nails or round-headed screws, which pass through holes in the plate and are driven into the wood. These holes must be large enough for the screws to pass easily through, so that the plate may lie loosely; otherwise, if it is fastened down in any way tightly the sound will be "damped." Of course, you can make an instrument of any size and number of notes you

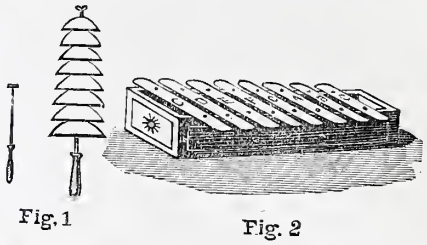
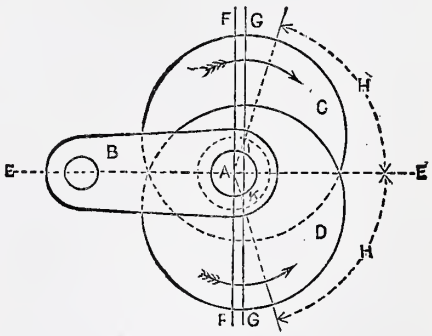


Fig. 1.—Glockenspiel and Beater. Fig. 2.—Metallaphon.

like, and either with or without semitones; if semitones are employed, it is usual to place them on another row at the back of the first. The metal used may be either iron or steel; the latter gives much the best tone, but, of course, is much more difficult to work. The note C on the ledger line below the treble stave is produced by a bar about 6 in. long by 1 in. wide and $\frac{1}{8}$ in. thick; but this is only approximate, as the pitch will vary with metals of different densities. Care must be exercised in the tuning, as, if the bars are made too short and, consequently, too sharp or high in pitch, they cannot be flattened or lowered again. The best instruments of this kind, as used in orchestras, consist of two octaves or more, and are played with a keyboard like a piano.—R. F.

Slide-Valve.—Maneo.—I assume that the rod of whichever eccentric is operating, the valve has its end opposite the end of the slide-valve rod, so that no allowance is required to be made for leverage, or for reversing the direction of motion by intervening weigh-shafts; then, having determined the weight of lead to be given to the valve, the eccentrics are set as shown in the accompanying diagram. A is the end of the rank-shaft, B the crank, C the forward eccentric, and D the backward eccentric. E E is the centre line of the main cylinder and piston-rod. The crank is shown in line with the piston-rod, and therefore on a dead centre, in which position the slide-valve, *if it had no lead*, would be at mid-stroke, and the centre of the eccentric would lie practically upon the line F F drawn through the centre of the crank-shaft, and at right angles to the line E E; it would be at the point of intersection of this line with the dotted circle, which shows the path of the eccentric centre when in motion. The lead is the distance the valve



Slide-Valve Eccentrics.

is ahead of its mid-position when the crank is on the dead centre. Draw the line G G parallel to F F, and at a distance from it equal to the required lead; then the points of intersection, I and K, will be the required centres of the eccentrics. The angle H may be found from trigonometrical tables, if desired, as the lead divided by the radius of the dotted circle—half the throw of the eccentric—is its cosine. The lead will be the amount of lap plus the width the valve is required to be open at the commencement of the stroke; thus, if we want one-eighth of an inch opening at the start, and there is a quarter-inch lap, the lead will be three-eighths of an inch.—F. C.

Drilling Holes in Glass.—G. M. R. (*Rastrick*).—The only practical method of drilling holes in glass or earthenware is to use a splinter of diamond set in a tin socket; it *can* be done with a highly-tempered steel drill, using turpentine as a lubricator, but it takes a long time, and there is a far greater liability of a fracture; if you have much to do, I should certainly advise you to buy or make a diamond drill and drill-clock. You say you have been a reader from the first; perhaps you have overlooked an article upon "Drilling Glass and China" in No. 53 of WORK. Refer to that, as it fully describes the process, and also tells you how to make the tools or where to buy them; but if there is any special point you need further information upon, I shall be glad to help you if you write again.—W. E. D., JR.

Bichromate Battery.—STUDENT.—I am only too pleased to be of some assistanee to you in your studies. As bichromate of potash is anything but a perfect depolariser, its use for this purpose in galvanic batteries does not conduce to their constancy. The bichromate of potash battery, in any of its forms, is by no means a constant generator of electric current. In its single fluid furm, as the "bottle bichromate," it is very erratic. By the employment of a very large negative surface of roughened carbon plates—such as three large carbon plates to two small zincs—the single fluid cell is slightly improved, but is still very inconstant, with its violent rush of current at an E.M.F. of 2 volts, and the subsequent rapid fall to 1·40 volts in ten minutes. This fall is due to the imperfect depolarising properties of the solution, and a consequent formation of a film of hydrogen on the negative plates. This film not only increases the internal resistance of the cell, but also opposes to the zinc a counter E.M.F., since hydrogen is positive to zinc. The relation of this battery to the Bunsen in point of constancy is clearly shown in a table published in No. 3, p. 42, Vol. I. of WORK. This table shows the results of tests made with Bunsen and bichromate of potash cells, and shows that the bichromate of potash cell failed rapidly during the first two hours, whilst the Bunsen remained fairly constant for nine hours. In experiments made by Mr. J. T. Sprague, the Bunsen gave a current of 12 chemics at starting, and yielded the same after two hours' work; a Daniell's cell yielded 6·8 chemics at the start, and 7 chemics at the end of two hours; the double cell double fluid bichromate yielded 7·3 at the start, but fell to 2·1 at the end of two hours; while the single fluid bichromate was worse still, starting with 12 chemics, and falling to 1·1 at the end of two hours. The bichromate of potash battery is therefore unsuitable to electro-plating work. I should advise you to get Mr. Sprague's book, "Electricity: Its Theory, Sources, and Application," and study this subject for yourself there. The price is 15s., so you would have to study it at a library. I do not know of a cheap book on all the subjects you name, but the price list of Messrs. Whittaker & Co. will give you the names of several cheap books, each dealing with one subject alone. The nearest approach to the book you desire is "Electricity in the Service of Man," published by Messrs. Cassell & Co.—G. E. B.

Covers for WORK.—BOOKBINDER.—Messrs. Cassell & Co., London, E.C., will supply you with these.

III.—QUESTIONS SUBMITTED TO READERS.

**** The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Telephone Connection.—A. S. B. (*Loughborough*) writes:—"I am desirous of having some arrangement on the outside of a building by means of which a man at work may be able to tell if the bell on a telephone inside the house has been ringing. I should be much obliged fur sketch showing suggestion."

Machine Wheels.—COG writes:—"Will any reader of WORK tell me of the best book on wheelwork for machines, or furnish me with information as to the best methods of wheel gearing?"

Bicycle Cement.—T. B. (*Great Orton*) asks for the address of the makers of Snell & Brown's Octopus cement.

Fretwork Exhibition.—NEMO writes:—"I should feel greatly obliged if any reader would kindly let me know of any exhibition in which fretwork can be exhibited."

Folding Garden Seat.—T. W. (*Cardiff*) writes:—"Will some reader of WORK kindly give me instructions how to make a folding garden seat of pitch-pine wood, with best way of cutting same to save timber?"

Stained Glass Designs.—J. B. (*Moss Side*) writes:—"I should be much obliged if any reader of WORK could give me an idea of where to get some good designs for stained glass, both geometrical and leaf-work. Could anyone supply me with a few, and at what price?"

Picture Framing.—J. P. (*Chester-le-Street*) writes:—"On page 126, No. 164, E. B. (*No Address*) says 'he could not get through half of his work if he had to bother with corner cramps.' Would he or any other reader tell me which is the best way to fasten the ends together?"

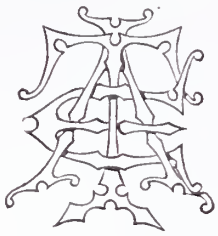
Glass Case for Model Ship.—E. C. (*Leyton*) writes:—"I should be greatly obliged if some kind reader would give me a detailed design for above. Dimensions, 2 ft. 4 in. long, 8 in wide, 1 ft. 4 in. high."

Engraving on Metal.—NELSON writes:—"Will W. J. B. (*Londonderry*) kindly oblige NELSON with his address? He wishes to write to him. A postcard will find NELSON, Duke's Town, Tredegar."

Vanguard Paint.—A. F. (*Luton*) writes:—"Can G. H. (*Leeds*), *re* answer to J. W. S. (*Guernsey*) (see No. 163 of WORK), kindly tell me where I can get the paint called 'Vanguard' paint, about the price, and if in colours or not?"

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

A. E. T. Monogram.—J. B. writes, in answer to SHAMROCK (see WORK, No. 156, page 830):—"I think this monogram will in every way fit the shield you mentioned."



Monogram for Shield.

Mitre Cutting.—G. E. W. (*Swanley*) writes to J. A., E. B., and SENTINEL:—"I have used Booth's Registered Mitre Cutting Machine for twelve months, and find that it is quicker, quite as accurate, and does not require so much practice as a plane, etc. My usual method is to cut the mitres first, and then to shoot them with the machine; as for the corner cramps, they are awkward at first, but only require practice. I certainly would not be without them now."

Surveying.—M. (*Bishop Auckland*) writes to C. J. T. (*Devonport*) (see No. 164, page 126):—"One of the following books will perhaps suit you. 'Surveying and Levelling,' by W. F. Stanley, 7s. 6d. (Spon, Strand); or, 'Land and Engineering Surveying,' by T. Baker, 2s."

Pinhole Photography.—M. (*Bishop Auckland*) writes to H. A. H. (*Tunbridge*) (see No. 164, page 126):—"You can use any camera, substituting a thin metallic plate or card for the lens, through which the hole is made. A long exposure is required. See page 131, Vol. IV. of WORK."

H. E. B. Monogram.—W. J. B. (*Londonderry*) writes to WIN (see No. 155, page 814):—"I enclose sketch of monogram H. E. B."

H. E. B. Monogram.

Pinhole Photography.—A. G. (*Sheffield*) writes to H. A. H. (*Tunbridge*) (see No. 164, page 126):—"Yes, any camera will do. Unscrew the lens from the mount, put a thin visiting-card down the diaphragm slot, and make your pinhole through centre. The nearer the dry plate is to the pinhole the wider the angle of view, and smaller the picture; the further away the dark slide the narrower the angle of view, but the objects in the picture will be larger. Of course, you will have to give a very long exposure—say, five minutes—for outdoor subjects."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—J. W. (*Darlington*); H. J. C. (*Compton Bishop*); R. M. (*Glasgow*); G. M. (*Sunderland*); WORKER; FACTORY LAD; CHEMICUS; E. S. (*Stockwell*); BUCKEYE; W. H. T. (*Westminster*); R. H. A. (*Forest Hill*); S. P. (*Huyton Green*); G. B. (*Frodsham*); S. P. (*Sunderland*); W. B. (*Golcar*); H. A. H. (*Wanaoesa, Manitoba*); WIRE; G. C. S. (*Inverness Gardens*); GREENHOUSE; E. A. (*Brompton*); T. G. (*Kettering*); W. L. J.; J. S. (*North Biggart*); J. E. W. (*Islington*); R. B. (*Ashton-under-Lyne*); J. F. (*Pimlico*); C. & P. (*Leicester*); REG.; W. M. J. R. (*Bristol*); D. B. (*East Grinstead*); G. D. C. (*Brixton*); J. B. (*Glasgow*); J. N. (*York*); W. R. (*St. Albans*); G. H. (*King's Lynn*); MODEL; P. E. B. (*Birkenhead*); A. H. G. (*Hampstead, N.W.*); P. B. A. (*Liscard*); R. F. (*Thirsk*); J. G. L. (*Merthyr Tydfil*); W. B. (*Balham*); C. C. (*Glasgow*); W. C. (*Plaistow*); T. D. (*Ipswich*); F. W. P. (*Battersea*); G. C. (*Aberdeen*); H. W. (*Bartholomew Road*); H. J. (*Tidswell*); D. D. (*Leven*); E. F. C (*Southampton*); A. G. (*Lambeth*); G. S. (*Banff, N.B.*); G. E. (*Notting Hill*); W. B. (*New Brompton*); F. J. K. (*Upper Holloway*); R. W. K. (*Bradford*); NEMO; D. D. (*Moida Vale, W.*); VILLAGE SHAVER; S. C. C. (*Manchester*).

"WORK" PRIZE SCHEME.

SECOND COMPETITION.

THE Editor of WORK has the pleasure of calling the attention of his readers to the Second Competition under the Prize Scheme, which so many readers of WORK have thought to be a suitable sequel to the late WORK Exhibition.

The subject for the present competition is, like that of "The Cycle," one that appeals to the whole of our readers, young and old alike, and places them, therefore, at equal advantage.

It will take the form of a suggestion for

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ALL Descriptions to bear the WORK Prize Coupon, cut from one of the numbers of WORK in which the Prize Scheme is announced.

Each Description to be signed with an original *nom de plume*, and to have the writer's real name and address securely attached to the manuscript in a sealed envelope.

Each Suggestion should be fully described in respect to its purpose, construction, and working, and, where possible, should be illustrated with a drawing of the article itself and its various parts to elucidate the description.

A Suggestion not illustrated will have an equal claim in the competition provided the description be sufficiently in detail to convey a full idea of the article suggested.

In the work of judging regard will be had to the practical nature and utility of the suggestions, and their prospective popularity.

The Prize Suggestions and Drawings, and any others, to be published, if desired by the Editor, in WORK, but the copyright thereof to remain with the authors.

Copies of MSS. and Drawings to be retained by the competitors, as in no case can the return of MSS. be undertaken.

The Editor of WORK will supervise the judging of the Suggestions, and the selection as determined upon is to be final.

All manuscripts intended for the "Useful Household Article" competition must be addressed to the Editor of WORK, c/o Cassell & Co., Ld., Ludgate Hill, London, E.C. They must reach him not later than SATURDAY, JULY 30, endorsed, "Useful Household Article" Competition.

NOTICE TO READERS.

Next week's issue (No. 173) will contain special papers on

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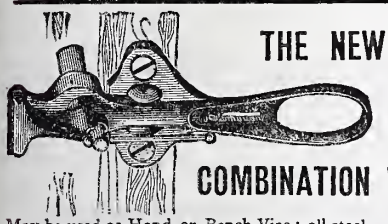

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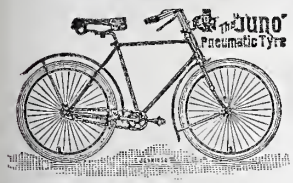

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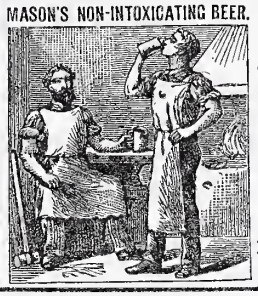

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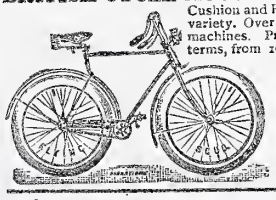

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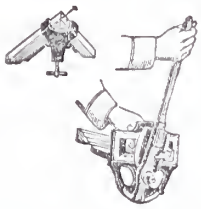

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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VOL. IV.—No. 173.] SATURDAY, JULY 9, 1892. [PRICE ONE PENNY.

WORK WORLD.

A NEW method of soldering aluminium is before us. The surfaces to be soldered are sprinkled with chloride of silver, and the solder is then melted down as usual.

* *

Long-distance telephones are now so reliable that St. Petersburg and Moscow are to be brought into communication by this method. The distance is 409 miles.

* *

A tramcar which owes its motive-power to the expansion of ammonia from the liquid to the gaseous state is now being tried experimentally in America. It runs eighteen miles with one charge of ammonia, the pressure obtainable being about 150 lb. per square inch. The spent gas, moreover, is absorbed by water, from which it can be extracted and used over again. The car takes two minutes to recharge, and is noiseless.

* *

Chrysoprase jewellery is one of the latest things out. This apple-green variety of chalcedony makes up into light, tasteful articles, particularly if a few small diamonds and rubies are added. Not being a bright stone itself, it needs them to set it off to advantage. It is introduced, doubtless, to succeed the moonstone, which has had so long a run. The moonstone possesses, however, an amount of life—a change or play of light that is—of which the chrysoprase has not a vestige.

* *

We can yet hold the first position in shipbuilding, or the French Government, which required a gun-boat to be built within forty days, would not have sought out Messrs. Yarrow, who built it in twenty-three days! It is 100 ft. long, 18 ft. beam, and draws 18 in. of water. It has two decks, and is fitted to carry seven quick-firing guns throwing shell loaded with bullets. It is propelled by paddle-wheels astern, and will carry 400 troops. On a trial trip a speed of nearly ten miles an hour was attained.

* *

The notion of a two-stone has been introduced into America for engagement rings. If the stones are chosen so as to represent the supposed good qualities of the engaging parties, somebody will have to look up Theophrastus, who divides precious stones into male and female orders. The Oriental ruby is said to be male, while the spinel ruby is female; with sapphires the deep blue is the male, the pale blue the female. These and other gems are credited with wonderful merits and properties.

* *

The Government of Holland is considering the project of draining the Zuyder Zee. It has an area of 760 square miles. It is proposed to construct a dam from the mainland on each side of the island of Wieringen, then to divide the enclosed area into four parts and drain them successively. The dam is estimated to cost over three and a half millions, and the drainage thirteen millions, the time occupied being thirty-two years. The machinery would be made in England.

* *

In two new photographic developers, the Amidol and Metol, the former has claim to novelty in that it energetically develops the images on gelatino-bromide of silver plates with an acid reaction of the solution, while an alkaline reaction is not only useless but prejudicial. The Amidol acts as a faultless rapid developer as well as a slow one. The Metol acts with the alkaline carbonates as a very energetic, clean, and quick working developer for gelatino-bromide of silver plates, and also weaker for chloride and chloro-bromide plates.

* *

When stiff boot toes are made, workmen bring the stiffening over the top of the toe. This is a mistake, and one which, it would be thought, practical men would not continue to commit. The vamp, cap, and lining, or even the stiffener itself, make a very hard substance to press upon the great toe nail. All that is necessary is that it shall be as high as the last is thick. This prevents the leather from falling into wrinkles—all that is asked of a block toe—and saves dame Nature the trouble of adapting herself to surrounding circumstances, by creating an ingrowing toe nail.

* *

Glasgow boasts the two tallest stacks yet built—St. Rollox, 435 ft. above ground level; and Townsend's, 454 ft. above ground, or, with the addition of the iron crown on top, 474 ft. The Germans claimed to have the highest stack in the world, but when they said so they had not heard of Townsend's. A noted steeple-jack is now employed to point the Townsend chimney from ground to top, which he does by means of ropes suspended from the top, on which is hung a "Bosun's chair." The surface to be pointed is 6,000 square yards, which it will take three months to execute.

* *

The work of the Mint is extensive. During the year 1891, 142 tons of gold bullion were melted and cast into sovereign and half-sovereign bars; and 237 tons of silver were melted for the Imperial coinage and for medals. Many experiments have been made in this country and abroad to ascertain the wear of gold coin, but trials in special apparatus are no criteria of wear in ordinary use. It appears that on the average it takes twenty years to reduce a sovereign to its least current weight. A new series of alloys of aluminium and gold is of interest from the intensity of the colours, which varies from yellowish-green to purple.

* *

A new retort house at the Rochdale gas-works is built on an entirely new system, which, if it becomes general, will do away to a large extent with that white slavery—gas stoking by hand. The coal is fed into a hopper on the ground level, and passes between toothed rollers which break it up into small pieces. It then falls into a pit, in which two series of buckets, mounted on an endless chain, revolve. These buckets convey the coal upwards to a height of about 35 ft., and discharge themselves into another hopper, which has a sliding bottom. Under this is a railway running the whole length of the retort house, along which runs a carriage capable of holding enough coal to charge two retorts, and having a spout at the bottom reaching to the opening of the retorts below, so that a man at the top to load the carriage, and one at the bottom to open the retorts, can manage the stoking for the whole. The coal falls in and "stokes" itself. The retorts are placed on an incline of about 30°, and when it is time to discharge the coke they are opened at the lower end and empty themselves.

ABOUT WORK AND POWER.

BY W. C. CARTER, M.I.MECH.E.

The Steam-Engine Indicator.

The invention of the indicator is attributed to the genius of James Watt, though some detractors have suggested that he stole the idea from a workman in his employment. However that may be, the discovery was a stroke of true genius, and from his achievements in other directions the probabilities point to Watt as being certainly one of the few men of that day from whom we might expect such a masterly idea.

The indicator is a machine which traces automatically a line diagram upon a card which possesses most interesting features. From it we can obtain almost all the information we want about the action of the steam in the cylinder, and it has been well compared to the stethoscope of a doctor, by which internal complaints may be diagnosed.

The diagram is confined to the operations of one stroke of the engine, and therefore its indications have to be multiplied by the number of strokes in a minute to find the Power developed, as they do not show any *time* data, which, we have seen, are necessary to the question. The diagram then shows us simply the work of each stroke, and therefore contains only two elements—Pressure and Distance. Referring to Fig. 5, supposing that we make the vertical lines to represent lengths of stroke of piston, we shall, by suitably combining them, form an area which shall represent by its surface the amount of work. For example—if A B is made to represent 5 lb. pressure on piston, and A D is made to represent 6 ft. stroke of piston, the work done is $5 \times 6 = 30$ foot-pounds; but if we multiply the side A B ($=5$) by the side A D ($=6$), we get an area of 30 square units of some kind, so that it is clear that the area of the complete figure does really represent the amount of work, just as we know that geometrical truths can be illustrated by arithmetical examples, as they are all a part of the exact science of mathematics. Thus our arithmetical operations in finding the work can be exactly reproduced by combining two dimensions into an area as in the figure. We see in Fig. 5 that the full pressure is maintained to the end of the stroke, as the pressure line, B C, remains parallel to the base line, A D. The line B C is, of course, formed of an infinite number of points which are the ends of imaginary vertical lines, each representing the pressure at that particular part of the stroke.

Suppose, now, that at half-stroke (E) we cut off the steam and the pressure begins to fall from the point, F, an expansion takes place, then the line, F C, will also drop as the vertical measurements become constantly less, and we then get the hyperbolic curve (approximately) of the expansion of steam as shown dotted.

Our argument still holds good, though the figure is no longer a rectangle, and the area is still proportional to the work developed, whatever shape the card becomes. It will be beyond the scope of this paper to go into the many points indicated by this wonderful instrument, such as valve-setting, compression, weight of steam used, etc., but we have said enough to show how it is that we can obtain a graphic and automatic representation of the work done by the steam.

Of course, it would be awkward to have a card as long as the stroke of the engine, so it is usual to drive the indicator from some point, the motion of which *corresponds* to that of the piston, but does not exceed about 5 in. altogether. The vertical scale is controlled by the compression of a spring, which can be changed at will. All that we have to remember is that, according to the scale of reproduction, our diagram is *proportional* in each way to the piston stroke and the pressure. We have in Fig. 6 a general view of a Richard's Indicator.

The vertical barrel, A, carries the card, and revolves upon its axis driven by a cord

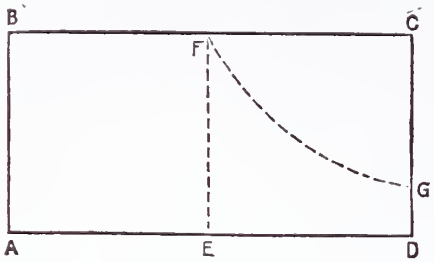


Fig. 5.—Diagram showing Work of Stroke.

attached to some suitable point with a stroke of about 5 in. Adjacent to the barrel is a small steam cylinder, B, containing a piston, which is open at the lower end to the engine cylinder, so that any steam therein can act upon it. The piston-rod, C, which carries, by means of the parallel motion, D, the pencil or marker, is kept down by a spring acting upon the piston in the cylinder, the strength of which is tested and known.

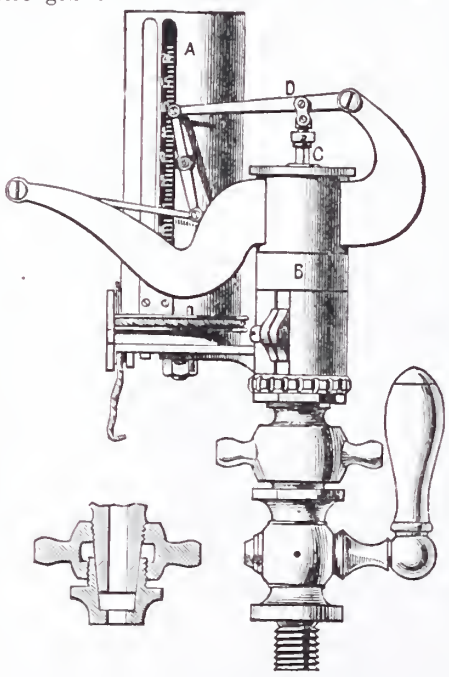


Fig. 6.—View of Richard's Indicator.

Supposing the spring to be what is called $\frac{1}{32}$, we know then that every inch it is compressed will represent a cylinder pressure of 32 lb., and so for other scales. 32 lb. pressure in the cylinder will compress the spring 1 in., and draw a vertical line upon the card of that height (A B, Fig. 5). Then as the stroke proceeds, and the pressure is maintained, a horizontal line will be drawn as at B F, Fig. 5. Steam is then cut off, pressure and marker begin to fall, and the combined vertical and horizontal motions produce the curve, F G. Then on the return stroke the exhaust opens, the pressure falls to its lowest point—we may call it zero for our purpose here—and the line, D A, is traced, completing the diagram. To find the work indicated, all we have to do is to take a series of vertical measurements, strike an average, refer to the scale of pressure, and thus find the mean pressure exerted by the steam during the stroke. The work done is then in one revolution—Mean pressure × piston area × twice the stroke; and in one minute, M.P. × area × 2 stroke × revolutions per minute; and therefore, to find horse-power, we get the formula—

$$\frac{\text{M.P.} \times \text{A} \times 2 \text{ Stroke} \times \text{Revolutions}}{33{,}000}$$

We thus find the horse-power in the cylinder, and when we have found the brake-horse-power by the method described on page 194 we have all the efficiency data we need to find the modulus.

We now conclude our brief discussion of this all-important and all-pervading subject of the indestructibility of energy, and it is hoped that these articles may, perhaps, place familiar problems in a new light, and that they may suggest to the reader many applications of their truth that have not occurred to him before, and also possibly save him from attempting to circumvent inexorable nature by bewildering but futile complexities of mechanism.

BOOT AND SHOE MAKING.

BY WILLIAM GREENFIELD.

The Principles of Lasting.

The Principles of Lasting.—In my last paper I left you with the inner soles fitted, blocked, holed, etc., on the lasts, and ready to receive the tops you will have bought.

The tops should be judged as to which is the best for each particular foot, putting the best part of the vamp—the stoutest or tightest—where you, or whoever is going to wear them, wear most. This is generally on the outside, though some people put undue strain upon the inside. This is occasioned by a spring in the walking, or through letting the heel tread over on the inside; so when this is known to be the case, the best part of the vamp must be put inside.

The upper should now be laced up as far as the bend or throat—that is, where the eyelets finish and the hooks start. This is done to prevent it flying open while it is being lasted and sewn. The stiffener—for you will only last one boot at a time—can be pasted on both sides. Judge the half of it, and put it into the upper between the lining and the outside, letting the centre be against the back seam of the golosh. The dotted line A (Fig. 1) shows its position in the boot. You then place the last upon your knees, inner sole downwards, with the heel to the left and the toe to the right. Place the top on the last, and pull it over at the toe with the right hand; place it at the back, so as to get the back seam exactly in the centre of the back of the last, covering at this portion only about two-thirds of the last, as shown at D. This is called "horsing."* Then turn it over, bottom upwards, holding the toe firmly with the right hand; place the heel between the knees, change the left hand for the right at the toe, and, with the pincers in the right, draw the toe of the upper over the toe of the last very tightly, taking care that the back seam and centre of the vamp and toe are quite straight on

* Horsing is hoisting the back of the heel. It enables you to last the boot more forward, and to throw that draft into it which it would be very hard to get by the use of the pincers only.

the last. Then hold the upper firm with the left to where you have pulled it, and place the forefinger on the spot where the pincers are, and hold it there till you can put your first tack in at A (Fig. 2). This is the plan of the sole of the last, with the tacks numbered in alphabetical order, to show each time a tack is put in, and which is the proper order to put them in.

The leather is then pulled over, and a tack put in at B and B, each time working a reasonable and equal portion of stuff between each two tacks. These three lasting tacks* —in fact, all tacks in lasting—are put in right through everything, and into the last enough to keep the work solid; for although they are there only temporarily, they have to remain till the boot is sewn and the stitch takes their place.

Now, if the upper be quite straight upon the last, the next two tacks to be put in are C and C (Figs. 1 and 2). These are called draft tacks, as they put and keep what is called a draft in the boot or shoe. This draft is got by pulling hard with the pincers in a direction from the top of the stiffener, as shown by the line E E. It is also to get this draft that the upper is hoisted at the back, for when the whole of the fore part is lasted, and the back or heel of the last knocked down into its place, it must necessarily form a line of tightness at E E, and it is this line of tightness which is called draft. The side linings are now put in between the lining and outside, only they are not pasted; their position is indicated by the dotted line, F.

The prime principles of lasting are tight lasting, the drafting out of all the wrinkles and pipes at the toe and C, and equal pull at all parts—one side equal with the other —for it is this evenness of lasting which makes the boot look clear and set nicely when it is finished. If lasted properly, it will look, when the last is out, as though the last had not really been withdrawn.

The two tacks, D and D, can now be put in—they will hold the side lining firm; and while lasting up the sides or round the heel, you must always see that you get the lining lasted tightly; otherwise, when the boot is finished it will set in puckers and hurt the foot.

It will be seen that the top does not touch the last at G, but it must be lasted, first on one side and then on the other, until all this foulness is away, or you will have your work a size too large when finished.

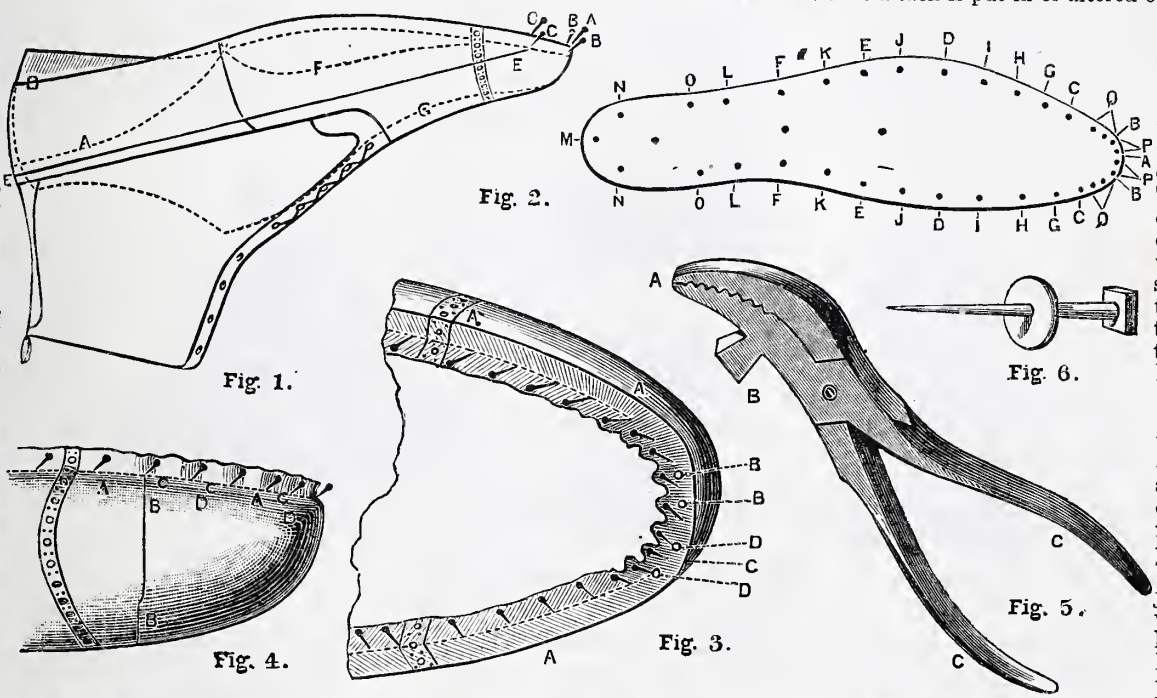
When you have got all the tacks in the fore part as far as E E (Fig. 2), the heel of the last can be knocked down into the upper until the bottom of the golosh is just above the insole, for at the seats it does not need much to last over. Sewn seats and pegged seats I shall deal with later on. The waist and seat can now be lasted similarly to the fore part, but these need not be pulled so hard, especially the waist. In fact, in the case of a shoe it will only be necessary to pull it over with the thumb and finger, or you may pull all the draft from the quarters, and thus make them baggy at the sides in wear.

Should you be lasting somewhat heavy leather, its stoutness will cause it either to set away from the last or form itself into wrinkles at the heel, and even up the sides. If this prove so, before you start to sew in seat or welt all these wrinkles or pipes must be got clear away. I shall fully explain this in lasting the toe, for the toe is a portion that will always form itself into wrinkles; and though the other parts will not need so much humouring, its treatment is exactly the same.

Now you have the last in the upper, and, with the exception of the toe, the boot is lasted. We will now proceed with the toe, which can, after you have got the first three tacks in, be very well left till the end, if you do as has been described. You will have gained practice and confidence, and this will enable you to spend as much time as you can spare upon the most important part, the toe, which, if not well and properly lasted, gives a boot or shoe, both before and after wear, a very ungainly appearance.

In lasting a toe there must necessarily be a lot of wrinkles, and as you put in each tack a "pipe" forms between it and the one next to it. Now, to last a toe properly, as much foul stuff must be got round the toe end as you possibly can, and this is where it must be lasted away: which means that you must pull as much stuff to the toe as you can in putting in the draft tacks. All must be lasted away between them, dividing the stuff as equally as you can between A and B and B and A, and also between B and C on either side. The two parts, P and G, will take a little care to last them well, but, as I have hinted, negligence here causes great defects before wear; because, if these wrinkles be not lasted out, a dreadful appearance of unevenness is given. Then, after wear, the toe falls in, and this sometimes all on one side. Thus, if the toe be lasted well at the outset, it will keep up and look smooth till the boot is worn out.

In lasting, the next thing is to tap the upper all round with the hammer at A A and A (Fig. 3). This will hammer out all the wrinkles that the "pipes" have caused in this region, and will have to be done each time a tack is put in or altered on the top.



Boot and Shoe Making. Fig. 1.—Top in Position for Lasting, showing Draft and Draft Tacks. Fig. 2.—Plan of Sole, showing the proper place for Tacks and their right order of using. Fig. 3.—Bottom View of Toe lasted. Fig. 4.—Side View of Toe lasted. Fig. 5.—Shoemaker's Pincers. Fig. 6.—Lasting and Sole Tack.

Previous to putting in each tack, the leather must be pulled quite hard. This is done according to the substance of the tops; the stouter they are the harder work it will be to last them. Fig. 5 shows a pair of shoemaker's pincers, A being the jaws with which to hold the leather while you lever the leather over, making B, the fulcrum, rest on the inner sole, while you pull and press upon the handles C and C, holding them quite firm, that you may have a proper grip of the leather. When it has been pulled enough, hold it in its place with the forefinger of the left hand until it has been made secure with a tack or rivet.

You can hardly have too many tacks in the toe. You want to keep putting them in until all the pipes and wrinkles are out, and the toe quite clear as far as the dotted line A A. (See Fig. 4).

I will now tell you what is technically meant by "pipes" and "wrinkles" in lasting. These are merely the hills and valleys that leather will form itself into where there is surplus stuff. This foulness must be lasted away as explained above. If a V-shaped piece of leather was cut out of each pipe when you had it lasted, as far as shown in Fig. 3, you would be able to tap it down, and in this way get out the wrinkles and pipes. This is sometimes done, but only by slovenly workers. No good seatsman* would think of resorting to such inferior

* Fig. 6 is a lasting tack—Scotch ones are best. ⅜ in. rivets will answer the purpose for light or medium work.

* Seatsmen: hand-sewn makers only.

means, for, although it looks very well at first, the result, when finished and in wear, is far from satisfactory.

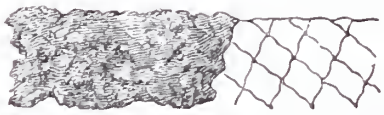
It often happens in lasting a toe it is harder to get a wrinkle out clear than it is to manage a "pipe," because if another tack is put in in the centre of the pipe—that is, between two tacks or the two wrinkles which two tacks have made—at B B (Fig. 3), this tack will help to last the pipe out. Then with a tap or two with the hammer it can be got clear away. Either of these means is useless for a deep wrinkle. The tack that has formed the wrinkle, as C, must be taken out, and an awl put under to push it out, so that a "pipe" is formed. The two tacks must be put in at B and B, and then the pipe can, as before, be tapped out easily.

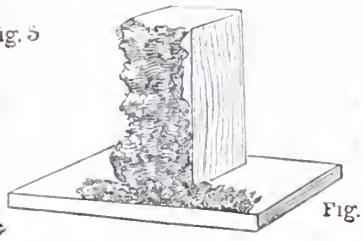
When there is a toe-cap, the vamp should be lasted first. The toe-cap can be turned back while this is being done as far as the line B B (Fig. 4). The vamp can be treated as above, and should be done as well as if it was not going to be covered up with the cap; in fact, to give it an extra fine finish before the cap is put back into its place for lasting, the vamp can be lightly filed or rasped round in front of the tacks at C, C, C on the top, and at D, D round the edge, and then hammered again at both places. This will make an even surface to last the cap upon.

In hammering the upper, do not give heavy blows, but, as I have said, only "tap" it. This can be done well all round the boot, especially at the toe, where there is a double substance, at the sides, where the side linings are, and at the heel, where are the stiffeners. This will all help to keep the boot in its place when made.

When a top is very hard to last, and there is difficulty to get it close down to the last in front—especially if the last is very hollow here, or the tops are heavy—it is best to last it down as follows:—Take half of a pair of medium welts (a half is quite sufficient, and then the remaining half will do for the other boot), and make a hole in one end: then get two sole tacks* or two large lasting tacks; cut two little round pieces of stout sole leather, and drive the tacks about half-way through, as at Fig. 6. Put the end of the welt with the hole in it at one side of the boot, and nail it there with one of the tacks, knocking it in down to the round piece of leather. Hold the boot firmly with the left hand, and pull the welt on the other side with the pincers, letting the piece of welt come right across the vamp, and when you see you have got any of the foulness away, put a tack in the vamp, or put the other sole tack in through the piece of welt and vamp as well, until you have put a tack in each side of the piece of welt, that you may take out the sole tack and liberate the welt while you are trying again to get more purchase, and the upper tighter to the last. This system is also very good for the waist when that is hard to get in. Although you adhere to the same principle, however, the mode of treatment is different, for in lasting the fore part, if you cannot get it tight enough with the pincers, you can give the two sole tacks a knock sideways, which will send their heads nearer together over the inner sole, and so tighten the tension of the welt. In the waist the welt does not go over the upper, but simply across the inner sole, from F to F (Fig. 2). To tighten the upper in this case—for although I have said tops need not to be lasted much in the waist, it often happens that they are cut so small that some means like the above must be resorted to—you must put a chisel or file under the welt, and gently lever it up while you knock the tacks sideways; but the tack must not only be knocked aside, but at the same time be sent a little further in. This, as this tack has the piece of leather on it, will prevent the tack from breaking away from the upper. Before leaving this chapter I must impress upon my readers and workers the necessity of thoroughly mastering the principles of lasting, for upon this so much of the beauty of a boot or shoe depends. In my next paper I shall hope to describe the way to fit the welts, and the method of making threads.

* Sole tacks are like lasting tacks, only larger.





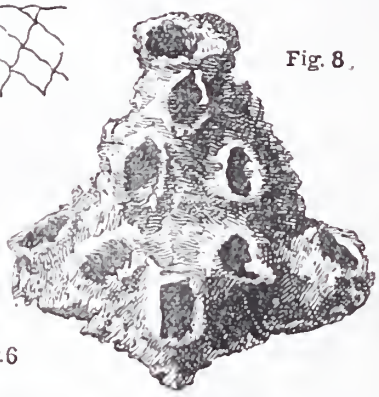


Fig. 5.—Rustic Vase. Fig. 6.—Method of constructing on Mould. Fig. 7.—Rustic Bordering. Fig. 8.—Rustic Pyramid.

SIMPLE UTENSILS FOR THE GARDEN.

BY C. MAYNARD WALKER.

Rustic Vases—Pots—Bordering.

While it is perfectly true that the chief ornaments in a garden, of whatever size, should be the plants and flowers themselves, it is pretty generally admitted that the pleasing effect of a flourishing garden is materially assisted by a few artificial surroundings judiciously applied.

The object of the present article is to describe a very simple method of producing a great variety of appropriate objects for this purpose at a trifling expense, the materials used being Portland cement, sand, and ordinary gas-coke.

Fig. 5 shows a rustic vase made of these materials to any desired size, and will be found very suitable for corners of beds, centre of wide walks, steps, etc., is practically imperishable, and improves in appearance with age. The process of manufacture is this: Ordinary gas-coke is broken up into suitable-sized pieces, about the size of a hen's egg, and dipped into a thin batter of Portland cement (these are laid aside until wanted); then, having decided upon the size and shape of the required vase or pot, it is made up as shown in Fig. 6. For the mould for the inside take any suitable object, such as a deep pickle-jar or other culinary vessel, preferably of a taper form; cover it with two thicknesses of old newspaper (this is to avoid contact with the cement); turn the mould upside down upon a sheet of paper, and proceed to build up (as Fig. 6) by sticking the pieces of bathed coke together with a mixture of one part of Portland cement to three parts of sand, using sufficient water to make it into an easily-worked, pasty substance, somewhat thicker than cream, but not so thick as mortar. So soon as the work has been built up and is *well set*, turn it over and build up the base (as Fig. 5), and afterwards withdraw the mould, and finish off with a few touches here and there of cement; sand may also be sprinkled on while the work is wet.

A rustic pyramid (Fig. 8) is made upon a similar principle, differing only in the details. Decide upon the size of the pyramid you wish to make and the number of pot-pockets; then get a circular piece of zinc or tin-plate, rather less than the diameter of the base, and to it solder an upright cylinder for the centre support; begin building up with larger rough pieces for the base; cover some ordinary flower-pots with newspaper, if you wish to withdraw them, if not, use them bare; lay them on the slant, and build up more rock-work; then lay another tier of pots and more rock-work until a rustic pile is made up pleasing to the eye. This will be found very useful for many positions. Any size and any shape of pots may be made up in the same simple and expeditious manner.

Fig. 7 represents a portion of a rustic bordering, which will be found very suitable for large or small gardens. I have frequently noticed that in many cases where the owner of a garden has not been able, perhaps, to afford stone or pottery edges, a good deal of labour and expense have been expended upon wooden borders, with the result that they are very ugly and unsatisfactory, and in a very short time become rotten. Fig. 7, however, is practically imperishable, and is very cheap, and may be made by anyone. The work is somewhat similar to the foregoing, except that it is constructed *in situ*, and the core is a strip, say, of 3 in. or 4 in., of wide-mesh galvanised iron-wire, upon which the coke is cemented, producing a serviceable and continuous bordering in any direction required.

The same kind of work may be advantageously applied to the construction of raised beds or banks near walls or pocketed rock-work upon walls, and the covering up of places which would be otherwise eyesores in or around the garden.

I may say that I have used this work for many years in all sorts of ways, and nothing could be more suitable for the purposes in view. Of course, Nature will in time clothe this rock-work with a minute vegetation, which will give it all the colour it needs; but at first it presents a rather raw appearance, which can be toned down by applying very sparingly a little colour—green, brown, or red—mixed with boiled or linseed oil, just enough to take off the raw colour of

the cement. For the bordering and for banks, walls, or other work of a similar description, as much as five or six parts of sand may be used to one of cement.

HAND WORKING OF SPECULA FOR THE NEWTONIAN TELESCOPE.

BY EDWARD A. FRANCIS.

ROUGH SHAPING THE CONCAVITY—STROKE AND ITS EFFECTS—FINE GRINDING WITH EMERY.

THE tool being fastened to the centre of the bench (Fig. 8, page 115), the first task, that of roughly shaping the concavity, may be attempted.

A handful of wetted sand, or a lesser quantity of grain emery, should be spread evenly on the tool, and over this the speculum should be pressed down and moved to and fro with long, swinging, deliberate strokes, the greatest care being taken that the centres of tool and speculum coincide at each stroke. The workman should also move slowly round the bench, in order that no two consecutive strokes may be given in the same direction. When it is felt that the sand or emery no longer cuts, it may be washed off with a sponge and fresh material supplied. The centre of the speculum and the edge of the tool will first become deeply scratched, and then actually worn away, but the grinding must be continued until the concavity of the speculum fits the convex metal gauge (Fig. 11, page 183). The gauge should, of course, be applied vertically and diametrically. It is better that the curve should be a little too deep than too flat, for it will flatten slightly in the first stages of the fine grinding.

Water must be freely used. In no circumstance should dryness be tolerated. After the rough grinding is completed, the glass and the bench must be scrupulously cleaned. The presence of a stray grain of coarse emery or sand during the later working might be disastrous, for which reason it is best to use a quite fresh sponge for the finer processes. The rough cutting of the concavity of a 5½ in. speculum should be completed easily in from four to five hours.

The desired final curve is given to the speculum by judiciously varying the length and variety of the movement of the speculum over the tool, and the skill of the workman lies almost entirely in a knowledge, gained by experience, of the exact effect of any given variety of stroke on the concave surface.

Since a long, swinging, straight stroke has been shown to best cut away the centre of the speculum, it follows that a shorter stroke will cut the surface more evenly, and for this reason a short stroke is adopted, generally, throughout the fine grinding.

A straight stroke of one-third or one-fourth of the diameter of the speculum will tend to equalise the wear and keep the concavity spherical. Any stroke greater will tend to deepen, and any lesser stroke will tend to flatten, the curve. But it is desirable at intervals to work for a short time with an irregular stroke, in which the centre of the speculum wanders erratically from the centre of the tool. Such a stroke is illustrated in Fig. 12, which is the reduction of a tracing from a Rosse machine.

The short curved stroke, which will be hereafter referred to, is illustrated in Fig. 13, which shows the path of the centre of the speculum over the tool.

With this knowledge we may proceed to the fine grinding.

The roughly cut surface of the glass has to be smoothed by working with the successive fine grades of emery powder. At first unwashed flour emery may be used until the glass presents a fairly uniform appearance—that is, until the coarse scratches or pits left by the sand begin to disappear. Then the graded emeries must be resorted to.

The object of the first emery grinding being to reduce the scratches left by the sand, so the object of each successive grade is to reduce the scratches of the preceding grade, and thus the workman may decide, by examination, when the time has arrived to change any given grade for the next finer. A "wet" of well-prepared, good emery should work for from ten to fifteen minutes before its cutting power is lost.

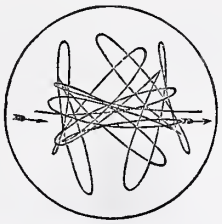


Fig. 12.—Reduced Diagram showing Irregular Stroke.

The best stroke will be one-third, and scarcely any pressure will be needed; the speculum for the rest of the working being always guided rather than pressed down. As the fine grinding reaches completion, the stroke should be reduced to one-fourth, and an occasional irregular movement may be introduced, because the danger of working the concavity out of centre will have passed.

Very little emery will be required for each "wet," and the lesser the quantity used the better will be the workmanship.

The actual process is as follows:—Emery wetted to the constituency of cream is carefully spread over the tool, the tip of the finger being used to detect and remove grit. The speculum is then placed centrally over all, and at once pressed hard down in order to crush any large grains of mineral which may have escaped notice. Two or three short circular strokes are then given to distribute the abrading material, and then work with straight strokes is maintained, the wetted emery, at first chocolate in colour, being felt to distinctly cut the glass. But the chocolate colour slowly changes to grey as the fine glass becomes incorporated with the emery. Finally, the cutting sensation ceases entirely, and the speculum moves as on stiff grease. It is then slid (not lifted) from the tool, and the glass surfaces should be cleaned before fresh emery is supplied.

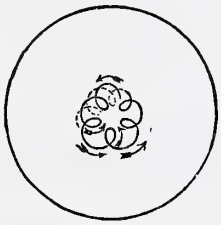


Fig. 13.—Reduced Diagram showing the Path of the Centre of the Speculum over the Tool in a Short Curved Stroke.

There is a likelihood that from lack of skill the centre of the concavity may, in the rough grinding, be cut too deeply by the sand. If this be so, it will become evident at once, when the finer working is begun, because, while the greater part of the glass will be perceptibly smoothed, the central depression will remain rough. In such a case it is best to return to the coarser grinding for a short time, and work with an irregular stroke and without pressure.

It is also desirable to test the focal length before the graded emeries are brought into use. This is effected by wetting the smoothed glass surface and placing it in the direct sunlight so that it will reflect a faint image of the sun on to a shaded paper or wall. When the reflected image is smallest the distance from mirror to wall will be the approximate focal length. If it be found to be too long or too short, it can be most speedily corrected by rough grinding, using a long, straight stroke to shorten the focus, and a short, circular stroke to lengthen it.

Assuming, however, that all is correct, the fine grinding may be now steadily proceeded with, using the graded emeries in careful succession from the coarsest to the finest, and doing the utmost that can be done with any one grade before the next finer is applied. With the three finest grades it is a good plan, at the end of ten or fifteen minutes' work, to slide the speculum off and wash it, leaving the tool unwashed, and then to return and work the wet speculum over the unwashed tool for five minutes longer. This secures an exquisitely delicate surface. It is not necessary, when changing emery, to dry either the speculum or the tool, and water (in drops) may, of course, be applied at any time as the working demands it.

When fine grinding has been properly and intelligently performed, the final curve is quite spherical, and the surface of the glass is "semi-transparent, appearing as if covered with a film of dried milk." It is then ready for polishing.

A THREE-CORNERED CHINA CABINET.

BY E. MONTAGUE AUSTIN.

INTRODUCTION—SELECTION OF MATERIAL—THE BACK—EASY METHOD OF SQUARING SAME—BASE AND PLINTH—CARCASE TOP—CENTRE PARTITION—DOORS—PILLARS—THE TOP AND MOULDING OF DITTO—BACK RAIL—FITTING SPINDLES—GENERAL HINTS—COST—CONCLUSION.

Introduction.—Perhaps, at first sight, a few of our amateur readers will be inclined to think that the subject of the illustration looks rather difficult for them to attempt, and that to "throw off" so large a job would be a little beyond their ability. Anyone, however, who has carefully read the lucid and thoughtful lessons given in previous numbers of WORK in the rudimentary use of wood-working tools ought to be able to turn out, with a very few tools, such a piece of work creditably and to their own satisfaction. Furthermore, I would just like to breathe (in only the faintest suspicion of a whisper) the old saying about the "faint heart" and the "fair lady," and so endeavour to dispel all fears for the result, provided with honest intention the start is made, and a little perseverance is brought to bear to carry the work through to the finish.

Being in the proud position of parent to the article which I have fondly christened "a three-cornered china cabinet," I feel I am able to speak with tolerable confidence as to the simplicity of its construction; but as I know our editor's space is limited, I will waste no more of so valuable a commodity in mere argument, but get straight to the work of description.

Selection of Material.—To repeat that somewhat monotonous phrase which usually prefaces all instruction for making anything of timber, the first thing to decide on is the wood of which our cabinet is to be

made. This is quite a matter of taste or convenience. Of course, the carcase of the cabinet is made of deal, and the remainder of whatever other wood is decided on.

The Back.—First in order of making is the back. This can be made of ½ in. matchboarding (*i.e.*, boards with tongued and grooved edges), and should measure, when complete, 2 ft. 6 in. wide and 3 ft. 6 in. high. Cut a sufficient number of lengths of the boarding (it is usually 6 in. wide exclusive of tongue) to make up the necessary width when fixed together and knocked up tight, and fasten the whole firmly together with two pieces 4 in. wide, screwed or nailed on across the back 4 in. from the top and bottom respectively. This is, perhaps, a little rough, but it answers the purpose very well, and as the back is covered internally with a lining, the work need not be too elaborately done. For the same reason, matchboarding need not necessarily be used; any ½ in. stuff closely jointed would suffice. Be sure that the back is quite square when finished. The following is a simple method of ascertaining whether the back is square: Carefully measure diagonally across from top right-hand corner to bottom left-hand corner; then measure in the same way the two opposite corners. If the two measurements agree, the back is square; if they do not agree, the necessary alteration must be made until they do.

Base and Plinth.—Next make the base, a plan of which, with measurements, is shown at Fig. 1. The cross lines show a method of jointing up the pieces composing the floor of the cabinet, those on the outermost edge being of the "face" stuff, the remainder of deal. The plinth is also made of the better material, and the dotted lines in Fig. 1 show the blocks underneath which glue this in position. The plinth is 4½ in. deep, of ¾ in. stuff, and must be very carefully put on and mitred where joined, to fit with a clean joint.

Having made the base, mark out on it the position of the various upright pieces as shown in Fig. 1, setting the face line back 2½ in. from the front all round, and then make the carcase top (shown in section, Fig. 2, B) in a similar manner to the floor of the base, only the size necessary to exactly cover the portion lined out—that is, 2½ in. less than the floor of the base, all round. When ready, this carcase top is screwed down to the top of the back and partition, and has the side and front pieces dovetailed to it. The side pieces and centre piece are of ¾ in. wood, the former being 4 in., the latter 3 in. wide at the face, and they must be cut the necessary length (3 ft. 2 in.), to allow of their being dovetailed into the carcase top as before mentioned, and dowelled into the base; or they may be screwed up from beneath, if preferred. The base is fixed in position with four screws through the back, as shown in Fig. 1. The inside edge of the sides (that next the door frames) must be bevelled off at the proper angle to bring their edges at right angles to the doors. The centre piece has each side bevelled in the same way (see Fig. 1, A). The four strips ¾ in. wide (marked B, Fig. 1) must be carefully fitted to the bevelled edges of the side and front pieces with a clean joint. The partition in the centre is of ½ in. stuff, 16½ in. wide and 3 ft. ¾ in. long, and is fixed in position with screws from the back, and through the carcase top and base.

Doors.—If everything has been made as directed up to this point, and the whole temporarily fitted together, you will now be in a position to make and fit the door frames. These are of ¾ in stuff and of the following measurements:—Uprights 2¼ in. wide, top rail 3 in. wide, bottom rail 4 in. wide. The frames are mortised together in the usual way. The outside measurement of the door frames will be approximately 1 ft. 7 in. wide by 3 ft. high; but the exact size had better be taken from the space left for them after fitting two narrow sills ¾ in. deep on the floor, and also the two head pieces over the doors shown in section (Fig. 2, E). Make the door frames a little large, to allow of accurate fitting, and with a ¼ in. rebate for the glass (Fig. 2, C), which is fixed in position with ¼ in. strips bradded to the frames, as shown. The glass is not put in, however, till the last thing, when the whole is painted or polished and the doors ready for hanging.

Pillars.—If possessed of a lathe of sufficient size in which to turn the pillars, these may now be got on with. These are turned out of 2 in. square stuff, and I think no difficulty will be experienced in drawing a full-length pattern from the sections given in Figs. 4, 5, and 6. They measure from end to end 3 ft. 1½ in., exclusive of tongues, but leave the ends a little long, to allow for fitting. The spindles on the back rail may also now be turned; one is shown reduced at Fig. 3, as also the terminal pillars. If not possessed of a lathe, make careful full-size drawings of the articles, and any turner will get them out for a few shillings.

The Top.—Now comes the top. Let this be of good material, ¾ in. thick, with a nice grain, and carefully planed up. It is rather less than the size of the base, say ½ in. each way, and is made in the same manner. When ready, fix it in position with screws from underneath the carcase top. Now mark the position of the moulding (Fig. 2, D), and also that of the pillars on the underside of the top (which, by the way, has its edge rounded as shown), and take it off again to drill the necessary holes (⅜ in. deep—not *through*, mind!) for the tongues of the pillars. Having fitted these in position (top and bottom), proceed to make the three pieces of moulding, as shown in section, Fig. 2, and carefully fit them in position ready to be finally glued to the top.

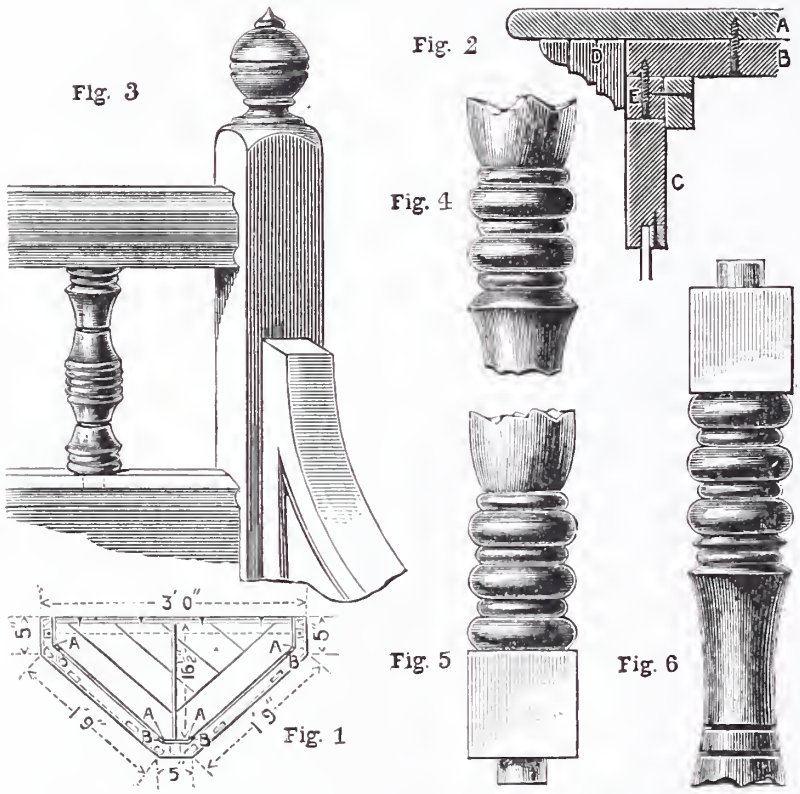
The back rail is made as shown in Fig. 3, and measures, extreme length 3 ft., width 5½ in. The narrow rail is ¾ in. wide, with the face edges grooved as shown; the upper edge of the wide rail is also grooved. Be careful in marking out the position of the holes for the tongues of the spindles that they are accurately placed above and below each other, so that the spindles will be perfectly upright.

When the doors are fitted ready for hanging, and with locks and keys, etc. (as to which I think no particular explanation is needed), the shelves may be made with any ½ in. or ¾ in. stuff you have at hand, and fixed in position (when covered) on narrow bearers, bradded or screwed to the back and partition. This is done after the cabinet is lined.

This concludes the description, so far as the making and fixing portion of the work is concerned. It only remains for the cabinet, when so far completed, to be stained, polished, or painted, as the taste of the maker may dictate, and lined with a suitable material, such as baize or Japanese paper. With a general hint or two, therefore, as to method and cost, I will now close this description, which I trust may enable any amateur to turn out a both useful and ornamental piece of furniture.

As to method: always plane up all wood, so far as is possible, before finally measuring. Cut rather too much than too little, as the waste caused by sawing and planing in getting things square and true frequently exceeds expectation and spoils the piece. Finish off with glass-paper each section as you go along; it saves time in the end. Make all measurements with the utmost care, and make them twice over, to prevent mistakes.

These few points, carefully borne in mind, will save much time and vexation, and greatly increase your pleasure in the work.



A Three-Cornered China Cabinet. Fig. 1.—Plan. Fig. 2.—Section through Centre of Door. Fig. 3.—Portion of Back Rail showing Spindle, Terminal Pillar, and Support. Figs. 4, 5, 6.—Centre and Ends of Pillars.

With regard to cost, the prices set out below are what the materials cost the writer, but they can be used as a rough guide only, as quotations vary with localities—

	s.	d.
Wood (deal)	3	0
„ (walnut)	6	6
Scarlet baize lining, 3 yds. at 1s. 4d. ...	4	0
Glass	2	6
Locks and hinges	2	6
Polish and sundries	1	6
	£1	0 0

If turning has to be paid for, the cost will be about 4s. 6d. more.

Wishing every success to those who may attempt this not difficult piece of work, I will only add that I shall be pleased to help anyone over any little difficulty they may encounter through the medium of that most useful section, "Shop."

WRINKLES FOR ALL.

To remove hot-water marks from mahogany, rub the mark on the wood with linseed-oil, and afterwards pour on the spot a little spirits of wine (not methylated spirit), and rub dry with a soft cloth.

For a leakage in iron pipes, mix iron filings into a stiff salve with vinegar. Well dry the pipe, and fill up the crack with the salve, and it will soon harden and effectually stop all leakage. If the hole or crack is too large to stop with the salve, a bit of thin sheet iron can be securely fixed over the fracture.

To detect iron from steel tools, place the tool upon a stone, and drop upon it some diluted nitric acid (four parts of water to one of acid). If the tool remains clean, it is of iron; if of steel, it will show a black spot where touched with the acid. These spots can be rubbed off.

Parchment paper can be prepared as follows:—Boil a bit of good white soap in soft water till an oily fluid is produced. Lay it on any kind of paper with a brush, and when dry, coat it with a strong solution of alum. It will be like leather, and waterproof.

For an imitation black walnut, mix one part of walnut-peel extract with six parts of water, and coat the wood with the solution. When the material is about half dry, rub on it a solution of bichromate of potash with water. This plan adopted even on poor pine will defy detection from real walnut.

An excellent furniture polish may be made with equal parts of shellac, varnish, linseed-oil, and spirits of wine.

For good harness composition, take ½ lb. of ivory black, 1 oz. of indigo blue, 1d. heel-ball, 1 oz. of gum arabic, 2 oz. of spirits of wine, ½ pint of turpentine, and ¼ lb. of beeswax. Dissolve the wax in the turpentine, and the gum in the wine. Mix the whole together, and simmer over a slow fire ten or fifteen minutes. Take care that it does not run over.

AMERICAN INVENTIONS.

The Yankee brain seems to be at once the most imaginative and the most fertile in the matter of inventions—spending itself as it does in original ideas for tools and appliances which find their way all over the globe. We bring before our readers suggestive details of a few of the most recent results of the inventive faculty of our "cousins."

One is a self-closing gas burner arranged to close automatically when the flame is accidentally blown out or the gas is shut off at a distant point. The tip passes through an opening in a plate made of two metal strips of different material, preferably brass and steel, so that when the plate is heated by the flame it bends upward. On the under side of the plate is a downwardly extending rod engaging a spring on the burner pressing on a wheel on the cock, the wheel containing a spring to close the cock when the other spring is disconnected, such disconnection being effected by the movement of the rod on the cooling of the plate to which it is attached.

Perspective View of Three-Cornered Cabinet.

A trace support is a simple and inexpensive metallic loop device adapted to be readily raised or lowered on the skirt to assume the proper position to carry the trace according to the size of the animal, the device being connected at its lower end with a strap to which the belly band may be buckled.

Another useful article is a labelling machine for quickly, accurately, and securely attaching labels to bottles, cans, and other receptacles, one operator, by its use, conveniently handling a large number of bottles and firmly attaching the labels. A bottle receiver contains a pad adapted to be dipped in a paste box next to which is a label table, revolving brushes being arranged next to the table, while there is a plunger for pressing a bottle between and through the brushes, and means for imparting simultaneously a vertical sliding motion to the receiver and to the plunger.

A vehicle pole is an adjustable pole adapted to vehicles of different widths. The pole has a cross-piece at its rear end, secured to the pole in the usual way, braces attached to the ends of the cross-piece being secured to the pole by bolts, and the rear ends of the braces are provided with eyes, while between the eyes and the pole in each brace is a longitudinal slot. The pole iron passes through the eye on the brace, extending forward underneath, and the iron is adapted to be moved in or out and securely clamped to the brace in any desired position.

An ingenious improvement has been effected in a wrench. This consists of a bar forked at one end and provided with serrations on the inner surface of one of the arms of the fork, the bar being bevelled and serrated at the opposite end and furnished with a pivoted serrated jaw, designed to act in conjunction with the serrated end of the bar as an adjustable wrench. A screw-driver blade is formed on the outer end of the pivoted jaw, the implement forming a simple and inexpensive tool for turning and holding round or polygonal rods, nuts, gas burners, etc., and for the use of bicyclists to turn the spokes of the wheels.

Coach, carriage, and cart builders will be interested in an axle bearing by which a simple, cheap, and easy running bearing is provided. It is adapted for application to all sorts of vehicles, and the outer end of the hub is so rounded off that when struck by the hub of another vehicle it is not likely to be injured. The outer end of the axle box is closed and its inner end recessed and screw-threaded, while the axle has enlarged bearings in the box and a collar to fit the recess, a nut on the axle entering the threaded portion of the box, and a binding screw being held partly in the nut and partly in the box.

In this country the weather is rarely hot enough to call for fans in our bedchambers, and the prospective uses of a bed fan would probably be more connected with illnesses than rude health. There seems to be scope for the invention somewhere! Hence the bed fan, a device adapted to be set up by a bedside, and operated by a treadle. It consists of a light standard from which projects a shaft carrying a fan wheel, the height of which can be readily adjusted, while the fan may be turned to throw the breeze in any direction. The device is worked noiselessly and almost entirely without friction.

Some new bicycle mechanism consists of a wheel formed with a hollow hub journaled in the bicycle frame, and carrying on its periphery a pinion in mesh with an internal gear wheel on a shaft passing through the hub, and also journaled in the bicycle frame. The improvement forms a driving mechanism of simple and durable construction, permitting of easily running the wheel at a high rate of speed, and rendering its construction very compact and strong.

A newly patented American harness saddle is for single harness, and is so made as to be expeditiously and conveniently fitted to the back of any horse. The construction provides for holding the tree of the saddle at an elevation above the back of the animal, to which the saddle is applied, and the pads are so made that they will not chafe or injure the skin, the pads being also amply ventilated.

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NOTICE.

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LOCAL WORKSHOPS.—Proposals having the object of stimulating craftsmen and apprentices of whatever trade or craft, cannot be too frequently or too forcibly introduced to their notice. The industrious workman or the apprentice, determined to improve his position, is legitimately and worthily occupied when devoting his spare time to the study of processes and the acquisition of knowledge of a nature likely to be of advantage to him in the fight for life, and of which he is called upon to make the best. The workman who does not see this aspect of matters places himself at fearful odds in the near labour struggle of the future. We believe that the time has come in this country when we need to return to the condition of things when a craft was not split up into branches as it now is, but when a craftsman's training and capabilities extended to, and were concentrated upon, his craft as a whole. Now, however, apprentices are content to learn little more than a section of their trade, which may be well enough so long as they are kept in steady employment in well-established works and factories. How does this method tell upon the worker, however, when he is face to face with some of the stern facts which are the attendant incidents of strikes and such-like emergencies? Emigration is the outlet often mooted at these critical times, but where, we inquire, is the chance for the craftsman or apprentice if he emigrates, taking with him the knowledge of a mere branch of his trade? It is a pity that the so-called friends of the workers, the agitators who stir up discontent among the men, the leaders who prate to them from rostrums—in fact, their whole host of irresponsible advisers—do not instil into them some of the teachings which would tend to make them more thorough and all-round workmen worthy of their ancestors in the old days of guilds and craft communities. A remedy for this evil seems to us to lie in the establishment of co-operative workshops, especially in villages and localities where it is possible for men of various and kindred trades to meet together for the purpose of interchanging ideas concerning modes and methods of work. This would be good if limited to men of any given craft, but far better if interchange of thought took place between those of different crafts. There is no reason why a smith should not know something of a plane, a shooting-board, or mitre, and a carpenter would be none the less qualified as a worker for an acquaintance with the tempering of iron and the forming of edge tools. Even if restricted to particular classes of trades, such as work in iron, wood, stuffs, etc., co-operative workshops would be productive of great good for the especial trade represented; but workshops arranged on a plan whereby several workers of different trades could meet for interchange of even the rudiments of the various crafts would be productive of untold good to the men and their trades, and would tend not a little to conserve many craft interests of the country which are now being slowly driven out, only to be superseded by foreign labour. Why should not a common workshop, with benches for different craft tools and paraphernalia, be fitted up and attached to working men's clubs? The clergy of town and country parishes might do much in starting a scheme of this kind. Even on a small scale village workshops would do much to divert men with leisure evenings from less wholesome pursuits. We should be glad to see the matter taken up and thoroughly ventilated in our columns by clergymen, masters, and workmen. We are on the verge of a great national crisis in connection with the trade and labour of this country. Employers and workers—be ready!

TRADE CLASSES AND YOUNG WORKMEN.—On the use the latter make of the former we have a word to say, and that word is one of serious importance to English trade in the future as well as to the individual well-being of the workman himself. On the way the young members of a trade act with regard to their own improvement, there is depending at the present time a very momentous matter; it is no less than the question of whether technical education shall or shall not be a success. We know that France and Germany have technical schools at work; then why should not we also find more of our young men availing themselves of all the advantages that trade classes give them? The fact is that very many are deficient in moral courage, or they have not pluck enough to take a course which shall separate them from those whose motto is, Take it easy, or don't trouble. If the apprentice or young workman will but look back, he will find that there has been an advance during the last few years in every direction. This much he will gather from conversation with even the most prejudiced of workmen, and yet the same older man may be the first to dissuade a youngster taking up with "new-fangled notions," such as joining a trade class, or a class in science and art. Let us make clear a prevalent misunderstanding with regard to technical instruction. It is not intended to supplant workshop practice, but to supplement it. At a trade class there are opportunities of arriving at the reason which governs this or that method; a course it is impossible to follow in most workshops, especially those where the teaching is—"Not to reason why."

IRIS BREAD-PLATTER DESIGN.

BY FLORENCE HUDSON.

I WONDER how many readers of WORK are familiar with the lovely berries of the wild purple iris (*iris fœtidissima*).

Please do not, because I begin with such a remark, jump to the conclusion that I therefore imagine WORK to be strictly urban in its circulation, or that its readers one and all despise country walks. It is to the true "yokel" that the proverb "Familiarity breeds contempt" is usually applicable; but real countrywalks worthy of the name mean glorious scrambles by footpath, wood, or moor—a turning aside from roads and beaten tracks often impossible during an English winter.

To those who love such rambles Flora reveals her choicest treasures — every season some fresh delight, the sheltered corner where the first spring sunshine tempts the celandine to show its golden stars, the undulating pasture where

"I saw a crowd,
A host of golden daffodils;
Beside the lake, beneath the trees,
Fluttering and dancing in the breeze.
* * * * * *
And then my heart with pleasure fills,
And dances with the daffodils"

—the moor above the sea, where a sharp eye spies the white heather token of "good luck"—the fairy crimson lichen cups nestling in feathery moss. Year in and year out Nature charms us by her "infinite variety."

But in January even Nature is economical; the glowing autumn leaves lie dank and sodden beneath our feet, even the hips and haws are scarce, and Flora can contribute little beyond a few stray gleams of golden gorse.

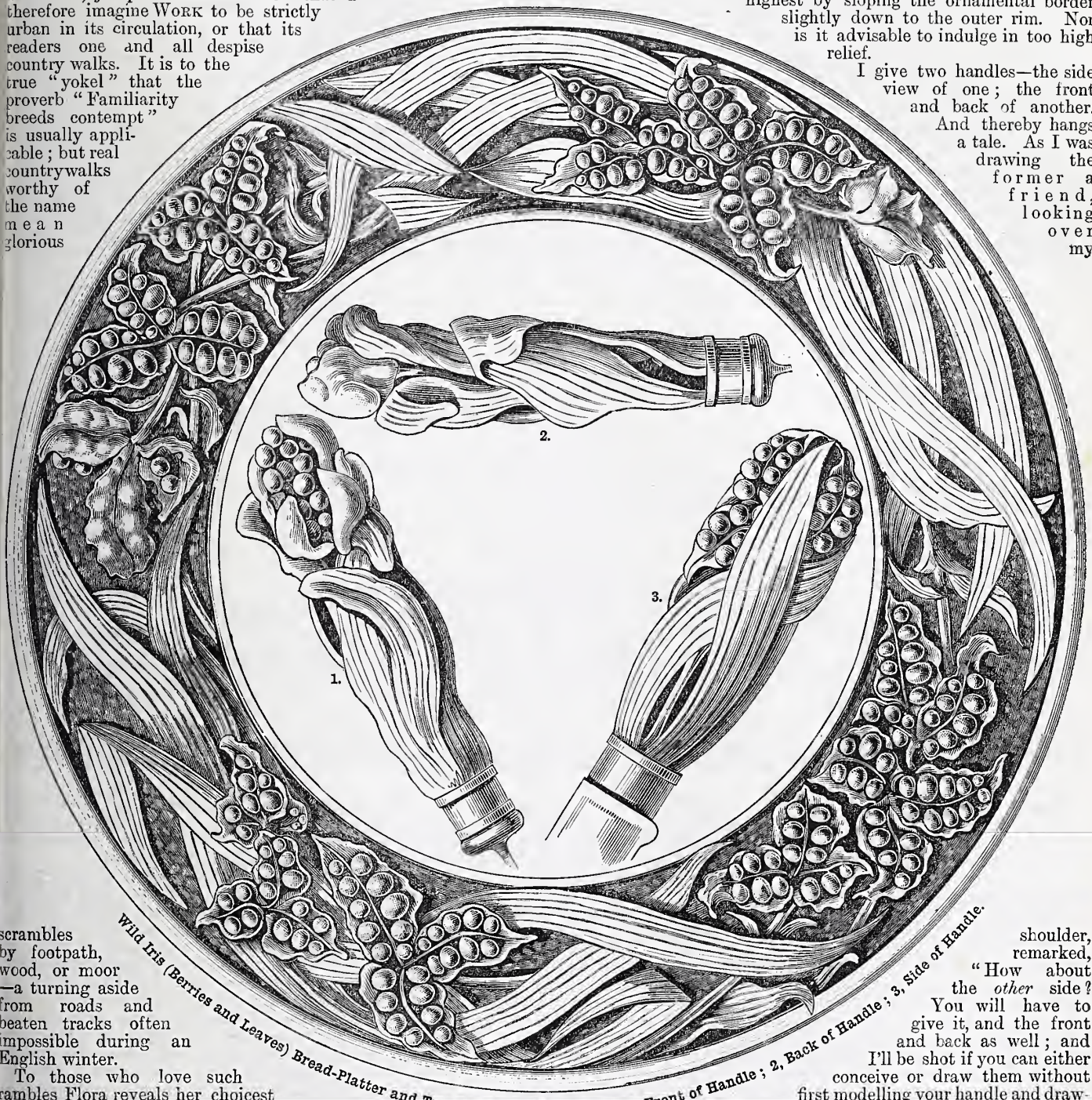
Then to come suddenly on a clump of iris, with long, sword-like leaves of vivid green showing off in fullest contrast the brilliant orange-scarlet berries, borne in a three-lobed, opened ovary of delicately withered brown—to come on such a treasure is indeed to secure a prize. Such was my good fortune, and, having carried home my treasure, the thought struck me, "How well such berries would look carved"! and the result was the design given in this number.

I do not think the pattern calls for much explanation. Bread-platters are articles in such common use that everyone is aware that they must be made of some very hard wood, that the centre part must be perfectly flat, and that it is usual to keep that part highest by sloping the ornamental border slightly down to the outer rim. Nor is it advisable to indulge in too high relief.

I give two handles—the side view of one; the front and back of another. And thereby hangs a tale. As I was drawing the former a friend, looking over my shoulder, remarked, "How about the *other* side? You will have to give it, and the front and back as well; and I'll be shot if you can either conceive or draw them without first modelling your handle and drawing from the actual thing."

"Well, yes! if that is *really* wanted, I suppose I must; but, for my part, I should say that it is *not* necessary. The other side would be very similar, and surely anyone capable of carving such a handle could easily make any slight variation or addition necessary."

However, we had a long argument, and at last, like the unjust judge, I gave way to his "importunity"; and modelling clay not being procurable, I resorted to putty, and with a stick inside as a support, I made the second handle.



Wild Iris (Berries and Leaves) Bread-Platter and Two Handle-Knife Designs—1, Front of Handle; 2, Back of Handle; 3, Side of Handle.

When done, I made careful drawings of all four sides—if you can apply such a term to rounded surfaces—and submitted them to my friend.

"Ah, that's capital! Now, wasn't I right? Let me put them together! *That* leaf goes up there, and turns so; and *that* one—no, it's the *other* one—stay, where does *that* bit come from? Let me see, *this* is the right side—no, it isn't, it's the left. Oh, bother the thing!"

Then, woman-like, I laughed at him, and said: "I told you so." The end of it was we both agreed that if

"Multiplication is vexation,
Practice drives us mad;"

and that we were quite convinced that the readers of WORK were far too clever to need anything beyond "suggestions" for a handle.

I ought to add that a good working size of the platter is a diameter of 14 in.

Personal patience is, however, indispensable. The occupation is cleanly, and need make no litter, and therefore calls for no special apartment for its pursuit. The straight-edges and curves for guiding cutting-knives must be of steel or brass, or else of wood edged with metal. The latter gives the better hold for the fingers, and is not so likely to numb their tips as rules entirely of metal. The cutting-knives should be of the best steel, with heart-shaped points, like that of the ordinary desk-knife, and well hardened, that it may not rapidly lose its edge. This is a most important point, because paper or cardboard will soon destroy the edge of any knife that is not made of the best steel. The point of the knife is kept close against the guiding-edge in order that the cut may be steadily and evenly made.

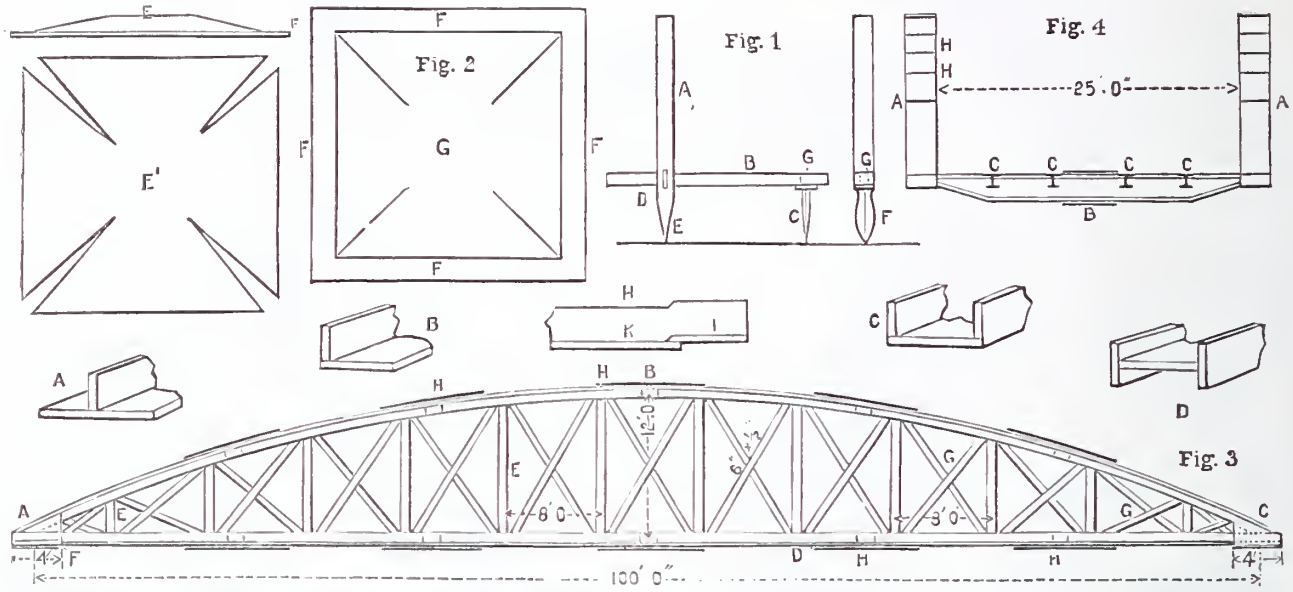
For cutting circular arcs, a compass of the form shown in Fig. 1 is used. It consists of an upright metal bar, A, with a point, E, at the bottom to rest on the centre of the arc to be cut. In the vertical bar a slot is made, into which a horizontal bar, B, fits, being passed through it to a distance which will place the knife-blade, C, at the desired radial distance from the centre, E. The bar, B, fits the slot closely, and is secured in position by a thumbscrew, D. A side view of the knife is shown at F. It is made with a tang, G, to fit tightly into a slot or recess in the bar, B. Small discs, such as are used to represent rivet-heads, may be cut out of card with a leather punch.

In making up the different forms, great care must be used to obtain neat joints, as upon this the whole appearance of the work very materially depends. In Fig. 2 are shown some forms of constant occurrence in iron bridge work. No angular forms are to be made by creasing and bending the cardboard, as clean, square corners cannot in that way be obtained. It is also obvious that the cutting-blade should be kept at right angles to the surface of the card, in order to secure square edges. The board upon which the card is cut should be made of elm or sycamore. A sheet of plate-glass is preferred by some, but this has the disadvantage of being somewhat slippery. Clamps for holding the parts together while the glue or cement is setting may be used at the option of the modeller. We, however, have not had recourse to them.

In selecting the cementing material strength and cleanliness must be sought. The slightest smear on the white cardboard is very perceptible, and mars the appearance of the whole work; and it cannot be removed without injuring the surface. The well-known Diamond cement is probably the cleanliest to be obtained, but it is expensive. Fish-glue is exceedingly strong, but it is also abominably nasty. The ordinary glue, properly prepared and carefully applied, serves the purpose very well. The best clear glue should be purchased, and soaked in cold water (previously boiled) until it assumes a gelatinous consistence. It is then to be boiled with sufficient water to render it thin enough to be filtered through book-muslin. After this it may be simmered down to any thickness found desirable; but it must always be borne in mind that the thinner the layer of glue in a joint is the stronger will the joint be. A piece of very smooth deal, sharpened down to a chisel edge, is very convenient for applying the glue to the edges of cardboard.

When several thicknesses of card require to be superposed, the glue used should be very thin and the work placed under a weight or in a press until it is dry. For tubular work the cardboard is not very suitable, and this may be more satisfactorily produced from cream-laid letter-paper. It is necessary to have a rod, or cylinder, to fit the internal diameter of the tube required and upon this the paper is rolled after having been coated with glue. The number of turns of paper will depend upon the thickness required. The strength of column made in this way is quite astonishing to people who are not accustomed to it use.

In Fig. 2 A represents the end of a T iron, such as are used for struts and stiffeners. A strip of card is cut for the table, and down its centre two lines are drawn, to show the position to be occupied by the rib. One thick pencil line, equal in width to the rib, should not be used in place of two fine lines, because the lead may interfere with the proper adhesion of the glue. When the rib is properly placed upon the table, it should be trued up to a vertical position by



Iron Bridge Modelling in Cardboard. Fig. 1.—Cutting Compasses. Fig. 2.—A, T Iron; B, Angle Iron; C, Channel Iron; D, Joist or H Iron; H, Joggled End of T or Angle Iron; E, E', and G, Buckled Plates. Fig. 3.—Side Elevation of a Tied Arch. Fig. 4.—End Elevation of a Railway Bridge.

IRON BRIDGE MODELLING IN CARDBOARD.

BY FRANCIS CAMPIN.

MATERIALS—TOOLS—KNIVES—RULES—CUTTING COMPASSES—T IRON—ANGLE IRON—CHANNEL IRON—JOIST IRON—JOGGLED ENDS—BUCKLED PLATES—TIED ARCH.

MODELS made in "Bristol board" of iron bridges, if neatly executed, always present a pleasing and interesting appearance; and their construction not only gratifies the amateur, but also educates the student if it is faithfully carried out. Bristol board is a very superior quality of cardboard, sold by those who supply artists' materials and by some stationers. Its uniformity of substance renders it very suitable for our purpose, but cardboard of a lower grade may be used with considerable success, but it does not present so finished an appearance as the work produced from the better material.

The tools actually required for this description of work are neither expensive nor numerous, though in this, as in other matters, those who wish to spend a good deal of money can do so; but they should remember that it is not always the one with the best outfit who produces the best work.

ressing squared strips of wood upon each de of it.

An angle iron, of which an end is shown t B, is made in a similar way; but here ne rib is glued on at the extreme edge, hich it must exactly meet along the whole ngth. Channel iron, C, and H iron, D, are uilt up in a similar way. Plates known as buckled" plates are very commonly used or bridge flooring. They have horizontal llets, F, around them, and the centre, G, is ished up while hot under a press (as shown n side elevation at E). To model this in ard the fillet, FF, must be cut out separately and the central part made of a piece f card, E¹, somewhat larger than the interior of the fillet edge (it is also gored out t the corners, as shown). All the edges are ouched with glue, and then brought together by bending the card so that it assumes dished form when it is pressed into the llet, which is laid on a board or piece of lass—the latter preferably, as the glue does ot stick to it, though this remark does not pply when Diamond cement is used. The ecessary length and width of the piece of ard, E¹, are found by drawing sections of it nd measuring round the curve, E, with a air of fine dividers. The extent of goring vill be such as to leave the edges equal in ngth to the inside edge of the fillet by hich they will be surrounded. Where ngle or T bars are to be joggled (as shown t H), the joggle, I, should be made in a eparate piece and glued on to the end, and he rib, K, cut out to fit it.

Having given these preliminary instructions, we will now take an example of an ron bridge and show how to proceed in nodelling it. It is, of course, taken for ranted that drawings are supplied, as it is ot the modeller's business to design the vork. The type of bridge selected is that nown as a tied arch (it is shown in side levation at Fig. 3). It is 100 ft. effective pan from centre to centre of the bearing-plates, which are each 4 ft. long, those at ne end of each girder being mounted upon ollers to allow of the expansion and contraction due to changes of temperature. Each main member consists of an arch, A, B, C, the thrusts at the end of which are resisted by a horizontal tie, D, instead of being taken on abutments, as is the case with masonry arches and also with some in ron. This arrangement, however, saves building heavy masonry supports, as the pressure on the bed plates becomes vertical. The tie is connected also to the arch by uprights, E, which take up the load brought upon them by the cross girders. The distance between centres of arch and tie at the middle of the span is 12 ft., and the uprights are 8 ft. apart; between the uprights are flat bars, G, 6 in. by ½ in., which act as counterbraces in distributing the load and resisting undue distortion of the arch. An end view of the bridge is shown at Fig. 4. A, A, are the tied arches, between which is a clear width of 25 ft.—they carry the cross girders, B, 8 ft. apart from centre to centre—and C, C, C, C, show the positions of the longitudinal bearers under two tracks of railway carried by the bridge. These bearers are connected by bracket irons to the cross girders.

In my next paper I shall complete this subject by treating of the composition of the arch and tie, the uprights, girders, rail-bearers, and cover-plates. I shall also describe the construction of the arch and tie. Should the bridge prove attractive, possibly the Editor will let it be followed by other cardboard designs.

SCIENCE TO DATE.

Properties of Pure Boron.—The pure amorphous boron recently prepared by Moissan has very remarkable chemical properties. It is infusible even in the electric arc, but it inflames in air at 700°, forming boric anhydride. It combines with sulphur when heated with that substance with brilliant incandescence; with selenium it behaves similarly, but without incandescence; but has no action on tellurium. A similar gradation of properties occurs in the case of the halogens, with chlorine and bromine it unites with incandescence, while with iodine there is no action. It combines with nitrogen at high temperatures, but has no action on phosphorus, arsenic, or antimony. On contact with silver fluoride in a mortar there is at once incandescence and detonation. It reduces metallic oxide like carbon, and even a gunpowder may be made of boron, sulphur, and nitre. It has no action on sodium and potassium, but silver, platinum, iron, aluminium, and magnesium combine with it to form borides.

Photography in Colours.—M. Lippmann, who lately communicated to the French Academy a process for photographing the solar spectrum, has made further progress with his experiments, and has succeeded in improving the sensibility of the film. He says that "On the layers of albumino-bromide of silver rendered orthochromatic by azaline and cyanine, I obtained very brilliant photographs of spectra. All the colours came out at once, even the red, without the interposition of coloured screens, and after an exposure of from five to thirty seconds." He submitted also photographs of a stained glass window of four colours—red, green, blue, and yellow—a group of draperies, a plate of oranges surmounted by a red poppy, and a many-coloured parrot. These showed that the form is produced in the photographs as well as the colours. The draperies and the bird required five to ten minutes' exposure in electric light or daylight, the other objects several hours in diffused light. It seems from this that we are not very far from the solution of the great problem of photography in colours.

New Chemical Element.—*Masrium* is the name of a new element which they have reason to believe exists in the mineral "Johnsonite," an impure manganese alum found in Egypt. Johnsonite contains about 2 per cent. of masric oxide. Masrium appears to have an atomic weight of 228, and in its reactions resembles zinc and aluminium, giving white gelatinous precipitates with ammonia, ammonium sulphide, and ammonium carbonate. It is distinguished from zinc by the insolubility of its hydrate in ammonia, and from aluminium by giving a precipitate with sulphuretted hydrogen in an acetic acid solution, and one with potassium ferro-cyanide insoluble in dilute hydrochloric acid.

High-tension Electricity.—The use of electric currents of high potential and great frequency, such as currents with a potential of 130,000 volts, have revealed many interesting new facts. They show that the insulating power of various bodies is only relative, and that with currents of a sufficiently high potential all bodies become conductors. Thus the conductivity of slate, which has hitherto been considered a perfect insulator, is made manifest by the establishment of the electric arc between electrodes of slate pencils when a high-tension current is used.

Fogs.—Experiments are being made on the dispersion of fogs by electrical means. It is found that under the influence of an electric discharge of sufficient force, fog resolves itself into rain, and in this way we may hope to be rid of our fogs.

Crystallised Anhydrous Sulphates.—M. Klobb has succeeded in obtaining the sulphates of zinc, copper, cobalt, and nickel, crystallised but yet anhydrous. They are prepared by adding the ordinary hydrous crystallised sulphates to fused ammonium sulphate, and then heating till all the ammonium sulphate is volatilised. Anhydrous zinc sulphate thus prepared crystallises in colourless octahedrons, which dissolve with extreme slowness in cold water, but more rapidly in hot water. Anhydrous copper sulphate forms grey crystals, which rapidly dissolve in water forming the ordinary blue solution. Anhydrous cobalt sulphate forms red octahedrons, which are only slightly attacked by water, even on boiling; while, still more remarkable, the green crystals of anhydrous nickel sulphate are practically insoluble in hot or cold water.

NOTES FOR WORKERS.

Electric tramways are generally superseding the horse cars in the United States.

Distilled water has considerable solvent action on glass, and even common water dissolves minute quantities. A German chemist has estimated the amount of glass dissolved by measuring the change in the electrical conductivity of the water.

Petroleum comes chiefly from Russia and the United States, but the Assam (India) Railway Co. have a well 650 ft. deep, delivering 700 barrels daily.

A portion of the test for all United States heavy guns now consists in firing them with full charges ten times in as rapid succession as possible.

The juice of the lacquer tree (*Rhus vernicifera*) is the natural varnish used by the Japanese for their famous lacquer work. Sixteen years ago specimens were brought from Japan to Frankfort, and from seeds of these there are now thirty-four trees, 30 ft. high and 2 ft. in circumference. It is intended to push their cultivation and make lacquering a German industry.

Kid gloves should be mended with fine cotton thread, and not with silk, as the latter cuts the kid more.

Mineral lubricating oils have no action on copper and zinc, and of other metals they act least on brass and most on lead.

It is said that metal surfaces can be effectively protected by dipping them, after chemical cleaning, into a cold bath of one grain isinglass dissolved (with boiling) in one ounce of water.

The most perfect preservative of the colours, etc., of fish, insects, and animal specimens is carbolised oil. Coceanut oil is the best, and a little carbolic acid is added to it.

A new telephone has been invented which is independent of insulators, is small, of simple mechanism, can be made cheaply, and is easily set up. The receiver is attached to the operator's ear, so as to leave his hands at liberty to write.

To restore faded manuscripts so that they may be more easily photographed, Herr Liesegang recommends passing them through a weak bath of ammonium sulphide.

The active crater of Tongariro, the volcano in North Island, New Zealand, is in a state of eruption.

During 1891 nearly 19,000,000 gallons of water were used by the Metropolitan Fire Brigade to extinguish fires in London. About one-third of this was taken from the river, canals, and docks. There were 2,892 calls for genuine fires.

To restore the elasticity of indiarubber articles, steep them for a few minutes in a mixture of 2 parts water and 1 part ammonia.

A mechanical engineer of New York has made a set of chessmen of silvered bronze. All the pieces are historical and contemporary, having the costumes and equipments of 1194. It took him six years.

A marble cutter has made a small working engine of marble. It has a vertical piston and two side fly-wheels; its height is 23 in., and it is 10 in. by 20 in. square. It comprises 100 pieces of marble, held together by twelve brass screws, and it is worked by air pressure.

It is said that there are over 100 electric elevators in New York City.

A singular phenomenon, lately pointed out but not yet explained, is that the interior of a piece of mild steel may be raised to the fusing point while the outside remains solid.

All the dynamos used at the Chicago Exhibition will be installed in the Machinery Hall, occupying a space about 700 ft. long and 110 ft. wide, or about 77,000 square feet. Here electric power to the extent of 22,000 horse-power will be obtained from dynamos of the principal manufacturers of the world.

One of the biggest rocks moved in railway construction in America was recently excavated on the Mexican Southern line. It was 120 ft. in height, and measured over 1,000 cubic yards. Six dynamite cartridges were successively fired under it, and at the sixth the giant boulder rolled away.

A firm of American distillers have discovered how to make whisky which is quite odourless, and yet retains all its other properties.

TRADE: PRESENT AND FUTURE.

**** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

SHIPBUILDING TRADE.—There is stagnation in almost every quarter. At present, writes our Liverpool correspondent, eighty-five vessels, of a total tonnage of 84,317, are laid up, owing to poor freights. The shipbuilding yards are doing little, and the launches are few.

ENGINEERING TRADE.—In the Lancashire district stationary engine building section scarcely any new orders of moment are being placed, while only those machine tool makers who are engaged on work of a special character are at all busy. Boiler makers report very little business. Considerable satisfaction has been manifested in connection with the performance of some ten-wheeled locomotives which were made by a Manchester firm for the New South Wales Government. These engines have proved highly satisfactory, while those of American manufacture have been shown to be unsuitable for the lines, owing chiefly to their excessive weight. Shipbuilding on the Mersey remains in a state of stagnation, while marine engineers have no new work of any kind coming forward. Many of the large textile machinists are becoming very slack, while the few orders that have been placed have only been obtained by the very lowest tendering. The iron trade of the district continues dull, and is characterised by a want of confidence with regard to the future, operations being necessarily restricted. Notice of reduction in wages has been served upon the engineers of the Tyne and Wear; some 18,000 men will be compelled to suffer a reduction of 10 per cent. The feeling of the men, who seem to understand the state of the labour market, tends towards a settlement without any strike. The two recent strikes have evidently shown the folly of turning out in the face of a falling market.

COAL TRADE.—The principal event of the week has been the tapping of the Barnsley seam of coal at the Cankiow sinkings of Sir John Brown & Co., Ltd., at a depth of 420 yards below the surface. The bed of coal at this point is 8 ft. thick. Sinkings are also being continued at the Parkgate seam, which will most likely be found at a depth of 620 yards. Barnsley coal is quoted at from 10s. to 10s. 9d. per ton. Steam coal sells quickly at from 9s. to 9s. 6d., and manufacturing coal at from 4s. 6d. to 6s. At Newcastle gas coals are firmer and steam coals are in demand. Household coals are slacker, bunker coals cheaper and more plentiful. Coke is likewise easier.

BUILDING TRADE.—Our Birmingham correspondent writes:—Both sides in the strike having waived points the strike has ceased. The grant by the London men of 5s. per week, bringing up the strike pay to 22s. per week, strengthened the case considerably for the men. In Rochdale and district the threatened strike of joiners has been averted, the masters having agreed to pay the extra ½d. an hour which was demanded by the men. This makes the wages 8½d. per hour, which is the same as was paid a few years ago, this rate of pay dating from July 1. At Colne the employers have agreed to raise the rate of wages from 8d. to 8½d. per hour.

IRON AND STEEL TRADES.—At Sheffield the iron and steel trades are fair. Best brands of crucible steel find a ready market, but there is no demand for common qualities. The work at the rolling mills and tilt forges increases, but improved business is more noticeable in cycle trade work than in the specialities for which Sheffield is famed. At the Middlesbro' iron market prices showed an upward tendency, the reason being that manufacturers have had great difficulty in restarting the furnaces; and though fifty-five furnaces are in blast, they are producing very little iron, and in some cases what is made is of such poor quality that it has been put back into the furnaces. It is probable that it will be near the end of this month before any considerable quantity of No. 3 is made. Merchants have been selling No. 3 for prompt delivery at 41s. per ton, but makers quote more. Buyers offer 40s. for July deliveries, and for July-September 39s., but sellers will not entertain these figures. Middlesbro' warrants have risen above Scotch, present price being 41s. 2d. Finished iron and steel works are more fully employed. Common iron bars are £5 10s.; best bars, £6; iron ship plates, £5 5s.; iron angles, £5 2s. 6d.; steel ship plates, £5 17s. 6d.; steel angles, £5 12s. 6d.: all less 2½ and f.o.t. for large lots. Blast furnace coke is 13s. 3d. per ton delivered.

FIRE BRICK TRADE.—The fire brick and sanitary pipe trade in Durham county is brisk.

CARRIAGE TRADE.—In Liverpool there are a few men inquired for; both body makers and carriage painters are in request.

CHEMICAL TRADE.—Chemicals remain steady, with a good demand, especially for soda ash and bleaching powder.

COTTON AND FLANNEL TRADES.—These continue to be in a very bad condition, particularly the former.

NUT AND BOLT TRADE.—This is very dull; one of the largest works in the Midlands avers that it is ten years since they were so slack.

ELECTRO AND SILVER TRADES.—The Sheffield silver, plated, and Britannia metal trades are greatly depressed.

CUTLERY TRADE.—The statements made in Sheffield of late concerning the slackness of trade are amply borne out by the circumstance that three firms have asked for reductions of 5 per cent. The men in one instance have given a fortnight's notice to leave their employment.

PLUMBERS' TRADE.—Our Liverpool correspondent writes:—There is no alteration to note; the amount of work is moderate. Plumbers are wanted for Bolton, and 8½d. per hour is offered.

TIMBER TRADE.—This is very quiet. The market is certainly firmer, and in some cases a rise in prices has been recorded. A fine parcel of Sequoia planks (California redwood) has been sold. Some of the planks measured 6 in. by 46 in. This is an extra width even for this wood, the average size being about 3 in. by 35 in.; prices averaged 2s. 6d. White wood fetched 1s.; American oak, 2s. 2d.; walnut, 2s. 6d.; ash, 10d. per cubic foot; and walnut boards, 3½d. per foot super. Our Liverpool correspondent writes:—There have been large sales of timber, including 277 tons lignum vitæ, 30 tons Malabar ebony, also large quantities of mahogany, rosewood, cedar, satin wood, walnut, and hickory spokes.

SHEET METAL TRADE.—Shipments of tin plates for abroad have been well kept up, in fact, in excess of production, so that stocks have been lowered. Prices consequently show a slight advance. Block tin has advanced in the last few weeks £10 per ton. Zinc and lead are a little easier in price. Copper remains at about the same quotation. Manufacturers of tin and iron goods are fairly busy just now, baths, trunks, and such articles being in good demand. London trade is somewhat dull.

HAT TRADE.—This is dull. The strike at Atherstone, in respect to women doing alleged men's work, is watched with great interest by the workers in Stockport and Denton.

SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of WORK *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given.*

I.—LETTER FROM A CORRESPONDENT.

Jewellers' Examinations.—H. S. G. (*London, S.W.*) writes:—"Seeing the great interest so many of your readers take in jewellery matters, and knowing that you have a very large number of working jewellers among them, I have thought the following questions, set by the City and Guilds of London Institute for their examination in the elementary grade of goldsmiths' work, would prove interesting. The questions were fourteen in number, of which not more than ten were to be answered. Three hours were allowed for the paper. 1. Classify, according to their respective branches or departments, the workmen employed in a large jewellery manufactory, where various kinds of personal ornaments are produced. 2. Give the processes in making a bracelet ⅜ths of an inch wide (lined or not) up to the point of receiving its ornamentation. 3. Describe the mechanism at the back of a diamond star which may be used as a hairpin, brooch, or pendant. 4. Explain the meaning of 'flush joint,' 'mitre joint,' and 'reversible joint.' 5. Describe briefly the following tools and their uses: treblet, rimer, drill-stock, belchering pliers, scorpers. 6. Name five varieties of ornamental engraving, and describe how different effects are obtained in any three of these varieties. 7. What do you understand by repoussé work, and in what does it differ from chasing? 8. Explain carefully what is meant by the 'repairing' of cast figures. 9. Describe the kind of surfaces to which wire decoration should be applied. 10. How would you proceed to make wire decoration, and on what parts of any ornament should it be arranged, (*a*) in bands, (*b*) in separate design? 11. Give some account of the process of *champlevé* and *cloisonné* enamelling, and describe the different effects produced. 12. What is the best style of 'cut out' for transparent enamels? 13. Name and describe not more than six different styles of finish for goldsmiths' work. 14. Describe fully the process of dry colouring. In the practical test the student had four hours allowed in which he had to do one of these three things:—1. Set out a given engraved pattern. 2. Trace and beat up the general effect of a given design in embossing or repoussé. 3. Shape and turn up a given geometric form ready for wire decoration."

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Fretwork.—J. H. (*Walsall*).—Without seeing the fretwork, it is impossible to be sure where the fault is; but as J. H. mentions piano panels, we may say that (1) these are cut by practised workmen at good machines driven very rapidly. (2) They are not varnished, but polished. (3) The polisher has had considerable experience of fretwork. J. H. might try the following: Oil with raw linseed-oil the fretwork, doing every part of the cut surfaces, wiping off as much of the superfluous oil as possible; then give a coat of French polish to the cut edges with a brush; with No. 0 glass-paper rub off all that has run on the flat surfaces, and then polish with care. I have seen polishers do fretwork, and they had a small flannel rubber with a penny in it, and were careful not to put too much polish in the rubber at any time. The coin kept the rubber flat, and less likely to catch edges of the fretwork.—B. A. B.

Slot Machine.—A. W. (*Lytham*).—An article will shortly appear.

Patent Office Rules.—S. E. (*Upper Clapton*).—The quickest, most certain, and, therefore, most satisfactory course for our correspondent to follow is to make a visit to the sale-rooms of the Patent Office, 38, Cursitor Street, Chancery Lane, and ask the clerk to show him a copy of the rules containing the fees. He will then have to write on a strip of paper the title of what he wants, take it to the pay-room, hand it in at the window, together with the sixpence, when the receipt will be handed to him, which he takes to the clerk at the counter, who, on receiving it, will hand him the publication. Stamps are not received, and all money has to be remitted by P.O.O. when other than personal application is made. The office is open daily from 10 to 4 p.m.—C. E.

Darkening Oak by Fumigation.—J. H. (*Walsall*).—This is without a doubt the most practical and cleanly plan to adopt for oak; but I am not quite sure that it is so effective for mahogany, this being usually darkened by wiping over with a solution of bichromate of potash, carbonate of soda, or common washing-soda, then allowing it to stand a few hours or overnight, wiped over with red oil, made by steeping ¼ lb. of alkanet root in one pint of linseed-oil. To darken the oak by fumigation, you will require an air-tight box, of a size suitable to contain the goods. A well-made packing-case will do, with strong brown paper pasted over the joints; if a square of glass is inserted to enable you to see the progress being made, so much the better. The liquid ammonia (880) should stand on the bottom of this case in open dishes, to allow the fumes to play round the goods. For a box 9 ft. long, 6 ft. high, by 3 ft. 6 in. wide, half a pint of ammonia is generally sufficient.—LIFEBOAT.

WORK.—A. F. (*Luton*).—This is published weekly at 1d., monthly at 6d., and yearly (bound) at 7s. 6d.

Frame Making.—J. T. M. (19, *Ivory Street, Burnley*) asks for the address of J. A. (*Smallheath*).

Limelight.—STAGER.—To buy the whole apparatus for limelight would cost about £8. I should advise buying lens, about £1 5s.; gas jet, 15s. Have a retort made of strong sheet iron, and make your own washing bottles. There is great danger to a novice in making his own gas. The best way would be to buy the bottles of gas, returning the bottles when empty. If you are resolved to make your own gas, I can give you instructions how to go to work.—W. C.

Condenser.—S. G. (*Cork*).—I cannot recommend the automatic condenser mentioned on p. 113, as so far it has not proved a practical success, and in fact, on the face of it, it seems contrary to physical laws that it should act. You do not say what kind of a condenser you have in charge: whether it is a jet condenser or surface. If it is a surface condenser it should have a condensing surface equal to half the heating surface of the boiler. A jet condenser should not be of less capacity than one-fourth of that of the cylinder which exhausts into it, and in quick-running engines it should be one-half the capacity of the cylinder. The injection water should be about thirty times the weight of steam condensed, and the injection orifice in square inches one-tenth of the number of cubic feet of injection water per minute. If you will send full particulars of the engine and condenser, I may be able to help you with advice in this special case.—F. C.

Gravity Battery.—CONSTANT READER.—This is a variety of the Daniell or sulphate of copper battery without a porous cell. A copper plate connected to a wire is placed at the bottom of a glass or stoneware jar, and covered with copper sulphate

ystals. A massive casting of zinc in the form of crow's foot is amalgamated with mercury, and spended from the top of the jar over the copper ate. A solution of sulphate of zinc is then poured to the cell until it just covers the zinc element. e sulphate of copper is heavier than sulphate of nc, its superior specific gravity keeps it at the ottom of the cell as long as it is undisturbed; ence the name of the battery. But why use this r a microphone when one of the dry batteries are finitely superior?—G. E. B.

Castings for Small Dynamo.—A CONSTANT READER.—Assuming that you mean 10 c.-p. lamps, ieu five such lamps will require a 50 c.-p. dynamo. he castings for a 50 c.-p. Siemens should he as llows:—Field magnets, 6 in. × 4 in. × ¾ in.; armaire, laminated, 4 in. × 2¼ in. The castings for a c.-p. Gramme should he: Four field-magnet cores, ich 2 in. × 1¼ in.; armature, 3½ in. diameter × 2 in. eep. The castings for a 50 c.-p. Manchester should two field-magnet cores, 4½ in. × 1½ in: armature, in. diameter × 2 in. deep. Any of these may he otained from Mr. Bottone, who will also tell you hat wire to wind on the castings. Full direcons for making dynamos of this class were given Nos. 92, 94, 97, and 99, Vol. II. of WORK.—. E. B.

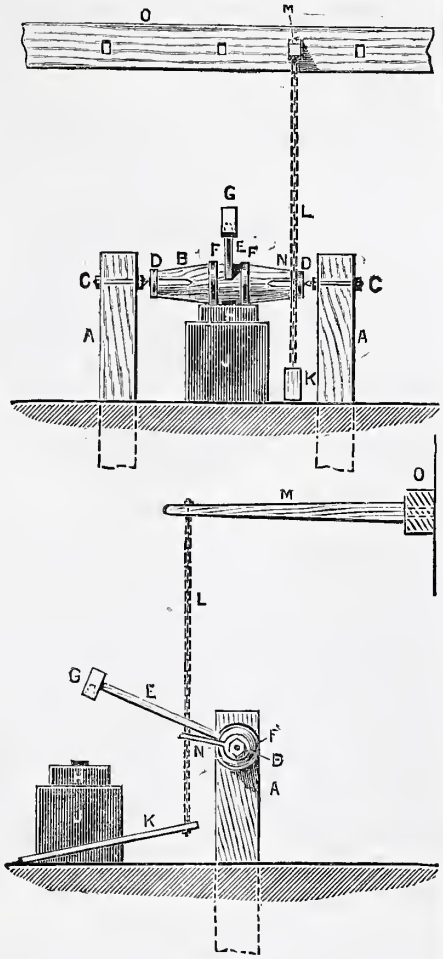
Metal.—A. W. P. (*Leeds*).—The piece of metal nclosed was aluminium. Although aluminium oes not occur in the metallic state, yet as oxide nd silicate (clay) it is one of the main constituents f the earth's crust. It is generally prepared from cryolite," a double fluoride of aluminium and odium. The cryolite is mixed with half its weight f common salt, and heated with sodium in an iron r earthern crucible. The liberated aluminium ollects, in the melted state, at the bottom, and is rawn off. It is used in jewellery, for making light hemical weights and the beams of small chemical alances, and in the mountings of astronomical nstruments. It is now coming into use for house-old utensils. Aluminium gold is an alloy of one art aluminium and nine parts copper.—F. B. C.

Violoncello.—H. H. M. (*St. Leonards-on-Sea*).—he editor is making arrangements for the publiation of Instructions for making a Violoncello, and is expected that these will appear in the current olume of WORK. The same materials are used as or violin, but, of course, the sizes are much larger. ou will find the address you ask for in the advertisement column.—B.

Rubber Tire.—S. B. (*Ardwick*).—S. B. will find ll the information he requires in the last of the eries of papers on Safety Bicycle construction in WORK. (See Indexes.) He must, with a sharp knife, ake a clean straight cut 2 in. long on both the roken ends of his tire, first wetting the knife in lean water. Wipe the cuts dry, and smear with ubber solution; leave unjoined for two hours or so, hen join evenly, and it will hold at once, and may e put on the wheel immediately.—A. S. P.

Melting Old Tins.—CLAUDIUS.—I do not think likely that a fortune can be realised by this means. f it were possible for you to obtain them in very arge quantities for nothing, as was the case years go, and had plenty of time, it might pay you very ell; but you will find that, as soon as people know hat any waste substance has a value, they will vant to be paid for it; and I think it very doubtful ndeed that you would be able to get a constant upply of tins to pay for the expense and trouble ou propose. You might, however, try a simple ethod, as you have a lot. Build a rough brick replace that will support an oblong cast-iron pan, bout 15 in. by 10 in. by 3 in. deep, and ½ in. thick. ut in this pan two or three pounds of metal for a tart, and having your tins handy, and a pair of lose tongs, place them in it. Melt out the bottoms, hen melt the side seam open, let them get well hot ll over in the metal and wipe them into the pan, and hrow on one side. You will find the metal in the an rapidly increase in bulk. The best thing to do vith it is to make tinmen's solder of it.—R. A.

Hammer.—J. A. M. (*Tierkelly*).—he figure shows an Oliver hammer. A, are two stout wooden posts driven eeply into the ground. Between these here is pivoted on dead centres a piece f wood, B, either round, or square, or olygonal in section. Iron centres are riven into the ends of B, and these ivot upon stud-bolts, C, C. The pivots, nd the countersunk holes in which hey work, should be case-hardened, and ron bands, D, D, should be shrunk on, o prevent B from being split out at the nds. E is the hammer-shaft, mortised nto B; and bands, F, F, are shrunk over , on each side of E, to prevent the conussion of the hammer-blows from splitting the wood. The hammer-head, G, is ecessed, as shown, to receive top wages, and corresponding bottom wages are let into the anvil, H, which n turn rests upon a massive anvil-block, . The hammer is worked by the foot pon the treadle-board, K. To the far nd of K one end of a chain, L, is attached, he other end of L being fastened to a long lastic pole of wood, M. A short lever, N, is also astened to the chain between K and M, and eing further driven over B, of which it forms n integral portion, moves B on its pivots, and auses E and G to descend with the treadle, K. n the release of the foot, the spring-bar M pulls G up; M is tenoned into a stout beam, O, fastened to the wall. I give no dimensions, but the drawing is proportional; so that, knowing the class of work required, you may make it of large or of small size. As regards the drop-hammer, there are several forms. I know one which is, I believe, that most commonly used. There is a pulley, to which a broad stout belt is fastened, the hammer being



Oliver Hammer and Parts.

attached to the lower end of the belt. The pulley is turned round when required, and to any height required within the range of the machine, by means of friction cones, operated with a disengaging clutch. When the clutch is released, the hammer falls; on throwing it into gear again, the hammer is lifted. The clutch is controlled by means of a lever handle within reach of the attendant.—J.

Back Gear for 3½ in. Lathe.—O. B. (*Hanley*).—Fig. 1 will, I think, show you all you want; you must, of course, be guided by your castings for the main dimensions. To throw in the back gear, pull out the pin, E, which in Fig. 1 engages in the groove, C; and slide the back-shaft, B, to the left about one inch, so that the wheels engage; then put the pin, E, back again, so as to work in the groove, D. Instead of having a nut on the face of the mandrel wheel to secure the pulley and wheel together, have a nut, F, on the mandrel, by means of which the pulley, J, can be clamped against the wheel, K, at H; there may be a spring washer between the bosses of these two wheels, just to keep them apart at the rims when revolving separately. This is a much better plan than the ordinary way with *small* lathes, in which the pulley must run fast; because by this means the pulley can be turned inside, and the whole may be in perfect balance; whilst with the usual plan, even if the little lock-nut is balanced in one position it will be slightly out of balance in the other. Besides this, with the nut, F, upon the mandrel, the whole of the front of the large gear wheel is free for utilising as a division plate, as shown in Fig. 2, which is a view in elevation of a somewhat larger headstock. In both these headstocks the end-long pressure on the mandrel caused by boring is taken by a washer and pair of lock-nuts, G, and not by a tail-pin, which leaves the tail end of the mandrel quite free to receive change-wheels of any size on the seating, M, M. Besides this, the mandrel may be bored *right through*, which should be the case on small lathes for metal turning, so that metal rods or wire may be passed up through the universal chuck into the mandrel, whilst a screw, etc., is made on the end and cut off, etc. etc. I would strongly advise the taper hole in the mandrel should be made to take the smallest size of Morse taper, and that in the moving headstock should be the same; get a twist-drill or small chuck of the correct size, and make the holes to suit it. In my opinion, 55° is too sharp for the point of the lathe centres; I would have them 60°, partly because most mandrels, taps, etc., that you buy are centred to that angle—which is almost universal in America, whilst 72° and 80° are common in England. Also, it is very convenient to make the screw in the cylinder of the poppet long enough to push out the back-centre when cylinder is drawn in.—F. A. M.

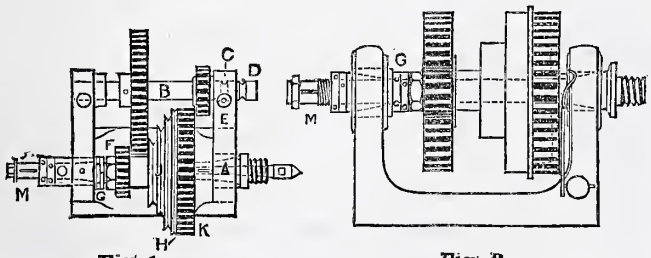


Fig. 1. **Fig. 2.**

Lathe Gear. Fig. 1.—Plan of Geared Headstock with Sliding Back-shaft. Fig. 2.—Elevation of Geared Headstock with Clamping Nut on Mandrel.

New Galvanising Process.—T. E. W. & SON (*Birmingham*).—This is the property of the London Metallurgical Company, Turnmill Street, London, E.C. Tests of the tensile strength of wire recently made, and the results indicated, were as follows:—Steel wire uncoated gave a breaking load per square inch of 165 tons. The same wire, galvanised by ordinary process, 150 tons; and coated by the new process, 165 tons. Many other experiments with favourable results have been carried out by Mr. David Kircaldy and Mr. Arnold Philip, of the Royal School of Mines, and the report of the latter is very interesting. The company do not propose to work the process themselves, but will grant licences; and they already have received a number of applications, some of which have been arranged.—R. A.

Sea-going Engineer.—SIRIUS.—Our correspondent is quite right in his views as to being qualified as a mechanic for this purpose, and he cannot do better than be apprenticed to some good firm of marine engine makers, where he will have the opportunity of learning his business thoroughly; and if steady, sober, persevering, and attentive to his orders and duties, need have no fear but that he will get on. As his letter does not give us any idea of what part of the kingdom he resides in, it is difficult to advise him as to what firm he should apply to. There are few large sea-ports in the north and east coasts where there are not marine engine makers, but if our correspondent will let us know where he resides, we might be able to indicate a suitable one to apply to near him. One thing our correspondent must carefully bear in mind, if he becomes an apprentice: and that is, to apply his spare time to improving his knowledge in mechanics, mechanical drawing, arithmetic, and natural philosophy, as well as learning to use the tools, and making himself a good mechanic. Fortunately, in the present day there are such enormous facilities afforded to those who are wise enough to avail themselves of them, in the shape of evening classes, in most large towns, that ignorance in such matters can only be looked on as a disgrace to anyone. It is not by any means a necessity that a good mechanic should, or must, necessarily be a bad scholar. The better a man is qualified to hold a high position, the more likely he is to get it, and retain it when got. The main object of all young men should be to rise in the world, and to qualify themselves, whilst young and able to do so, for so doing. The mere fact of a person producing his indentures to show that he was so long under a certain firm no more proves that he is a mechanic, or capable of carrying out work, than his bare word would prove it. All persons intending to go to sea as engineers afloat in charge of machinery have to pass a proper examination by practical men to prove their fitness; therefore, our correspondent should begin and keep on in his leisure time to qualify and prepare himself to give proofs of his ability and fitness when the time comes that he will be called upon to do so.—C. E.

Manchester Dynamo, Shunt Wound.—A. J. (*Lhanbryde*).—Connect the finish end of one field-magnet coil to the commencing end of the other coil. The two free ends of these coils must then be connected to the brushes. Wires lead from the brushes to the terminal binding screws of the machine. The current from the armature then divides between the field-magnet coils and the work in the outer circuit.—G. E. B.

Lengthening Dynamo.—AN ELECTRICAL STUDENT.—I am in receipt of your kind letter, and note its interesting contents. I think you slightly

misunderstand the formula quoted by you. The voltage of the current from a Siemens dynamo is governed by the *length* of active wire on the armature, its rate of speed, and the intensity of the magnetic field. I do not see any discrepancy between this statement and the working of the formula quoted by you. By lengthening the armature, you will get a greater length of wire on it, but the capacity of the wire will be unaltered, and the other parts of the machine must be altered proportionately. To get a greater output, all the dimensions must be altered, including the size of the wire. The reply I gave on p. 813, Vol. III., was intended to prevent the querist from following a will-o'-the-wisp idea approaching that of perpetual motion: and my advice to him respecting more *turns* of wire only applied to his machine and his requirements.—G. E. B.

Electric Light for Bedroom.—HYSTERESIS.—As a No. 4 gas-burner will furnish a light of from 10 to 12 candle-power, and can only be matched, light for light, by a 16 candle-power electric light—and a lamp of this power is very expensive to maintain with current from a battery—I advise you to give up the idea of getting an incandescent electric lamp to light up your bedroom in place of a No. 4 gas-burner. Be content with something less—say an 8 volt 5 c.-p. lamp taking ten large Leclanché cells, or a 5 volt 2½ c.-p. lamp taking some five or six cells of either the Leclanché or one of the better types of dry cell, such as the E.S., E.C.C., Gassner, or Helleser. The light will be very small, but will be enough to see the time on a watch, and enough to see to dress and undress by. I have had one of the E.S. bedroom lighting sets in use since the commencement of last winter, and it has done me good service. A friend at Ipswich has tried the Leclanché with good results. The larger Leclanché, such as the six-block agglomerate type, are preferable to the smaller cells. Use No. 18 or No. 20 cotton-covered wire to conduct the current.—G. E. B.

Dry Battery.—TOM.—(1) A dry battery is not suitable for lighting a 5 c.-p. lamp for any length of time; intervals of from five to ten minutes at a time only. (2) If a battery of five cells will light a lamp properly, you will injure the lamp by adding more cells, and may increase the number of cells until the filament is ruptured. In this, a dry battery differs in no way from other batteries. The lamp filament may be protected from rupture by placing a safety fuse in the circuit, together with a suitable set of resistances. (3) Dry batteries, like all others, can only furnish a fixed amount of current from one charge. Therefore, supposing that the charge will light a given lamp for four hours, and you use the battery for two hours, there should be enough energy in the charge to light the lamp for another two hours. The charge may be economised or used wastefully. As a rule, rapid exhaustion follows a too rapid discharge.—G. E. B.

Curative Magnetic Appliance.—F. C. (*Belfast*).—As your friend has been cured of a bronchial affection of sixteen years' standing by wearing a magnetic appliance, there is hope for your mother being cured by a similar appliance. I have met with many persons who have been cured of different ailments—or, at least, believe that they have been cured—by wearing magnetic appliances. Their construction is most simple. You have simply to make a flannel pad to fit the part of the body affected, and sew on to this, or quilt between two pieces of flannel, a number of flat bar permanent magnets, the number and size of which is entirely a matter governed by the comfortable fit of the appliance. The magnets may be covered in jean or flannel before sewing them on, if so desired. All the polar extremities should point in the same direction, preferably with the north poles downward. For bronchial affections it is sometimes preferable to wear a magnetic pad at the back, between the shoulders.—G. E. B.

Shocking Coil.—J. P. (*Leeds*).—Bobbins with mahogany or walnut ends 3 in. in diameter, and a strong paper tube ¼ in. thick, 5 in. in length, and inside diameter of 11/16 in. Core to slide in this tube, or to be fixed at one end with a brass tube to slide over it, of No. 20 soft iron wire bound into a bundle ⅝ in. in diameter. Primary wire, four layers of cotton-covered No. 20 copper wire. Secondary wire, 1 lb. of No. 34 silk-covered copper wire. You should have a separate contact breaker with this coil. Detailed instructions and illustrations have already been given in the series of articles on Induction Coils recently published. With current from a pint cell of a bichromate battery, a coil of the above dimensions will give you stronger shocks than you will care to take.—G. E. B.

III.—QUESTIONS SUBMITTED TO READERS.

**** The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Folding Clothes-Horse.—J. W. B. (*Huddersfield*) writes:—"I have designed a folding clothes-horse which shuts up like a music holder on a piano, and the patent agents in this town are pleased with it. How would I obtain a sale for it and secure it, etc.?"

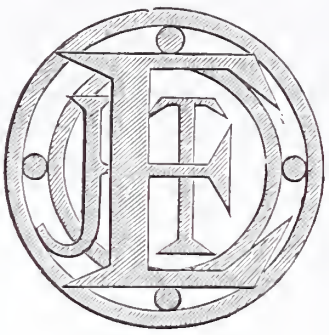
Dulcimer.—AMATEUR writes:—"Will MUSIC give me a few hints regarding the construction of a dulcimer he gave the measurements of in No. 27, Vol. I., of WORK? Do the measurements given include the wrest- and hitch-pins, and what number wire does he use for the different notes? Also let me know the position of the bridges; I have tried to make one, but it has not turned out all right."

Osteology.—OSTEOLOGIST writes:—"Could any correspondent tell me how I may skeletonise birds and small animals? I have been much puzzled over some very delicate specimens that I have seen. How is it done? The names of any books on the subject would be welcome."

Cardboard Boxes.—W. E. (*Herts*) writes:—"Will any reader of WORK kindly inform me as to the best and cheapest methods of making the above; also where the machinery may be obtained that is required for the purpose?"

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Monogram of J. T. E.—C. K. (*Stratford*) writes:—"In WORK, No. 157, p. 14, YOUTHFUL READER asks for a fretwork monogram. Possibly this one may suit him."



Fretwork Monogram.

Lathe Attachment.—J. A. M. (*Stamford Hill*) writes:—"If LEARNER will refer to No. 131, Vol. III., he will there see a sketch of a fret saw that I have in use, and which answers fairly well."

Perspective.—M. (*Bishop Auckland*) writes to SPECTEMUR AGENDO (see No. 165, page 142):—"There are two works on perspective by Messrs. Cassell & Co., advertised on page 143 of WORK, which may be suitable for you."

Binding WORK.—M. (*Bishop Auckland*) writes to J. H. B. (*Pendleton*) (see No. 165, page 142):—"I am just finishing the binding of Vol. III. of WORK. The materials have cost under 1s. per vol., and the information was obtained from Vol. II. I shall be glad to give you any information. I think you could manage from the instructions given."

Engravers' Tools.—M. (*Bishop Auckland*) writes to ENGRAVER (*Wales*) (see No. 165, page 142):—"You will find full instructions, price of tools, etc., on page 519, Vol. I. of WORK."

Crystoleum Painting.—S. J. (*Failsworth*) writes to HANSOT:—"I would recommend him to procure a book entitled 'A Guide to Crystoleum Painting,' by Mrs. L. H. Goggs, price 1s. This is published by the Crystoleum Company, 500, Oxford Street, London."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—A. J. F. (*Bow, E.*); W. R. (*London*); GARBOARD STRAKE; J. M. H. (*Glasgow*); G. L. (*Poplar*); E. R. (*Camberwell*); B. F. B., JUNR. (*Liverpool*); A. F. (*Ovenden*); A. W. (*Glasgow*); SOUTHPORT; AMATEUR; JUVENILE; ASHWORTH; A. B. (*New York*); S. H. (*Cardiff*); A. B. (*Newnham*); JERSEY COMPANY, LIMITED (*Stroud*); D. A. (*Glasgow*); P. L. (*Bolton*); PERSEVERE; NOVICE; YOUNG SMITH; J. W. M. (*Sheffield*); P. B. H. (*Southport*); V. B. (*Egham*); H. B. S. (*Wolverhampton*); F. H. T. (*Hornsey*); J. C. T. (*Dalston*); ONE THAT WANTS TO LEARN; J. T. (*Edinburgh*); S. J. H. (*Leicester*); A. L. W. (*Aberystwith*); CYMRO; SECOND APPLICATION; J. A. L. (*Hammersmith, W.*); F. S. (*Old Swindon*); PLUMBER; THOMASO.

NOTICE TO READERS.

Next week's WORK (No. 174) will contain, among other articles:—

HOW TO MAKE A PHONOGRAPH;
MAHOGANY MAGIC LANTERN;
TESTING PRECIOUS STONES;
SIMPLE UTENSILS FOR THE GARDEN;
OLD SPANISH IRON WORK;
etc. etc.

"WORK" PRIZE SCHEME.

SECOND COMPETITION.

THE Editor of WORK has the pleasure of calling the attention of his readers to the Second Competition under the Prize Scheme, which so many readers of WORK have thought to be a suitable sequel to the late WORK Exhibition.

The subject for the present competition is, like that of "The Cycle," one that appeals to the whole of our readers, young and old alike, and places them, therefore, at equal advantage.

It will take the form of a suggestion for

A USEFUL ARTICLE FOR THE HOUSEHOLD.

For the three best suggestions for a new domestic appliance, household article, or labour-saving tool of general utility, the following prizes will be awarded—

First Prize, £3;
Second Prize, £2;
Third Prize, £1.

CONDITIONS AND RULES OF THE "USEFUL HOUSEHOLD ARTICLE" COMPETITION.

ALL Descriptions to bear the WORK Prize Coupon, cut from one of the numbers of WORK in which the Prize Scheme is announced.

Each Description to be signed with an original *nom de plume*, and to have the writer's real name and address securely attached to the manuscript in a sealed envelope.

Each Suggestion should be fully described in respect to its purpose, construction, and working, and, where possible, should be illustrated with a drawing of the article itself and its various parts to elucidate the description.

A Suggestion not illustrated will have an equal claim in the competition provided the description be sufficiently in detail to convey a full idea of the article suggested.

In the work of judging regard will be had to the practical nature and utility of the suggestions, and their prospective popularity.

The Prize Suggestions and Drawings, and any others, to be published, if desired by the Editor, in WORK, but the copyright thereof to remain with the authors.

Copies of MSS. and Drawings to be retained by the competitors, as in no case can the return of MSS. be undertaken.

The Editor of WORK will supervise the judging of the Suggestions, and the selection as determined upon is to be final.

All manuscripts intended for the "Useful Household Article" competition must be addressed to the Editor of WORK, c/o Cassell & Co., Ld., Ludgate Hill, London, E.C. They must reach him on or before SATURDAY, JULY 30, endorsed, "Useful Household Article" Competition.

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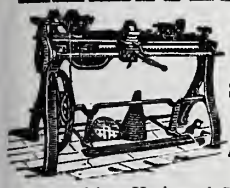

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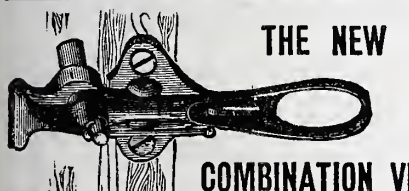

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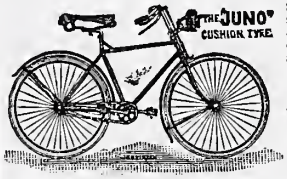

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(*See Notice in "Work," August 22, 1891.*)

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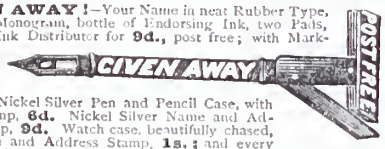

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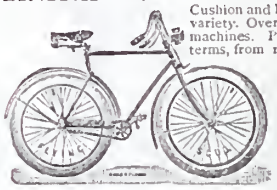

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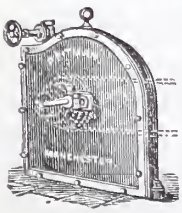

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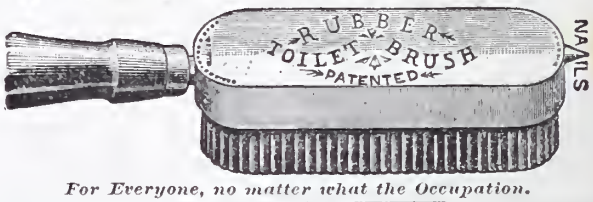

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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VOL. IV.—No. 174.] SATURDAY, JULY 16, 1892. [PRICE ONE PENNY.

WORK WORLD.

THE best cement to use for floors is made of three parts coke breeze, three parts sharp sand, and one part best Portland cement. Why not more clean and warm cement and fewer dirty wooden floorings?

* *

A furnace at Halauzy, one of the great French pig-iron centres, yields seventy tons of foundry pig-iron of good quality in twenty-four hours. This furnace is constructed on a new model, and its yield is excellent. Our English furnace engineers should examine this model.

* *

A Welsh firm of tin-plate manufacturers have acquired several acres of land in New Jersey, U.S.A., where they intend putting down a tin-plate plant. The plates will be made in Wales, and taken to the States to be tinned. This is one of the results of the heavy duties levied on tinned plates.

* *

At the Scotia Works, Sunderland, the proprietor, who was one of the first to test the eight hours' working day amongst his *employés*, finds that the scheme has been attended with so much success that he is returning to his men the five per cent. in wages which was deducted from them on the inauguration of the shortened hours plan. Will this be the case everywhere?

* *

An electrical instrument has been invented for avoiding the pain incident to the extraction of teeth. It consists of adjustable prongs, carrying buttons and connected with an electrical battery. The buttons are placed on the face over the nerves leading from the teeth to the brain, and a circuit is established the moment the extracting instrument touches the tooth. Thanks!

* *

The Neunkirchen method for consolidating sand in water-bearing strata consists in ejecting powdered cement by means of compressed air, steam, or water under pressure, into the ground to be consolidated. The cement is screened, and other measures taken for the success of the operation. The system was used in England fifteen years back, but this is "made in Germany."

A Glasgow engineer has, after nineteen years' labour and experiments, succeeded in an engine-fitting by which he returns all the steam back to the boiler after doing its work in the cylinder. The arrangement is being adopted, and is giving extraordinary results. In one case, at a textile factory, an engine fitted with the invention is doing as much work with one ton of coal as was formerly done with ten tons.

* *

In the United States they have been testing the holding powers of lead, sulphur, and Portland cement, for retaining bolts. Of four bolts set in sulphur (42 in. deep, $\frac{3}{4}$ in. diameter) one was drawn out by a pull of 12,000 lb.; with the others the iron yielded before the sulphur gave way. Three of the bolts "caulked" with the lead broke in place, and one pulled out; of those set in cement, one yielded slightly, and one broke.

* *

The uses of mica are extending. For insulation in the armatures of dynamos and electro-motors, this material is in great demand. It is, therefore, satisfactory to learn that the supply in Idaho is practically inexhaustible. In the Idaho building, at the Chicago Exhibition, mica is to be used as a substitute for window glass. We have never seen mica in this country sufficiently transparent or cheap enough for this application.

* *

An appliance for ascertaining the muzzle velocity of shot has been introduced by the Elswick firm. It consists of a plug, twelve of which are inserted at regular intervals from the muzzle end of the shot chamber to near the muzzle. The shot passing down the bore, and its conical end coming in contact with a small ball $\frac{5}{8}$ in. in diameter, drives this ball, together with a small piston, in an upward direction inside the plugs. The piston in its turn cuts an electrical communication. Each of the disconnectors cuts the communication immediately after each other, and so mean time is recorded and the muzzle velocity is obtained.

* *

It is a remarkable fact that many engineers and others in charge of engines and boilers, who carefully heat their boiler-feed water by means of live steam in feed-heaters, forget to keep the water hot after it has gone from the heater to the boiler. In many cases the water loses as much as 9° or 10° of heat by the feed-pipe being exposed to a cold current of air. This may only mean, perhaps, 1 per cent. lost, but if taken for the year round represents tons of coal. It is, therefore, necessary that all feed-pipes from the heater to the boiler should be well cleaded with a good non-conducting material in order that there will be no loss of heat, by radiation, that has been so carefully sought after.

* *

There is a kind of jewellery which depends for part of its beautiful appearance on the reflection of one part in another. This style was fashionable some thirty years ago, but, although much used then, it was not carried to anything like the full extent of its possible development. Rarely was anything more elaborate attempted than a fluted gold bead or a plain coral bead in a coloured gold cup. Yet even with these simple means great richness of effect was obtained. An effect so easily got, and which enhanced the appearance of the article out of all proportion to the work put in it, would, we think, now repay any study with regard to its re-introduction. It would come in as a welcome contrast to the narrow wire ornaments that have nearly played their innings out.

* *

Among the wonderful clocks for the Chicago Exhibition will be the invention of a native of Warsaw, who has worked for six years in the construction of an ingenious model representing a railway station. It includes railway line, signals, telegraphs, station buildings, with the usual waiting rooms, offices, etc. Every fifteen minutes the miniature station becomes a scene of activity; doors open, officials appear on the platform, signalmen in the boxes, and ticket clerks in the booking office. Then a long row of passengers appear, luggage is wheeled about, a bell is rung, and a train runs into the station; and while a man taps all the wheels with a hammer, another pumps water into the locomotive tank. After another signal with the station bell, the engine whistles, the train starts, and disappears in a tunnel, the porters leave the platform, and the doors are again closed.

SIMPLE UTENSILS FOR THE GARDEN.

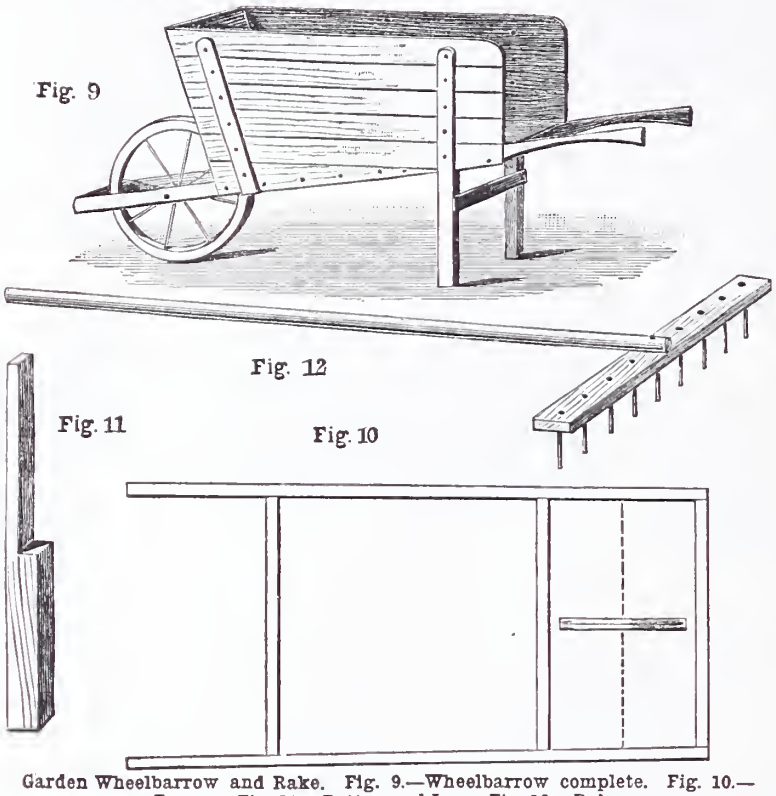
BY C. MAYNARD WALKER.

Wheelbarrow and Rake.

In the cultivation of a garden, whether of small or large dimensions, a handy wheelbarrow becomes an important and very desirable labour-saving apparatus. To say nothing of the necessity of moving soil, rubbish, transplanting, etc., a barrow comes in most handy to hold all necessary tools, pots, plants, etc., when performing the ordinary operations of gardening, and prevents a lot of fetching, finding, and carrying on occasions when time can ill be spared.

To buy a wheelbarrow is a somewhat expensive matter, and may not be convenient to many to obtain; but, as I shall presently show, a serviceable article can be turned out easily and cheaply by anyone who is familiar with the practice of rough carpentry, or, in other words, who can use a saw and hammer and nails.

Fig. 9 represents such an article. The question of size must be left to individual requirements, having regard to the purposes to which it is to be applied. I may say, however, that I find mine a useful size—viz., length of barrow body, 22 in.; width, 16 in.; depth (back), 12 in., front, 7 in. The advantage of making it shallow in front and deep at back is that the top is brought to a level plane, and can be readily used, with a wide boarding, as a movable table for potting, etc. For the timber, any tough kind may be used for the frame, and ordinary rough or planed deal will do for the barrow-body. The handles, frame, and wheel bearing are made in one (see Fig. 10); and in the frame I have made an addition at the end, in the form of a cross-piece beyond the wheel, not usually seen in barrows. This not only greatly strengthens the woodwork, but will be found to be very useful in tipping.



Garden Wheelbarrow and Rake. Fig. 9.—Wheelbarrow complete. Fig. 10.—Frame. Fig. 11.—Batten and Leg. Fig. 12.—Rake.

It frequently happens, in tipping soil on to a bed, that the load shoots out at a spot which was not intended, owing to the awkward manner in which an ordinary barrow has to be turned over to empty; while it is almost impossible to tip it over in front or over the wheel. The cross-piece entirely remedies this; and to tip the contents of the barrow neatly, you have only to lift up the barrow sufficiently high for the cross-piece to touch the ground, when the wheel is raised off the ground, and, as the barrow remains on end, the stuff is easily tipped with the least possible trouble.

In fitting the legs, strength and neatness are gained by using the upper portion as battens to the sides of the body, cutting a portion away (as in Fig. 11). The handles are readily shaped with a spokeshave. An iron wheel, suitable for the purpose, if one be not at hand, can be obtained through any ironmonger or from the Carron Iron Foundry, retail price for one being about 3s. 6d. These measure 12 in. in extreme length of axle, by 2 in. wide; but even this is not indispensable, and a serviceable makeshift can be made by using a wooden wheel, made of two discs of wood fastened together the cross-way of the grain, fitted with an iron rod in the centre, with this advantage: that the rim of the wheel can be made to any thickness, and be less likely to cut up the paths when in use.

I would also remind the worker that no projecting parts should be left on the inside of the barrow, as they would interfere with the use of the spade in taking out mould or other loose material. All battening should be on the outside.

The wheel is fitted in a manner which, I have no doubt, a wheelwright would object to. All I can say in defence of it is that it answers its purpose well. An ordinary gas-barrel socket is let into the woodwork, and the axle of the wheel, which fits loosely therein, is put into its place when the frame is made, the only objection to this plan being, as far as I can see, that the wheel cannot be got out except by taking the barrow to pieces; but as this event is not likely to happen until the barrow is worn out, that is a small matter. The whole of the work should be painted with two or more coats of good paint.

A Cheap Rake.—Although an ordinary iron rake is not by any means an expensive article, a handy and serviceable substitute can be made for about twopence. Take an ordinary broom-handle and a piece of wood for the head, 9 in. long, $1\frac{1}{2}$ in. wide, by 1 in. thick; into this put nine or more 3 in. French nails for the teeth; then fasten the handle across the head (Fig. 12). A ferrule of tin-plate, put on the wood handle previously to fastening, will very greatly add to the wear of the rake. The writer has had one in use for six years, and it answers its purpose admirably.

In my next paper, dealing with these simple utensils for the garden, I shall hope to describe how to make a garden roller—one of those very necessary adjuncts to every well-ordered garden.

HOW TO MAKE A PHONOGRAPH.

BY WILLIAM DUFF.

Easy Method of cutting Groove upon Face of Cylinders—Mounting the Diaphragm and Stylus—Adjusting the Stylus—Tinfoil—Reproducing Funnel—Necessity of having all parts well made—Fastening the Foil to Cylinders—First Experiments performed alone—The Capacity of the Instrument—Showing it to Friends—Joy and Pleasure to be derived from Home-made Things.

After the face of the cylinder has been turned perfectly true, a continuous spiral groove must be cut upon it, or, in other words, it must have a screw of the same pitch as the screw of the shaft. This is not a difficult matter, although it may look so at first sight. Remove the chisel from the hole, and in its place fix a small bodkin whose point has been filed V-shape, fasten the cover by the hooks and eyes (the eyes are shown at H in Fig. 1, page 164; the hooks are on the standards, but not shown), and rotate the cylinder as before directed. This will have to be done carefully, for the top of the screw thread is provokingly easy to chip. Do not allow the bodkin to cut deep; have a little patience, and there is no fear of the result. To lessen the chances of chipping during the above processes, the cylinder may be saturated with paraffin wax. To do this, place it before the fire or in a hot oven for some time, until it gets thoroughly heated; melt some paraffin wax, and baste it well; the wax will soak in and fill up the pores of the plaster, and render it more workable.

The next point will be to fix the diaphragm and needle in position, and screw the mouthpiece to the top. Proceed in this manner: cut out six rings of blotting-paper the size of the diaphragm; place three on the top (C) round the hole; pass the needle through the hole, and allow the diaphragm to rest on the blotting-paper; lay the other three rings on the top; place the mouthpiece on the top of these again, and screw up tightly. The blotting-paper makes a better bed for the diaphragm than the hard wood, and ensures it being clamped tightly all round. It will be better to have six screw nails round the mouthpiece. The diaphragm must be as tight as a drum, and there must be nothing to interfere with its vibrations. Fig. 9 is a section of the mouthpiece, needle, etc., and as I have drawn it full size, each part will be seen readily, and the necessary arrangement easily understood. The large curved line represents the cylinder.

Before putting on the tinfoil, adjust the needle; it must enter the groove on the face of the cylinder, and must not touch the cylinder at any part. If the instrument has been carefully made, when the needle has been once adjusted it will not require to be touched again. The point should be slightly chisel-shaped, so as not to cut the foil. The foil itself must be carefully chosen. The dull leady stuff is no use. The more like

tin it is the better. It is sold in sheets 11 in. by 14 in., and costs 1s. 6d. per lb.

When reproducing the sound record from the surface of the indented foil, it is necessary to have a large funnel placed in the mouthpiece, and we had best get it made before we commence our experiments. It is simply a large paper funnel about 8 in. long. One end must fit tightly into the mouthpiece of the instrument, and the other end should not be less than 6 in. wide. This is called the "phonet." The inner surface must be smooth, so as not to interfere with the sonorous waves set up by the vibrations of the diaphragm caused by the stylus passing over the indentations on the surface of the foil, and the bottom edge must not touch the diaphragm.

The construction of the phonograph should now be complete. I have not given any directions for varnishing or polishing the wood or brass work. I trust, however, you have attended to this, and that you can sit down and look with pride at your workmanship. You should always strive to do things well; although you may be an amateur, that is no reason why your work should be carelessly done. "A thing that is worth doing at all is worth doing well."

The next step is a very important one: in fact, *the* most important of all. Having made your phonograph, you want to hear it speak. Take a sheet of tinfoil and cut it into lengths; its breadth must correspond with the breadth of the cylinder: viz., 4½ in.; its length must be just sufficient to meet round the circumference of the cylinder. Have beside you a little flour paste and a few narrow strips of tissue-paper for joining the ends of the tinfoil or blank phonogram. The join must be on the under side of the foil; to do this, paste a strip of tissue and lay one half of it along one edge of the foil; lift the foil, and place it on the cylinder with the paste side of the tissue-paper uppermost; bring the other end of the foil round, and place it upon the other half of the tissue, and allow it to dry in this position. When doing this, the top with the mouthpiece must be let down, so that both hands can be used in manipulating the foil. There must be no creases or wrinkles in the foil. To smooth it out before putting it in the cylinder, lay it on a piece of glass, and rub it from left to right with a piece of cotton-wool. When the cylinder has been covered, place the top in position, and see that the needle merely touches the foil; it must be regulated not to tear or otherwise injure the foil, for the slightest mark in it produces a sound when the cylinder revolves.

As it draws near the critical moment I can imagine you becoming a little excited; so I would advise you, if you can, to perform your first experiments alone. You will not be able to make your phonograph speak perfectly plain all at once; the needle will require a little adjustment now and again, until the best result has been obtained. People who come to see and hear things expect so much, and if the object of interest does not come up to their expectations all at once, they are rather fond of smiling; and he must be a very good-natured man who can take that smile with perfect equanimity.

If you are alone, you will have to perform two things at once. Take hold of the handle and turn the cylinder at the rate of about forty turns to the minute, and speak very deliberately into the mouthpiece. If the needle is working properly, you will be able to see distinctly little indentations in the foil, not cuts or strokes, but clear sharp markings following closely upon each other. After you have spoken a few words, lift the top, and reverse the cylinder until it reaches the point from which it started; having replaced the top, put the phonet or large funnel into the mouthpiece, and turn the cylinder at the same speed as before, when you will hear your own voice most wonderfully reproduced, providing every point has been carefully attended to. If there seems to be too much sound, the needle must be raised a little; if the reverse, it must be lowered. You must keep on experimenting until your instrument has become a success. There is a certain tone of voice which it will reproduce most faithfully, and this can only be found out by experiment. It is extremely fond of nursery rhymes, and can laugh splendidly. Speaking the alphabet into it will be reproduced with remarkable distinctness, as will also simple figures. Singing or musical sounds are not very successful, because the regularity of motion is not sufficient to ensure the exact pitch.

Of course, there is really no limit to the capacity of the instrument; it will reproduce any sound made in its vicinity, providing it is loud enough, and directed upon the diaphragm through the funnel or mouthpiece. After you have acquired the necessary swing of the handle to produce the desired speed of the cylinder, and accustomed yourself to speak into the funnel, you can trot out your instrument, and invite your friends and neighbours to a worthy entertainment, and if they do not pronounce you a genius, put it down to their want of soul; but do not speak your mind to the phonograph, lest the after consequences might be undesirable.

And now I must bid you adieu for the present; and if there is anything requiring further explanation, I will have pleasure in attending to you in "Shop." But as I always strive to write plainly and to give my instructions explicitly, I think I may use the adage, as far as this paper is concerned, "that he who runs may read."

TESTING PRECIOUS STONES.

BY H. S. GOLDSMITH.

Of rough tests, the simplest is that of applying a file to the stone. The reason of this is based on the fact that real gems are hard enough in most cases to resist a file, while the common imitations will not remain unaltered, but will scratch and crumble away under the action of a file or knife. The imitation gems now spoken of are those usually called "paste." They are a fine, bright quality of glass, and very often are softer than the ordinary glass. These pastes are made of all colours, to imitate all the gems, but they do not, of course, keep their brilliancy if subjected to rough wear; they are too soft.

The next most common imitation stone is one made up partly of paste and partly of some real stone—say a garnet, crystal, or sapphire.

Figs. 1 and 2 will explain the construction of these articles; for the hard stone parts are left white in the sketch, while the paste is shaded. Fig. 1 is composed of two parts, and is called a doublet; Fig. 2 is made up of three pieces, and bears the name of a triplet.

Now, these pieces have to be joined together, and in most cases a doublet or triplet can be detected by the air bubbles in the cement which joins them. If they are not perceptible, then put the stone in a little clean water; then, as it is turned about, the layers which go to make up the deceitful article will clearly show up. Or it might be put in chloroform or boiled in water, when the pieces would separate.

A file, if applied to the front of either of these, would have no effect, the crown being of garnet or sapphire, or some other hard stone. It is then necessary to try what the back will stand. If it is a doublet, the file will scratch it anywhere, but a triplet will not be affected, except on the layer of paste just under the girdle of the stone, which is a part generally hidden by the setting.

The water test is a good one for these, and the appearance of minute bubbles in the cement is fairly decisive; but there are real stones which have bubbles in them, so take care how a stone is condemned on that account. A cinnamon stone or essonite often has the little bubble-like specks; and there are others.

An imitation gem need not have glass in its composition, for sometimes a real stone is so cut that it is really an imitation of a more valuable one. For example, a jargoon or a chrysolite can be made to very fairly represent a diamond. To these it is useless to apply a file, for they are hard enough to resist it. The appearance of the sharpness of the facets is some guidance, but if the tests of hardness by Mohs' scale and of specific gravity are not going to be applied, then a lapidary will easily judge for you; or, if you have had a fair experience, your own eye should be sufficient to discriminate between them. A file will indicate the relative hardness of the two stones by the sound it makes, although it has no effect on the stone; but the ear must be an educated one before it is able to discriminate in this way.

Concerning turquoise—real turquoise can be filed, but not so easily as glass. The surface of a real turquoise is more waxy than glass. A minute or two's practice with a file or scraper on paste turquoise and on the real article will teach a valuable lesson. As to other imitations of turquoise, there is a real stone called "callainite," whose hardness is below that of glass; but it is rarely met with.

Odontolite is another natural production, and is yet not a true stone, much as it resembles a turquoise. It is coloured like it, but, being a fossil bone or ivory, the bony structure can be traced.

With turquoise the test of the file or scraper is useful, but in this, and in the other stones too, do not apply your test to the prominent parts of the stone under examination.

Coral.—This natural production has a good many imitations; but many are so coarsely done that a moment's inspection will expose their falseness. I mean the things formed in coraline, xylonite, and celluloid, or dyed ivory or bone.

A more tricky imitation is one that is shown in packets. It is a beautiful pink colour, ready cut for mounting and setting, and is very soft, being, I am told, made from rice.

There are others, but if their own appearance does not give judgment against them the file can be used; and by comparing the way a known piece of coral "talks," and the difference of feel and sound that imitation coral has, a just opinion can easily be formed. Coral is also well imitated in glass.

Of opals little need be said. A passable counterfeit of a good opal I have never seen, and do not think it exists. If it is a bad

one, then the value will be so little that the trouble of testing it is not worth doing.

Of lapis lazuli the file is again a good means of discriminating. Its imitations may be either harder or softer—*i.e.*, stained agate will be harder, so will enamel on metal. This last makes a splendid imitation, but the polish is generally too perfect for lapis; while the Xylonite Company's lapis is first-class for appearance, but it is much softer to the file than the real thing.

Xylonite can also be cut with a knife like cheese. Now, we have no gem which will stand having pieces cut off with a knife; in fact, one of the necessary conditions of a precious stone would be absent—that of sufficient hardness to be durable.

To judge whether a pearl is real or not is nowadays not always an easy thing to do at a glance, the imitations are so excellently got up. Doubtless, a pearl of the highest class is matchless in its orient; but of the general run of pearls one finds that the best imitations are nearly, if not quite, as good as the real in appearance.

First, let us clearly understand the formation of a real pearl. It is simply a series of concentric spheres, one enclosed in another sphere; or, to put it the other way, layers or shells completely enveloping each other, beginning with a very small one, and gradually increasing in size as they have to enclose larger and larger kernels, as it were.

Being formed in this way, it follows that if a round pearl (Fig. 3, A) is cut across in any direction, then the appearance of the interior, when it is exposed, must be something like Fig. 3, B—that is, a series of concentric circles.

If the pearl is an oval or a drop shape, the lines will still appear concentric—*i.e.*, one within the other, but of the shape of the pearl; not circles, that is, but ovals or pear-shape, as the case may be. These are formed by deposition of the nacreous or pearly material in stages, and it is only when it is deposited *round a nucleus* that it forms a real pearl.

The same pearly material is also deposited on the shell itself. Now, even if it is possible to cut off raised portions of the shell, and even if such portion is just as bright as a pearl, as it often is, still, the piece is classed differently, being called a blister pearl, and its value is much less.

Its structure will be often approaching parallel lines, the particular concentric formation being either absent altogether or else much modified as shown in Fig. 3, C and D.

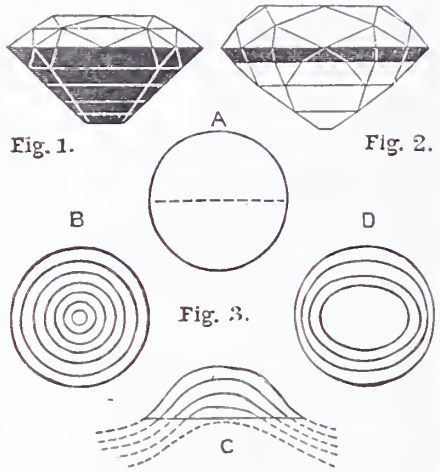
These blister pearls, being formed as shown by the dotted lines, the shape cannot be so good or so regular, but will be more or less on the twist. But this question of shape is rather a complicated one; so it had better be left out of further consideration in this reply, which already is taking up too much space.

We cannot always observe the structure, particularly in the case of an undrilled, or only partly drilled, pearl; but then we have the shape to guide us. If it is entirely undrilled, then it will be a pearl; and if partly drilled, the glassy formation can easily be recognised if present, and some of the waxy stuff that is used to fill them is generally to be got at.

These mock pearls have many names—Roman pearls is one of them. They are thin glass beads, filled with certain matters, or lined with them to counterfeit the real article. The exposure of the edge of the hole is usually sufficient to decide the question. Church's description of imitation pearls is as follows:—

"They are small spheres blown on tubes of slightly opalescent glass, and coated internally with a preparation made from the scales of a certain fish (as the bleak) and called *essence d'orient*. The little opalescent glass globe first receives, while still soft, a few very slight dents; then a coating of parchment size is introduced, and then a film of the pearl essence. Lastly, when the essence is dry, the bead is filled with wax."

Another substitution of a genuine article for one of greater value is the case where hematite (the iron ore) is cut and polished to represent black pearls. The weight and hardness of this are sufficient to distinguish



Precious Stones. Fig. 1.—A Doublet, two pieces, the Crown of Garnet or Crystal, etc., the Base of Paste, shaded in Sketch. Fig. 2.—A Triplet, three pieces, Crown of a real Stone as far as the Girdle, then a layer of Paste, shown shaded in Sketch, the lower part of base being composed of a real Stone. Fig. 3.—A, Whole Pearl; B, the same. If cut across and turned to show the flat Surface, it shows the Concentric Structure of a real Pearl; C, Sectional Elevation of a Blister Pearl as it would be cut from a Shell; D, the same, to show the appearance of the cut Surface.

it from the real thing. Pearls are also dyed sometimes to represent black pearls. They are real pearls, but still not genuine articles.

In this paper I have purposely left out acid tests, and any but passing allusions to other tests. I will go into the matter more fully later on, but the papers will have to be restricted to one class of gems at a time.

In conclusion, let me warn all young jewellers against applying any test to a customer's stone in such a way as to damage it; and a little practice on the lines suggested will be the best course to follow. Rough stones are interesting too, but will want a page to themselves. Indeed, there are many branches of the jeweller's art which young workmen would do well to read and learn about, and I have the Editor's authority for saying that the matter shall have full attention in WORK.

HOW TO MAKE A MAHOGANY MAGIC LANTERN.

BY O. BECKERLEGGE.

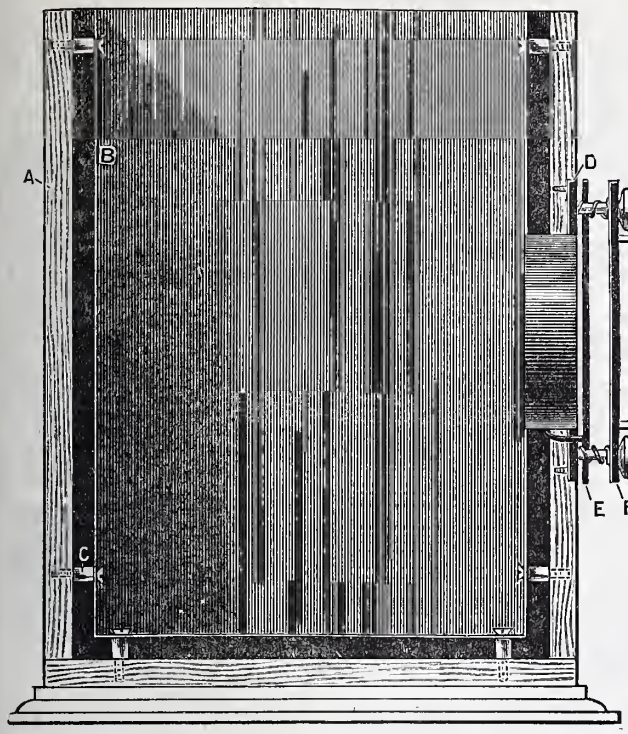
As is made evident by numerous inquiries which have appeared in WORK from time to time on the construction and working of the lantern, there must be many of its readers interested in the subject, therefore I purpose giving practical instructions for the making of the same.

The three essentials of a lantern are: the body, illumination, and optical arrangement. The body is of the least importance, so we put it first. But there are bodies and bodies, and my advice is to pay all needful attention to it. Do not go in for the essentially cheap. I have heard of a lantern being constructed out of a biscuit-tin. Without doubt it could be done, but why do it? Is neatness or elegance nothing? I knew a man who lived in a hut made of discarded soap-boxes. No doubt, that was a trifle better than having no shelter, but it must have been neither elegant nor comfortable. So for our lantern: in some cases it may be better to have one with a biscuit-box for its body than having no lantern at all; but if there is no necessity for such an arrangement, then let us construct that which, when completed, shall give us pleasure in looking at and using. The writer's experimenting goes back to the time when WORK was an undreamt-of quantity, and when practical men were far too conservative to give outsiders any information. Then not only did old tins work in, but even cardboard, for some purposes, was brought into requisition; but I know this: that no sooner was the novelty worn off than the clumsiness and unsightliness of the construction would assert itself, and a craving for something better would master one. At present there is a great variety of types of lantern. For some reasons, the modern one with the circular head to turn over is admirable, but its construction requires more than the average ability possessed by the readers of WORK, whilst the ordinary japanned tin body is hardly up, perhaps, to their standard. I therefore propose to construct a mahogany body; this will not be difficult to make, and presents a handsome appearance. A full-size lantern has the following proportions: inside measurement: height, 13 in.—this does not include the chimney; from front to back, 8½ in., and 6½ in. wide. Old lanterns will be found much larger than the dimensions given, but there is no advantage obtained. Before commencing, it will be necessary to decide on the size of the condenser, which we will assume to be a 4 in. compound. This is the most convenient size if we intend using the lantern in any public entertainment. If it is a matter of cost, then we must decide accordingly.

A set of 4 in. condensers will cost, with front lenses, 17s. 6d.; 3½ in. do., 12s. 6d.; and 3 in. do., 8s. 6d. We shall, however, make all our measurements for the larger size.

For our work we must procure a few feet of well-seasoned mahogany, straight in the grain; when finished up, it should be ½ in. thick. A piece may sometimes be picked up at a reasonable price at an old furniture shop, when it will certainly be well seasoned. For sides, two pieces 13½ in. by 9½ in.;

A Mahogany Magic Lantern. Fig. 1.—Section of the Lantern—A, Body; B, Tin Lining; C, Screw to fasten Lining to Body; D, the Plate carrying the Tube for the Condenser Cell; E, the Presser Plate actuated by the Spiral Springs; F, Plate carrying the Front; G, Sliding Tube over the Front; H, Sleeve carrying the Pinion; I, Tube carrying the Front Lens; J, Stop in front of Lens. Fig. 2.—Plan of Lantern—A, A, Blocks at the



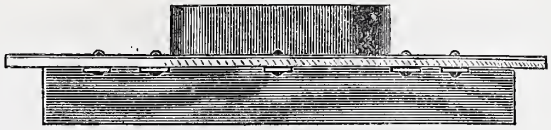


Fig. 7A

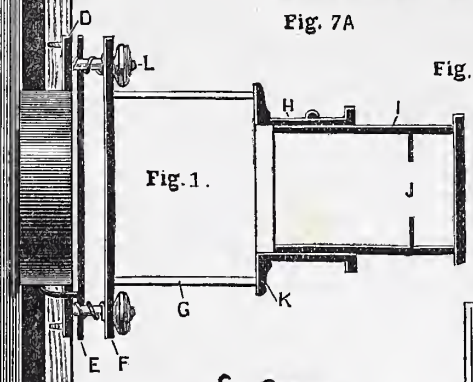


Fig. 1.

Fig. 8.

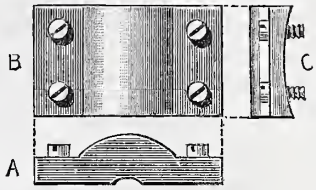
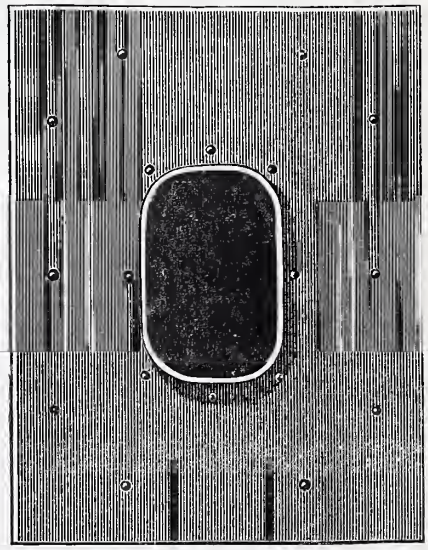


Fig. 7B.



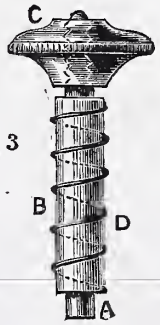


Fig. 3

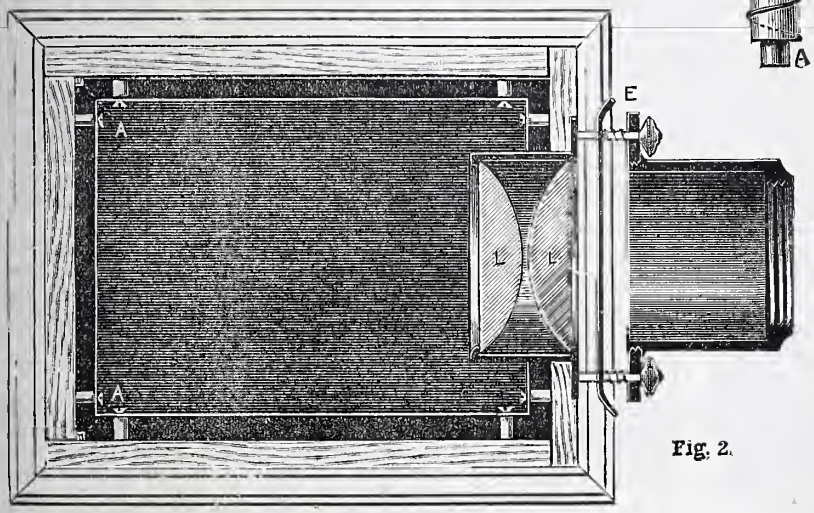
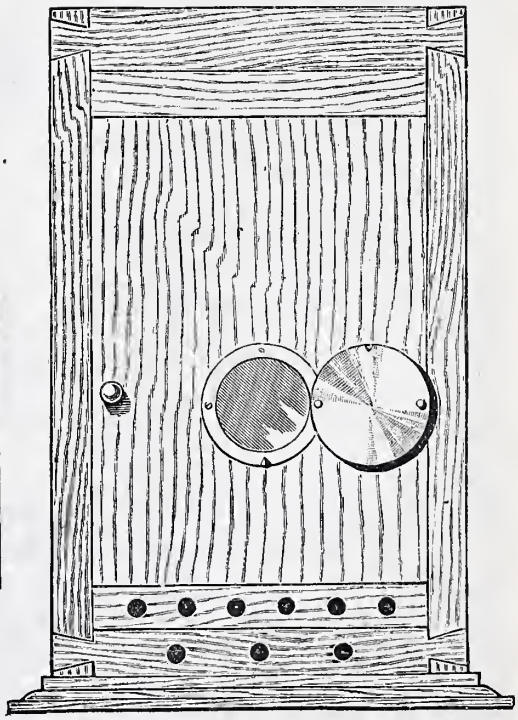


Fig. 2.

Fig. 6.



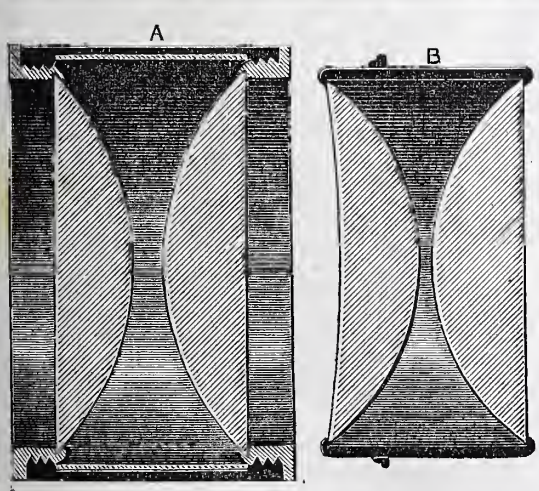


Fig. 5

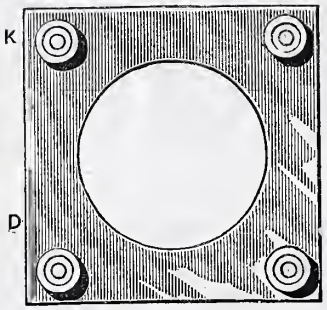


Fig. 4.

Sides against which the Door closes; E, the Presser Plate with the Ends curved forward; L, L, Condensers. Fig. 3.—Full-size Pillar and Boss for the Front and Presser Plate—A, The Pillar; B, the Sleeve over it; C, Running Boss; D, Spiral Spring. Fig. 4.—Plan of the Front Plate. Fig. 5.—A and B, Condensers in Cell. Fig. 6.—Back of Lantern. Fig. 7.—A and B, Top of Lantern. Fig. 8.—A, B, C, Plan Side and End of Pinion Cover.

front, 13½ in. by 8½ in. For the back will be required, at present, two pieces 8½ in. by 1½ in. These are dovetailed into the sides at top and bottom, as in Fig. 6. The bottom must be 1 in. larger all around than the body, with the edge moulded as shown.

Difficulty is often experienced by amateur wood-workers in working up a square edge: everyone should provide himself with a square shooting-board. If the block is set perfectly square with the board, the work must come out square, as also will be the edges. The front must have a circular hole cut to receive the lens and cell—say, about 4¼ in. diameter, the centre of the hole being 6 in. from the bottom; this, in ½ in. wood, can easily be cut with a hand fret-saw. In the illustration the brass plate carrying the condenser lens is represented as let in the front, but this is a mere matter of taste; for some reasons it is better not so, but this will be referred to again.

The front and sides are joined by brass screws; these will look much better if the heads are burnished, when they have a slightly rounded outline. They can be purchased, but are more expensive; they are easily burnished if one has a lathe. I have seen a small boy in a lantern factory do them exceedingly quickly thus: A piece of hard wood is screwed to the nose of the mandrel as a chuck, in the centre of which is a small hole into which the screw is turned. A burnisher is pressed firmly against the head, and a slight motion is given, so as to produce the convex outline, and in almost less time than it has taken to write these sentences the screw has been burnished and withdrawn.

It is hardly necessary to say that the screw holes must be marked off at regular intervals and be slightly countersunk, which will add much to the appearance of the instrument and be more workmanlike.

The bottom can now be put on. This should be fixed in its place by two screws, when with a ¼ in. bit two holes should be bored through the sides, front, and back. Hard-wood pins must be glued and driven in; these will hold much better than screws, as the wood is the long way of the grain.

The body must now be lined with tin-plate or thin sheet-iron—I should recommend the former—leaving the side nearest the wood bright, as it is well known that a bright polished surface radiates less heat than a dull one.

The lining need not be joined together. Sixteen or more bits of brass tubing will be required, ½ in. long by ¼ in. diameter. Holes must be punched in the corners of the lining, and screws passed through the tubes into the body, as shown (C, Fig. 1). Three ½ in. holes must be bored in the bottom rail of the back; by this means the lantern will be ventilated, and a current of air will pass around between the inside of the lantern and the lining, keeping it cool. It may be well to say here that probably a false bottom may have to be placed in the lantern, so as to rightly adjust the height of the lamp, but this, of necessity, cannot be done until the lamp has been procured. We may, however, indicate the rule to be observed. The edge of the burning wick should be about 1 in. lower than the centre of the condenser. When it is ascertained that a false bottom is required, one can be added by removing the bottom lining and riveting the false to it, using pieces of tubing of the requisite length to bring it to the required height.

The door must now claim our attention. The exact length of the door will depend on the form of the lamp used. Should the knobs of the rods for raising the wicks project beyond the back of the lantern—and they often do—then the door must be short enough to close over them. If, on the other hand, they do not project, then the door may come down nearly to the bottom rail. Both for appearance and strength, the door should have a piece grooved and tongued into the top and bottom, the opposite way of the grain. A 2 in. circular hole must be made in the centre of the door, with a narrow rabbet to receive a piece of ruby glass, which must be secured in its place by a ring of brass, as shown; this will be of service should the limelight be used. The body may now, with the exception of the top, be considered finished, and in our next paper we will treat of the optical arrangement.

HELICAL GEARS.

BY J. H.

Spur Wheels.

Methods of Moulding—Wheel-Moulding Machine—Method of constructing Tooth-Blocks for withdrawal—Explanation of Figures—Details of Construction.

Methods of Moulding.—These helical wheels are, as a rule, made with wheel-moulding machines from tooth-blocks; scarcely ever from complete patterns, and only occasionally in core boxes. And but for the extensive employment of these wheel machines, the helical gears would not even now be used to any great extent, owing to the difficulty of constructing them by the other methods. Their invention actually dates from the early part of the present century, but it has only been since the invention of wheel-moulding machines that they have been a practical success.

Wheel-Moulding Machine.—I may mention, in the interests of the general reader, that a wheel-moulding machine is essentially a dividing wheel and worm and change wheels, together with the mechanism necessary for holding and carrying and withdrawing a couple or

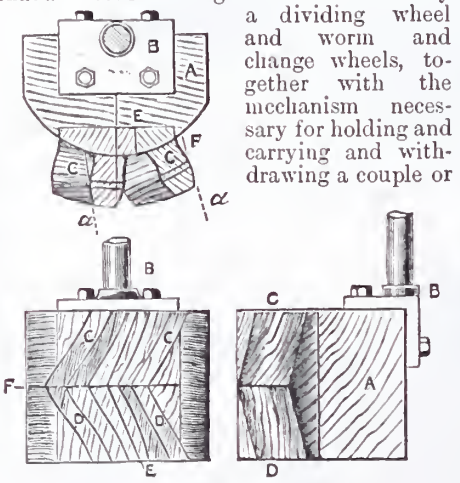


Fig. 4.—Pinion Tooth-Block.

three teeth, pitched and shaped like those on the complete wheel which has to be moulded and cast. A good example of a wheel-moulding machine is illustrated in my book on "Practical Ironfounding," p. 134. Wheel-moulding machines are constructed to withdraw the tooth-block from the sand after ramming, either in a vertical or horizontal, and sometimes also in a diagonal, direction, being thus adaptable to spur, bevel, worm, or skew gears. An entire spur helical block can never be drawn vertically, but it may often be drawn horizontally, though not always. Spur wheels can mostly be drawn horizontally; pinions seldom so, because of the undercutting of the outermost flanks. Neither bevel wheels nor pinions can be drawn horizontally.

Method of constructing Tooth-Blocks for withdrawal.—Now, the general practice is to adopt a compromise in both spur and bevel wheels. The teeth themselves are made distinct from, though temporarily attached to, a main b' ck, or backing (A, in Figs. 4 and 5). The backing supports the teeth during ramming, and is then lifted vertically by the arm of the machine, leaving the teeth themselves behind in the sand. The latter are then taken away by the fingers of the

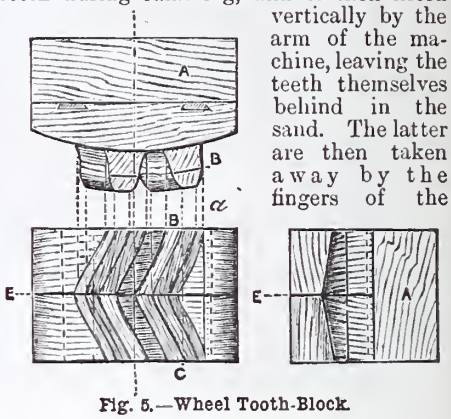


Fig. 5.—Wheel Tooth-Block.

moulder in the direction in which they will happen to come out the easiest.

I will confine my remarks during the remainder of this article to the subject of helical spur wheels, reserving the next for the description of bevels. And to guard against captious criticism, I will remark that, though I explain the commoner methods of construction, there are modified methods adopted in the formation of helical tooth-blocks. It matters little, however, which is selected, so that the ultimate result is secured.

I show a couple of tooth-blocks as used for spur wheels, in which two of the best and most frequent methods adopted are illustrated. I will first explain the reasons for their construction, and afterwards explain in detail how they are marked out and worked.

Explanation of Figures.—In Fig. 4, which is a spur pinion-block, A is the backing screwed to the carrier, B, of the wheel-moulding machine; C, C and D, D are four several pieces, between which the two pattern teeth are divided for convenience of delivery. These four blocks fit into the backing, which is grooved to receive them. They fit closely, yet slide freely in their grooves, so that the lifting of the block, A, does not disturb them in the sand. The same purpose is fulfilled by the dovetail fitting of the wheel-blocks (B, C, in Fig 5) into the backing, A. There is, further, no vertical division between the teeth, as in Fig. 4 (shown at E in that figure).

The reason why the tooth-blocks are divided vertically in Fig. 4, and not in Fig. 5, is that in consequence of the undercutting of the tooth flanks at F, due to the small diameter of the pinion, the pair of teeth could not be drawn back from the sand together without tearing it down, while they can in Fig. 5. This is shown clearly by the dotted lines, *a*, *a*. In both cases, however, the teeth are divided along the middle planes (F, Fig. 4; E, Fig. 5). This is not always necessary for the purpose of easy withdrawal; but it is convenient, and is an advantage for marking out the teeth upon the middle plane, which, without the joint face, would have to be cut with a templet. Further, if the teeth are not divided along

the middle plane, the proper ramming of the lower portion is somewhat interfered with by the upper portions leaning over in the way of the rammer. If the upper half is removable, the lower portion can be rammed in a more nearly vertical direction than if the teeth are in one piece. In the latter case the direction of ramming must be more horizontal. Sprigging the teeth is also better done with the top portion of the teeth removed out of the way.

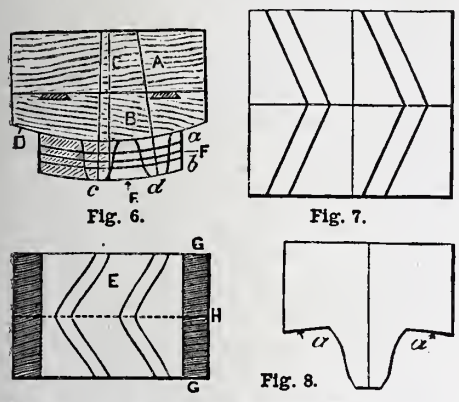


Fig. 6. Fig. 7. Fig. 8.

Fig. 6.—Lining out of Tooth-Block. Fig. 7.—Paper Templet. Fig. 8.—Wooden Templet for working Inter-Tooth Curves.

The construction of the spur tooth-blocks is easy enough; that of the bevels is not so easy. In the spur-block we have only level surfaces and curves at right angles thereto to deal with; in the bevel we have nothing but bevels.

Details of Construction.—In the spur helical block (Fig. 6) a piece of backing, A, is first prepared by planing into a cubical form, and the piece B is attached to it with dovetailed strips or other suitable fittings. A centre-line, C, is squared over, the curve, D, representing the roots of the teeth, struck and worked, and the block from which the teeth are to be worked fitted to this curve, and glued on.

The curves representing the tooth-point, E, the pitch-line, F, and such striking-lines, *a*, *b*, as may be necessary, are marked with trammels, the centre-lines, *c*, *d*, of the teeth upon the outer faces marked radially, and the outlines of the teeth struck thus:—Since in these wheels there are three terminable planes—namely, the two outer faces, G, and the middle plane, H—which coincide with the apex of the meeting teeth, the shapes of the teeth are marked upon all three faces, no matter whether the wheels are spur or bevel. The curve, E, which corresponds with the tooth-points, is worked round, and then the tooth-centres and outlines marked in the joint-face upon either one of the blocks. The lines representing the extremities of the tooth-faces are then marked upon the curved face, E, of the pattern block, along the edge of a bit of thin steel bent round from outer to middle faces.

My pattern-making friends will recognise this method as one commonly employed for marking out the threads of screw-wheels, worm-wheels, small elevator screws, etc. They scarcely need be reminded that it is necessary that the face, E, should be a true curve, free from lumps and hollows, and that the steel should be flexible and pressed to perfect contact all through its length. Then, and only then, will its edge yield a true helix.

Another good way—perhaps a trifle better than the bent steel dodge—is to get a slip of paper (Fig. 7) of the same width as the pattern-block from face to face; mark diagonal lines upon it corresponding with the terminations of the tooth-points and the angle of teeth, and lay and glue this upon the curved face, E, of the tooth-block. The diagonals will then develop into the helices required.

The helical form of the tooth-points and the shapes of the teeth on the outer and middle planes being obtained, the inter-tooth space is worked out by the aid of a templet (Fig. 8) cut to the exact shape of the inter-tooth space, and the helical twist of the flanks and faces is correctly developed during the act of working. This is clearly the case, because the centre lines of the teeth on both outer and middle planes are radial, and the centre line of the templet is radial; consequently, if the tooth flanks and faces are worked until the templet beds at *a*, *a*, accurately on the outer curve, E, representing the tooth-points, every separate section of the teeth will be truly radial, and the essential conditions of a helical thread will be fulfilled.

I may remark that the shapes of the teeth themselves are the same as in ordinary gears, and may be struck by means of rolling generating circles, or by means of an odontograph scale.

HARDENED SPLIT STEEL CHUCKS.

BY F. A. M.

Of all the chucks for holding small rods, wire, etc., while being turned, these are the best; in fact, it may almost be said they are the *only* chucks that will hold small work really true. Scroll chucks are very useful for holding stock, or material such as wire, and metal rods, off which screws, etc., are to be made; also for holding drills; but no one expects absolute truth in a scroll chuck. The Essex chuck springs have a range of

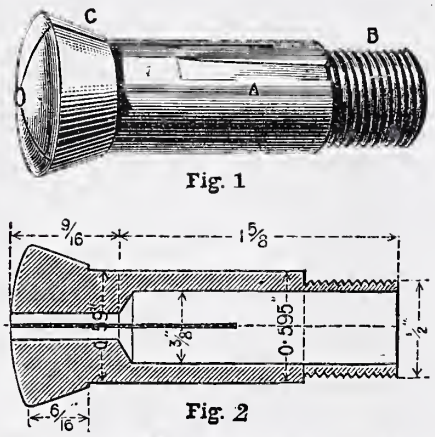


Fig. 1 Fig. 2

Fig. 1.—Outside View of Spring Chuck. Fig. 2.—Section of Chuck

about $\frac{1}{8}$ in., which prevents all hope of arriving at real accuracy; they are very cheap, and may do well enough for holding drills. To hold small work with perfect truth demands something in the style of Fig. 1, which is an outside view of a spring chuck, one of a set of thirty-seven sizes having holes varying by only $\frac{1}{100}$ in.; the smallest has a hole of $\frac{4}{100}$ in., and the largest of $\frac{4}{10}$ in. The same kind of chucks, but of much smaller size, are made for watchmaker's lathes, and they will hold a small needle perfectly true while being turned.

The chucks fit into a perfectly true hole in the mandrel of the lathe 0·015 m. or 15 millimetres (a full $\frac{1}{2}$ in.) in diameter. The hole runs right through the mandrel. A tube is put in at the tail end of the mandrel having a wooden hand-wheel fitted on it to hold and turn it by; this tube also fits the bore of the mandrel, and at its front end where it meets the chuck it has an internal screw which takes on to the screw B at the end of chuck (see Figs. 1 and 2). The key-way at A receives a little pin, which projects into the bore of the mandrel and prevents the chuck from turning. As the tube is turned the screw threads draw in the chuck, and the conical part C, which fits a similar internal cone, causes the chuck to close upon anything placed within it to the amount of $\frac{1}{100}$ in. The sides of the cone are inclined to the centre line 20°.

Fig. 2 gives a section of the chuck with its principal dimensions, which are metrical, but are here given in fractions of an inch. The pitch of the screw is 1 millimetre; or very nearly 25 to the inch.

These chucks are interchangeable; they are very carefully made in America and very expensive, the list price being $2\frac{1}{2}$ dols., say 10s., each. They are made of the best tool steel, hardened at the front end and ground true. The smallest sizes are ground true in the hole by tiny steel pin-like laps, charged by rolling them in diamond dust; the chucks are placed in a slowly revolving mandrel whilst the little lap runs at a great speed in touch with one side of the hole till it is quite true.

Probably anyone who wished for a set of chucks like these could get them made in this country for about 6s. each, but I am not aware that any of our lathe-makers supply them.

KALSOMINING.

Kalsomining, or wall colouring in distemper, is best done when the walls are not too cold or too hot. It may be done during the winter, so long as the walls do not freeze. There are a good many preparations put up for this purpose, and called by various names. However, if you are where you cannot procure this, it may be prepared in the following manner: White—To 10 lb. best whiting use $1\frac{1}{2}$ lb. white glue, $\frac{1}{2}$ lb. alum, and a little ultramarine blue. Put the glue in cold water, set it on the fire, and stir until dissolved. Put about half a gallon of hot water over the whiting, and when dissolved, add the glue, the blue, and the alum, which must also be dissolved in hot water. Stir this mixture well and run through a sieve. For first coating this may be used while hot, but the other coats must be cold. If your colour works too stiff, a little soap will help. All colours and shades are made by adding the dry colours. Before kalsomining, the crack and nail holes should be filled with plaster-of-Paris. Mix this with paste, and it will not dry so quickly. If you have a good brush, and work as quickly as possible to avoid laps, you will have a good job of kalsomining. A neat stencil border run around the top of the wall makes a nice finish.

The keeping clean of walls is a most important matter in every house, especially in the hot weather season, when so much dirt and dust cling to them—endangering life and health at every respiration by reason of the germs of disease contained on unclean walls. With colouring matter cheaper than paper, thousands of people might easily purify and brighten their own walls.

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NOTICE.

"WORK" COMPETITION COUPON

will be found on page 288.

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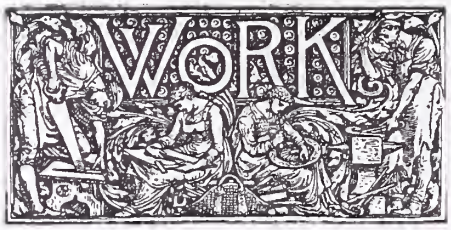

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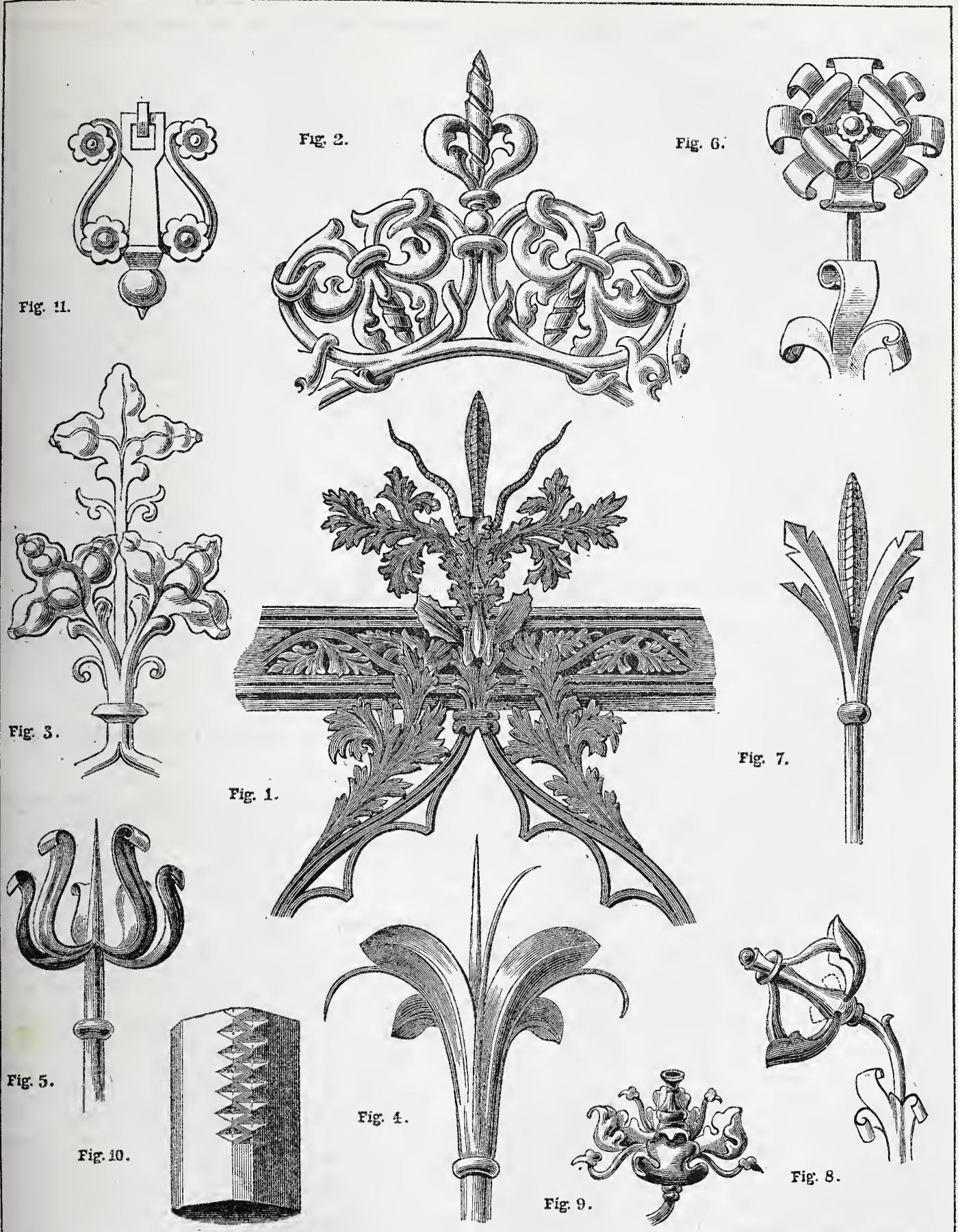
NICKEL SMELTING.—The value of nickel as a non-corrodible material is well known, but so refractory are its ores that it is chiefly used for plating. We may, however, look now for wider applications of the metal itself, as some fifteen months since the Orford Copper Company experimented on new methods of treating the nickeliferous pyrrhotite and chalcopyrite ores of Sudbury, Ontario, and the result is that a method is devised for the proper reduction of the "mattes." The details of the process are kept secret, but the copper and nickel in the matte are separated, and the nickel converted into nickel oxide, which may be reduced or used in that form for making nickel steel, which is more homogeneous in texture when made from the oxide than from the metal itself. This new discovery has given such an impetus to the owners of the nickel mines in Northern Ontario, that the Drury Nickel Company have not only built a large smelter, but have also constructed a line of railway to connect their works with the Canadian Pacific Railway. Nickel, at a cheap rate, will be a blessing to the amateur, as it can be welded like iron; and so we can have a smith's shop at home without the dirt, and moreover it is a very clean metal to turn.

LINERS FOR BORING.—At the present day, when accuracy as well as speed is required in the manufacture of machinery, engines, etc., a good system to observe, when boring out bearings and connecting rod brasses, is to put in between the points of the brasses a liner. Say for a 6 in. brass put in a $\frac{1}{8}$ in. liner, and bore the brass out to $6\frac{1}{8}$ in. diameter. After this is done, take out the liner and put the brasses together, and it will be found that they will measure 6 in. diameter at the crown, and at the points $6\frac{1}{8}$ in. diameter, or $\frac{1}{16}$ in. clear at each side of the shaft—a necessary space at the points to avoid unnecessary friction. As this space has to be filed out by hand, why not do it by machinery at the same time as we bore out the shaft? It, at all events, saves time, and, as time is money in manufacture, a few hours saved on the brasses of an engine is a move in the right direction. This system also ensures that the brasses fit the shaft better.

CO-OPERATIVE HOME INDUSTRIES.—A new society which commands our interest and support is about to be started for the promotion of home industries, especially among our rural population. The object of the society is to afford a means of sale for the various handworks which are already carried on in cottages, and which might be produced in much larger quantities under further encouragement. It is estimated that some £30,000,000 annually is paid out by England for minor art work done abroad, and it is argued that a large proportion of this work might as well be done at home. Our working classes have often only too much leisure. There is the "out of work" time to which nearly all trades are subject, and in our agricultural districts the really active time of the year is small compared with the slack season. Farmers complain, too, of being obliged to support throughout the year the labourers whose services are only required for part of it, and the low wages, which is all they can afford to pay, come hard on the labourers, who do little to add to them. The proposed society would bring the home producers in direct contact with the world of buyers, everything being done on strictly co-operative principles, shareholders, salesmen, and craftsmen all sharing in the profits. It would thus fill the post occupied in Germany by the Kunstgewerbe, which exist in most of the towns of that country. By their means the people of the district may, on payment of a small fee, exhibit anything which they produce for sale, without an intermediary system of middlemen. Before long a definite plan of action will be submitted to the public. The new society must not be confused with any of those now existing for the purpose of teaching art work to the poor. Its object is simply to provide a means of sale for such work when it is produced. The foreign manufacturers of the articles for which we pay the £30,000,000 are content with so much smaller profits than our own people would think it worth their while to work for, that with a fair field it would be useless for us to attempt to compete with them; but when the expense of carriage and all the profits of intermediate agencies are taken into consideration, it is clear that British workers start with an immense advantage, and given proper organisation in the selling department, they ought, as soon as they can make things as they are "made in Germany," to sell their work for less than is now given for the foreign imports, while gaining considerably more than the actual workman in France or Germany has done. Already this society has some headquarters in the West End of London, and it should not be long before it develops into a thoroughly prosperous institution. There cannot be too many societies of this kind throughout the country in order to conserve the trade, and utilise as much as possible of the unemployed labour of the country. Those having time and means with a desire to do some good for their generation ought to co-operate and lend their services and encouragement to such a cause as this—one having so excellent an object as the cultivation of small home industries.



Old Spanish Hammered Iron. Figs. 1, 2, 3.—Crowns of Archways in Railings. Figs. 4, 6, 7, 8, 9.—Ornaments of Railings. Fig. 5.—Candlestick. Fig. 10.—Ornament on Shaft of Lectern; the Examples from the Cathedral of Santa Maria, Murcia. Fig. 11.—Murcian Street-Door Knocker.

SOME HINTS IN ART IRONWORK FROM OLD SPANISH EXAMPLES.

BY HIRAM PRICE.

THE OLD HAMMERED IRON OF SOUTHERN SPAIN—DESCRIPTION OF THE ILLUSTRATIONS.

The old Hammered Iron of Southern Spain.—To the art workman it is ever an advantage to make acquaintance with examples in his craft from new or unfamiliar sources. It enables him to infuse new blood, so to speak, into his work, and to keep his style from becoming mannered and uninteresting. The accompanying illustrations of old hammered iron cannot, therefore, be otherwise than acceptable. They are from the Spanish city of Murcia, which, it will be remembered, is in the south-east angle of the Peninsula, and out of the track of the ordinary tourist.

The cities of Southern Spain contain much interesting ancient ironwork both within and without their buildings. The windows of old houses of the better class are each protected by a "*reja*," or projecting grating. These gratings are credited with having been made less as a safeguard against robbers than to prevent the Spanish damsels being carried off by their lovers without the paternal consent. The lower part of the *reja* is almost invariably decorated with grotesques in hammered iron.

Many doors, too, show fine work. Fig. 11 is the knocker of a Murcian street-door. This of course is late Renaissance—seventeenth-century work. And in addition to effective hinges, the studding of Spanish doors is often effective, the iron stud-nail forming the centre of a flower, which it attaches to the wood.

But it is in church interiors that the finest old work is to be found; and most of the examples given were sketched by me in the cathedral of Santa Maria, Murcia. Iron railings, which from their importance might almost be called screens, are made to separate the several chapels from the body of the building. Eight of the illustrations are from the ornamental parts of such railings. Without entering into precise dates—which would be useful to the antiquary, but not to the practical man—these examples may be said to belong to the later Gothic period and to that of the transition to the Renaissance.

Description of the Illustrations.—Fig. 1 is a rich example of the head of a gateway or entrance through railings to a side chapel. The grotesque animal in its centre is of much the same order as those found on the *rejas*. Fig. 3 crowns another entrance of a somewhat less ornate type. The part left unshaded in this is missing in the original, the restoration being a conjectural one of my own. Fig. 2 is the central part of another chapel entrance, exceedingly fine and effective, but in a later style. Figs. 4 and 7 are graceful iron finials from chapel railings. Figs. 6, 8, and 9 are also decorative parts of such railings. In Fig. 8 the flower has, in reality, four petals, but two have been omitted to avoid confusion. Fig. 5 is one of a row of iron candlesticks before the altar of one of the chapels in the same cathedral. Fig. 10 is from an iron lectern, also in Santa Maria. This lectern is supported by a square bar of iron, which would have looked out of keeping with the ornate foot and top but for the simple zig-zag ornament with which it has been enriched, made by taking off the right angle and cutting notches down the two obtuse angles thus formed. Of Fig. 11 mention has already been made. It is a knocker from the door of an old house in the city of Murcia, and is of more recent date than the other examples.

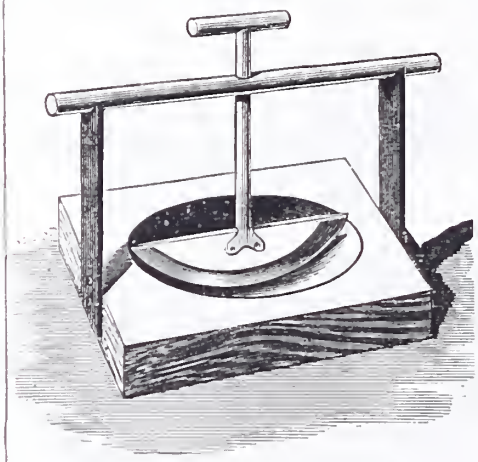
SUET AND HERB CHOPPER AND BLOCK.

BY J. C. K.

THIS was made to save time, and fingers from cuts, in a household where much of the food cooking was done by the farmer's wife. She prized it as being so useful that her small children could do chopping of suet and light easy-cutting herbs, as parsley and mint, without risk of fingers or spilling the cuttings from the chopping-block, the action of the knife being a driving and sloping cut in the hollow of the block.

The block, of 4 in. hornbeam (beech or lime will do nearly as well), is hollowed out three inches, forming a segment of a sphere in shape of hollow.

The chopper was a part of a broken handsaw blade, curved at one edge like a cheese-knife, and sharpened to almost razor keenness. A ⅜ in. iron rod, 9 in. long, was riveted to this blade, and a large cross handle of wood was riveted on the top of the knife-rod. To keep the knife fairly



Suet and Herb Chopper and Block.

vertical in chopping, the rod passes loosely through a cross-piece framed to two uprights, notched and screwed into the sides of the chopping-block.

The illustration will make clear the whole of the utensil, so that anyone inclined to imitate it can easily do so.

GARDEN VERMIN ERADICATORS.

To protect Carnations from Wireworm.—Scrape out part of a potato and bury it close to the stem of the carnation. The wireworm prefers potato, and will take up his abode there, with all his numerous following. Destruction is then easy. The frost kills wireworms and their larvæ, so dig up to let the frost into the ground in winter. Another plan to kill wireworms is to sow the ground with crushed rape-cake before a shower; the wireworms eat it ravenously, and the rain causes it to swell in them, and kills them wholesale.

To prevent Maggots eating into Onions, etc.—Dig into the ground intended for planting, soot and wood ashes, and water it with ammoniacal liquor.

To prevent Broccoli Plants from Clubbing.—Dip the roots of each plant, before setting, into a mixture—a gallon of soot and 1 lb. of saltpetre, made into thick paint with water.

Another plan is to put into the ground with the plant a handful of sweepings of a farrier's shop; the hoof-parings prevent the attack of the grub.

To ensure a Crop of Turnips from the Fly.—The fly mostly only settles once, and that is only on the smooth leaf of turnips, seldom on the rough leaf to do harm. Soak half the seed to be sown in water over night; this will promote germination of the seed soaked; mix it with the dry seed in the morning with lime powder, copperas powder, or sulphur powder, and then sow. The earlier turnips will be taken by the fly, and the later growth will get into the rough leaf before the second visit of the fly, and pass unscathed.

To kill Wasps in their Nests.—In a wine bottle put a little turps, and pour it out, so as to leave only the fumes in it. Thrust this into their nest entrance; it will kill them. So will a tube of sulphur and gunpowder thrust in, and lighted when thrust in, and a turf put over it to keep the fumes in the hole. This stupefies those it does not kill, so that the nest may be dug out and the wasps killed.

To destroy Earwigs.—Earwigs may be destroyed easily. Get broad bean stalks, cut five or six inches long, and laid horizontally in the fruit trees they assail; blow them out of the hollow stalks into scalding water. A little moss in a small inverted flower-pot is a trap for them for dahlias.

To protect Flowers from Rabbits.—Dip some twigs or sticks in brimstone, and stick them in the ground round the flowers to be protected.

To extirpate Moles.—Strew the leaves of the elder in their runs; they will desert them. To kill moles—Get carbonate of barytes, put in a shallow pan, and some worms on it. When covered with it, lay the worms in the runs of the moles to eat; it will kill them.

LONDON FIRE-BRIGADE WORK.

BY HENRY FRITH.

PEOPLE who stand aside in amazement, and stare at or after the rushing fire-engine drawn by its powerful pair of horses, steaming furiously perhaps on its headlong way, do not see the work of the brigade. They see the engine, but do not see the machinery, the propelling power as it were, which sends forth the fire-engine thus fully equipped. Let us take a glance at the headquarters where Captain Simonds reigns supreme.

As the visitor enters the establishment in Southwark Bridge Road he perceives two fire-engines: one is a steamer, and is never permitted to get cold; the other is one of the ordinary type of manual, and around both are firemen busy, in "stable dress," polishing and rubbing the brass-work, etc. Everything on the extensive premises is beautifully clean, and we are certain that no "personage" will here find any mischief for the hands to do. Close by the entrance are the office and ante-room furnished with telephonic apparatus from the several districts. But scarce a sound disturbs the silence as we pass on to witness the inner life of the brigade on duty.

Someone may imagine that when the fireman is not engaged in extinguishing fire he is enjoying himself, pipe in mouth, but this is far from being the case. There is plenty to do. There are engines to be repaired, and service engines and surplus engines to be inspected. There are boilers to be tested, and many smiths, carpenters, etc., are daily employed in these repairs and in painting.

Everyone is busy, yet everyone is alert for duty if necessary. In the model stables we perceive the same condition of preparation. Horses stand

facing the door—not the manger—and wearing collars suspended over the neck, the harness is thus held up by a weight which the alarm bell releases. In a second the animal is ready, his halter drops, he trots out to the entrance, is harnessed to the engine, the great doors fold back at the same moment, the coachman, who has come in with his horses, pulls a rope which hangs over his driving seat, the street portals fly open, and the engine starts. This business is so rapidly performed, that on the occasion on which the writer was present, less than thirty seconds was sufficient to get all into order and ready to go.

As in other properly organised corps, there are recruits to be drilled, and practice to be attended to. The recruits are drilled from 9 a.m. until noon, and from 2 until 4 p.m. The drill consists in learning how to perform the duties which the men will have to become perfectly proficient in before they are permitted to be enrolled in the ranks as attendants on fires.

For instance, they must learn the manner in which ladders and the escapes are put upon the wagons for conveyance to the scene of the conflagration. The escape or ladder must be properly placed in position, and as there is a wrong way as well as a right way, the latter must be learned. Mounting and rescue drills also form important portions of the work to be learned and performed, but as every fireman is first a sailor, he already is naturally active, handy, and self-reliant.

Rescue is performed by means of a "dummy" figure, and with this heavy burden the recruit descends the escape, sending the rescued man head downwards into the receiving netting. A rescued man is carried differently from a rescued woman, the latter being grasped below both knees when carried on the shoulder, but when placed head first in the net the rescuer descends with her, holding her dress round the ankles. So the female comes down quietly, her swift progress being retarded by the fireman. The manner in which the men tumble into the escape and check themselves in mid-career when burthened with a body is something wonderful to witness.

This is not the only practice which has to be gone through. The other day we all read in the papers how two firemen leaped out of a window at a great height from the ground, and alighted without any injury. This was the result of practice, and of knowing how to jump. At the head-quarters the men are taught the "jumping drill." They leap from the windows into a sheet, or in some cases, perhaps, to the ground, without injury. By constant practice they are enabled to fall without any serious effects.

To see the men perform all these feats, to watch them proceeding steadily along a narrow parapet carrying a dummy representative of a man without fear or giddiness, to see them save the rescued one by the escape even in practice is astonishing. Much more surprising is it to watch them working at a fire, where to all appearance they are as cool and collected as at the head-quarters of the brigade upon a sunny afternoon.

The manner in which the men run, climb, and swing as actively as monkeys is owing to their training as sailors, and to the deft management of a hook which every man carries on duty. This implement, with a swivel-catch, supports the fireman, thus permitting him to use both hands in assisting the threatened inmates of a burning dwelling. What the caudal appendage is to the ape the hook is to the fireman on duty.

It will be perceived that the fireman at head-quarters has little leisure, and we understand that the members of the brigade are always supposed to be on duty save and except during their short holidays. At night as well as by day the men are always on the alert, and when the "call" comes they snatch coats and helmets from their pegs, leap on the engine, and only asking one question, "Where is it?" the coachman dashes out into the streets. We all know how the tide of traffic rolls back to permit the engines to pass; and when their work is done the men return drenched, scorched, weary, half-blinded by heat and smoke, or perchance wounded and bruised by fragments or stone walls.

Some, alas! never return. Go and look within yonder room in Old Winchester House, whose once famed precincts rang with revelry, and eke with strife. Proceed upstairs, and peep into yonder cupboard, and there you shall find some relics of those brave men who have sealed their devotion by the hands of death.

Remains! Yes; only remains indeed! relics: fragments, charred and blackened by fire and smoke, are all that rest here or elsewhere of many brave men who have died on duty. Here is a helmet, here on a pad a few fragments of a uniform, all that remains of a man and his dress; here a hose-nozzle, here a spanner, etc.: no more, save an inscription recording briefly the name of the deceased and the service he was performing when he died.

* * * * *

Thus the work of many men is ended. They pass to dust suddenly amid the roar of the flames, the rushing of the water, and the crash of falling buildings! Ashes to ashes! Let us pass on.

The fireman's work is over; he has quitted his brigade full of honour. He has done his duty. From recruit—one of 707 devoted men—he had kept watch twelve hours daily; he had polished his engine and repaired it—one of 158 in use; he had dragged miles of hose; attended telephone calls to numerous fires. He had been promoted, had wedded, had lived respected, self-respecting, in the brigade buildings, had saved many lives, and had been killed on duty at the last. His work is done: he obeyed orders—

His not to reason why;
His but to do or die,—
Into the valley of death,
Rode the men onward!

A few statistics will fitly conclude our brief sketch, as illustrating the work of the brigade. In the year 1891 the calls received were 4,164 (about one-fourth of these were false alarms); 2,892 were calls for fires of which 193 resulted in serious damage, and all of them necessitated the attendance of members of the brigade. This account shows an increase on the previous year of 337.

Sixty persons were burned out of a total of 268 endangered. Eleven men of various grades in the brigade have been commended for special merit in saving life, and one of them was also the recipient of a medal. The total distance run has been 65,800 miles, and 84,000 tons of water has been expended in extinguishing the fires.

Four hundred and fifty men are kept on watch every twenty-four hours in the metropolis, of whom 325 are on night duty. Numerous cases of accident and illness were reported, and in addition to attending fires the brigade has kept 164,250 watches of twelve hours each, has made 35,922 hydrant inspections, and 84,662 fire-plug tablet inspections, besides maintaining all the machinery and appliances in order, and written thousands of reports. There are 55 land fire-engines, 4 river stations, 9 steamers on barges, 47 land "steamers," 78 "manuals," and 17 under-six-inch engines; besides barges, tugs, skiffs, fire escapes, miles of hose, hundreds of call-points, alarm-circuits, and telephones, telegraphs, and bells to attend to; ladders, vans, and trucks.

Who cannot find a word of praise for the men who do all this important and varied work almost unrecognised by the public?

TOOLS AND MACHINES.

We have received from Messrs. Melhuish, Son, and Co., the well-known tool merchants, two volumes of catalogues got up in excellent style. One volume is devoted to cabinet and brass-foundry fitments, and forms Messrs. Melhuish's latest list of patented inventions and selected patterns of superior quality for the use of builders, ironmongers, cabinet-makers, etc. The other volume, price 1s. 4d., contains 800 illustrations of labour-saving tools and machines for woodworkers—among which we observe those specialities the Excelsior and Windsor Tool cabinets. All who can should get these volumes.

SCIENCE TO DATE.

Electro-deposition of Nickel.—The following is a good process for obtaining a white, soft, and homogeneous deposit of nickel:—1,000 grams of pure nickel sulphate, 700 grams of neutral tartrate of ammonia, 5 grams of gallic acid, are made into a solution with 20 litres of water. The neutral tartrate of ammonia is obtained by the saturation of ammonia by a solution of tartaric acid. The nickel salt should be neutral. The whole is first dissolved in 3 or 4 litres of water, boiled for about half an hour, and then diluted to 20 litres after filtering. Only a weak current is required.

Transmission of Power by Electricity.—The industrial importance of the new high tension currents is well brought out by the following calculation. Thus admitting that the transmission of force can be accomplished for a tension of 130,000 volts, then 50 horse-power could be transmitted across the ocean by a wire 2½ millimetres in diameter with a loss of 2 horse-power only.

Coco-de-mer.—There is now growing at Kew a young "double cocoa-nut palm" or coco-de-mer. The plant is a native of the Seycheiles, and is very rarely seen in cultivation, for the germination of the double cocoa-nut occupies two years, and then it grows but slowly. The trunk of the adult tree reaches a height of nearly 100 ft., but it is only 1 ft. in diameter. The fruits average 40 lb. in weight, and each contains two or three large nuts in a thick, fibrous husk.

Artificial Formation of Globular Lightning.—Von Lepel has been making experiments on the artificial formation of globular lightning by means of static electricity. Two small copper wires are led from a powerful induction machine, and their terminals placed at a certain distance from the opposite faces of a plate of mica, ebonite, or glass. If now the machine is set in action, "small luminous red balls will be seen moving here and there, at times slowly, at others rapidly, and sometimes in a stationary position." The phenomenon is apparently dependent on weak tension electricity, for if the tension is increased it disappears, and the spark of an ordinary discharge is produced.

NOTES FOR WORKERS.

The first railway made and controlled entirely by natives is being laid down in India, between Tarkeshvar, in the Hooghly district, and Mugra, a distance of about thirty miles.

The American Society of Civil Engineers has selected next October 12 for the adoption of twenty-four-hour time on the railways of Canada and the United States.

Manganin—an alloy of copper, nickel, and manganese—has a very high electric specific resistance, being 0·42 ohm per centimetre, and is used largely in Germany for resistance coils.

Japan already possesses two modern cruisers of about 18 knots, one about 19, and three of 16 knots, and a torpedo gun-vessel of 22 knots per hour.

Coal has been discovered in the Port Curtis district of Queensland, Australia.

The extreme distance at which the Eddystone light is visible from a ship's deck on a clear night is said to be 17½ miles. The lantern is 180 ft. above water level at high tide.

The French smokeless powder is much more bulky than the English.

An alloy of 95 parts of tin and 5 parts of copper is recommended for connecting metals with glass. It adheres strongly to glass, and its rate of expansion is nearly the same. It can also be used for coating metals to give them a silvery appearance. It is made by pouring copper into molten tin, and one-half to one per cent. of lead or zinc added will make it more or less easily fusible.

Vegetable fibre is used in Germany instead of animal wool. Two establishments near Breslau convert pine leaves into wool, flannels, and blankets. The latter are exclusively used in the hospitals, barracks, and prisons of Vienna and Breslau. Vegetable fibre clothing, etc., keep the body warm, and is vermin-proof.

Paraffin is found to be a good solvent for camphor. When required for use, it is warmed, and forms a clear and limpid solution which keeps well.

TRADE: PRESENT AND FUTURE.

*** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

TIMBER TRADE.—The timber trade in Durham county is steady, and there is now a much increasing demand for mining timber and pit props. Imports are rather less, and the stocks at West Hartlepool are being drawn upon. Prices are, on the whole, maintained firmly.

IRON AND STEEL TRADES.—The depression which has been experienced in all classes of railway material is at an end. We hear of considerable inquiries which should result in a greater demand for labour, and, perhaps, lead to an increase in the price. Many Sheffield manufacturers say that they have done more business during the first six months of the year than in the corresponding period of 1891. Inquiries are being actively made by the Government for large quantities of shell shot and piercing shot of various sizes. A fairly good turnover is taking place in the heavy iron trades.

BUILDING TRADE.—The building trade in Durham county is still brisk, and now that bricks can be obtained, works which had been stopped are being restarted. In the Newcastle district building operations are very active. In Rochdale and district the building trade continues in a fairly prosperous condition, work being plentiful and likely to be so for some time to come.

COTTON AND FLANNEL TRADES.—The condition of these does not improve in the least—in fact, in some places trade gets worse. Some people expect an improvement after the General Election. This is doubtful.

SHIPBUILDING TRADE.—On the Mersey there is no brightening of the prospect in the shipbuilding and engineering trades; general ironfounders are moderately busy.

COAL TRADE.—Steam coal is in large request, and manufacturing coal finds a ready sale at from 5s. to 5s. 6d. per ton. The house coal trade is weak, but prices have not fallen lower. Our Liverpool correspondent writes:—Owing to large stocks in Liverpool, prices in the export and ship coal trade are diminished. The present price, delivered at Garston Docks or on the High Level Railway, is 8s. 6d. to 9s. per ton for steam coal.

SILVER TRADE.—In the silver trades of Sheffield there is little change. Travellers from France bring back few orders. Usually a good trade is done in Paris from about this time until just before Christmas in wares made of Britannia metal, and which are designed and finished as a special line for the French markets.

TIN-PLATE TRADE.—Tin plates are delivered in Liverpool for exportation at the following prices: IC cokes, BV grade, 14 × 20, 12s. per box, best quality, 13s.; ICW, 12s. 3d.; IC charcoal, common, 15s. 6d., best, 17s. 6d.; black plates, 14 × 20, Bessemer, 9s.; best Siemens, 9s. 3d.; terne plates, 12s.; crystallised, £1 9s. 6d.; crystallised and decorated, £1 12s. One of the large tin-plate makers has gone out to America to build a mill there, and workmen from New South Wales have also gone. The tariff on tin plates being prohibitive, it has almost, if not quite, ceased to be an article of exportation to the United States. Makers of tin plates have been warned that Russians are in England with letters of introduction to makers to spy out the process of manufacturing tin plates from tinned blocks, the Russians having failed to do it.

CUTLERY TRADE.—This is very depressed in Sheffield. The Spanish houses are now closed to this country, owing to the new tariff, which came into force on the 1st of July. For months Sheffield manufacturers have been engaged in exporting goods into Spain and Portugal in quantities, and, in consequence, the trade with those countries will be paralysed for years in many branches of industry.

ENGINEERING TRADE.—No improvement can as yet be reported in the condition of the general engineering industries of the Lancashire districts, although one or two firms engaged on work of a special character are fairly busy. Machine tool makers are keenly competing for the few orders that are being placed; while stationary engine builders report a decidedly increasing slackness all round. Boiler makers are also now loudly complaining of absence of trade, while locomotive builders are but little better circumstanced. The Mersey shipbuilding trade shows no signs of returning activity, but in the Barrow district both shipbuilders and engineers are busy, and the former expect several new orders to be placed shortly. The iron market is in a state easily affected by outside influences, and the Parliamentary elections are having an appreciable effect upon business. It is generally considered that, although manufacturers of finished iron are working actually at a loss, prices will further decline, so that the present outlook is most discouraging. The steel trade continues quiet, and business in the metal market is also very unsettled.

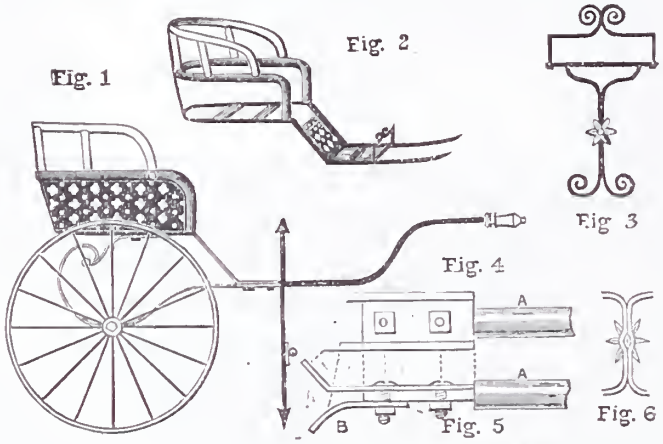
SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

*** *In consequence of the great pressure upon the "Shop" columns of* WORK, *contributors are requested to be brief and concise in all future questions and replies.*

I.—LETTERS FROM CORRESPONDENTS.

Metal Mail Cart.—S. P. (*Plymouth*) writes:—"Having taken WORK for some time, and seeing some readers inquiring for a design for mail cart, I take the opportunity of giving a design similar to one I have made for my child to ride. In the first place, I have made it without a particle of wood in it—the materials being steel, iron, brass, zinc, and plush. I am not a draughtsman, but you will be able to reproduce the design. Fig. 1 shows the side elevation, the body being covered with perforated zinc, and the top edge covered with crimson plush to prevent the child's clothes being torn by rough edges of zinc. At the top I have made a brass rail ¾ in. diameter, and polished, with uprights. The wheels and spring I took from my perambulator, while the shafts are made with ½ in. iron pipe, with china handles, the same as those used for coal shovels. Fig. 2 shows how to fix the battens for cushion, and also foot-rest. Fig. 3 shows the front leg and rail, also the brass star. Figs. 4 and 5 show how to fix the shafts to foot-rest; while Fig. 6 indicates the method of fixing the brass star with brass knob and nut."



Metal Mail Cart. Fig. 1.—Side Elevation. Fig. 2.—Method of fixing Battens for Seat, Foot, and Brass Rail. Fig. 3.—Front Leg and Rail and Brass Star. Figs. 4 and 5.—How to fix Handle to Foot-Rest. Fig. 6.—How to fix Brass Star with Brass Knob and Nut.

Manitoba and Emigrants.—H. A. H., M.D. (*Wawanesa, Manitoba*) writes:—"In No. 163 of WORK you publish a communication from a correspondent on the advantages of Manitoba. As a resident of that country for the last seven years, please allow me to give my views with regard to Manitoba for the benefit of intending emigrants. In the first place, there is no occupation in the country *but farming*. In November we 'freeze up,' and this 'freeze up' continues to the first week in April. The bricklayer, stonemason, and plasterer has to hibernate. If he has a farm, he cannot work at his trade and farm in the summer, and must have hired labour, which is very expensive—25 dols. to 30 dols. per month, with board. In the winter all farming operations are stopped, and the farmer is occupied in hauling out his grain to market and collecting wood to keep himself from freezing, often having to go ten, fifteen, or twenty miles, with a thermometer from 25° to 40° Fahr. below zero, and not infrequently is caught by an 'amiable blizzard.' Carpenters may get work all the year round; but I have seen carpenters working with nails heated too hot to hold, and with heavy buckskin mitts on. Work under such circumstances is too frequently scamped. If holding a farm, the same objections apply to him as to the bricklayer. Besides, out here we have the 'handy man' *ad nauseam*. Every man with a steel square, hammer and axe is a carpenter, and if he possess a jack-plane and saw, he sets up as a 'cabinet-maker.' When I first came here I was pestered by men to build my house whom I afterwards found out had never learnt the rudiments of their trade, and on full investigation were only 'handy men.' Fortunately, my hobby has been carpentry, and I soon detected the genuine from the spurious article, and got an old country carpenter to help me. The skilled carpenter has to contend with these handy men, and as the farmers are, as a rule, poor men, with heavily mortgaged farms, the skilled mechanic is nowhere. Blacksmiths do well, as a rule, but they must learn to adapt themselves to the wants of the country; they, too, suffer from the inroads of the handy man. In the machine shops of Canada—and to some extent this is true of the States—the skilled mechanic is scarcely needed. The machinery is put together in the roughest manner; any man who can use a file and rub off the burrs of the sand mould takes the place of the skilled mechanic. Articles are not painted, but dipped in coloured solutions and allowed to drain. A good deal of the furniture is simply dipped in cheap varnish and allowed to drain, as before stated. French polishing is unknown. As the manufacturers are protected by heavy import duties, there is no incentive to produce good work. The wage of the 'handy man' is that of the skilled workman. The cost of living in the towns is very high; a small wooden house costs 15 dols. per month rent, payable, when it can be got, in advance. A decent suit of clothes costs from 20 dols. to 30 dols. Everything except goods imported at a high tariff rate is of the shoddy type. And here let me enter a *caveat* against English manufacturers. Owing to the high import duties, only the third-rate articles of the manufacturers are imported, and these are charged at a high rate, and put forward as 'English goods.' The one-horse Canadian manufacturer produces something a shade better, and shouts that he 'downs the English manufacturer.' We get the tools generally found in country ironmongers' for amateur use palmed off as the perfection of English manufacture. I have heard it said in large wholesale places in London, 'Oh, that will do for the colonies; that is good enough for them.' This is a mistake. There are Old Country men in the colonies who do know a good article when they see it, and they suffer a severe mortification when they see poor goods palmed off as the finest productions of the dear Old Country. My parting advice to the skilled mechanic is to stay where he is and produce his very best; it is God's work, not his, that he is about. In spite of high tariffs, those who can afford them will buy English goods."—[Thank you for your letter and cuttings.—ED.]

Workmen's Holidays.—N. M. (*Sheffield*) writes:—"Working men have from time to time been roundly lectured from the pulpit, from the platform, and by the press for the persistency of their offerings at the shrine of their god, Football. Parsons, pressmen, and politicians alike have had their fling at them, but still their words are as though they had never been spoken. What is to be done? Do our workers ever think of the injury they are doing their wives and little ones, their employers, and trade of old England? No. We are inclined to think they have never thought of the question at all, but have been going on from day to day as though their periodical absences from work were to be taken as a matter of course, to say nothing of the personal loss of time—which means money—and the consequent inconvenience which arises through the absentee's neglect, whereby several pairs of hands are thrown idle through the fault of the footballer. In a large town in the north of England, which boasts of one of the finest football and cricket grounds in the kingdom, it is not uncommon for a gathering at an ordinary match to number 20,000 persons, *mostly working men*; and at a first-class 'final' match the spectators may be increased to 30,000. Each afternoon it has been calculated to cost a working man *three shillings and sixpence* (and this at a low estimate) for the afternoon's pleasure, or an average loss of £3,000 in work undone which should have been done. Could not these matches be confined to Thursday and Saturday afternoons, or so arranged to take place in the evening? In these days of electricity darkness is made light, and the extra outlay of capital would be amply remunerated by the increased number of spectators. Something must be done to keep the trade of the country together."—["Shop" is a section of WORK open to all readers alike, therefore insertion is given to your letter. It does not follow, however, that we agree with all the views you express. "All work and no play," etc.—ED.]

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Patents.—S. R. (*Withington*).—When will the public understand that in granting a patent neither the Office nor the law in any way guarantees the validity of the patent, but simply grants one in response to the declaration of the applicant that he is the "true and first inventor," and that the same "is not in use to the best of his knowledge and belief?" An applicant for a patent is assumed to know and have clearly ascertained *whether* he is

he "true and first inventor" *before* he makes the application, and it has been laid down in the Law Courts by Lord Cairns that "every specification must be read as though the patentee had a knowledge of every previous complete and published specification of earlier letters patent." In England here is no power of refusing a patent so long as the regulations are complied with, except it be in the case of something extremely ridiculous, immoral, or judged to be prejudicial to public interests. The fact is that a patent is granted to the applicant on the strength of his declaration and statement and his compliance with the rules of the Office; so that, instead of its requiring wondrous ability to obtain the grant of a patent, any person who complies with the rules is almost quite sure to get one granted. But what such a thing is worth when it is obtained is *quite another thing*, its value not being decided by the fact of the grant, nor the grant even creating it a property. It is one thing—and an easy one—to get a patent; but it is quite another to *create* a property, and obtain a valid and sound patent which the law will support. When people can realise this great fact, we shall probably be less annoyed with the constant re-patenting of old inventions, and the creation of an increasing mass of "waste paper," which is daily proceeding at such a rate, as they will then have realised the ridiculous folly of inexperienced persons of any kind meddling in matters of which they know nothing, and which require skill, education, and experience on the part of those who undertake this kind of work. With these remarks we will proceed to reply to the questions of our correspondent. (1) None whatever. Only examines the documents to see if rules are complied with. (2) None at all. It is not their duty to do so. The applicant is assumed to have done all this before he applies. (3) As this is not done, there is no need to further remark on this question. (4) You are quite right in your supposition, which is the actual fact of the case. But the grant is, as before shown, made to you on *your* statement and application. If that is *untrue*, and you have ample means of ascertaining whether it is or not before making application, there is no one to be blamed but *yourself*. If it were otherwise, there would be no end of a row, and everyone refused would be considering himself an injured party, and the victim of some spite, ignorance, or prejudice. If our correspondent will refer to the article on Patents in WORK, No. 44, Vol. I., p. 691, to the replies in No. 136, Vol. III., p. 508, and also in No. 151, Vol. III., p. 749, and read and study the same, he will probably derive some benefit, and increase his knowledge on patent matters, and possibly be aided in avoiding many of the rocks on which so many inventors and intending patentees are so constantly landed.—C. E.

Designs.—J. W. (*Dublin*).—"Metal Work, and its Artistic Design," by M. Digby Wyatt, published by Day & Son, Lincoln's Inn Fields; it is probably out of print, but you can get a second-hand copy sometimes for about 35s.—J.

Foreign Competition. — MARKWELL.—Thanks for your letter and suggestions. The workers of the country cannot be too well informed upon these vital questions. We cannot, however, throw our columns open to correspondence thereupon. Controversialists must go to larger papers with smaller circulations than ours.—ED.

Battery.—A. H. (*Manchester*).—You will find that two or three bichromate or chromic acid cells, in series, will drive the model motor in WORK, Vol. III., No. 154, very well indeed. These cells have been given in "Shop" many times. As to your second question, if you number the binding screws from 1 to 4, making 1 and 2 from the magnet and 3 and 4 from the brushes, then if you connect your battery up to 1 and 4, and connect 2 and 3 together by a short piece of copper wire, you will have your model driven in series. If you will look up what has already appeared upon batteries in WORK, you will find connections fully explained. For your last question, when winding the magnet keep the wire even on the two arms and on the inside of the bend, making each coil radiate towards the outside; it will make no difference to the working if they do—as they must—go between each other on the outside of the curve.—J. B.

Gymnasia. — AJAX. — This subject shall be treated.

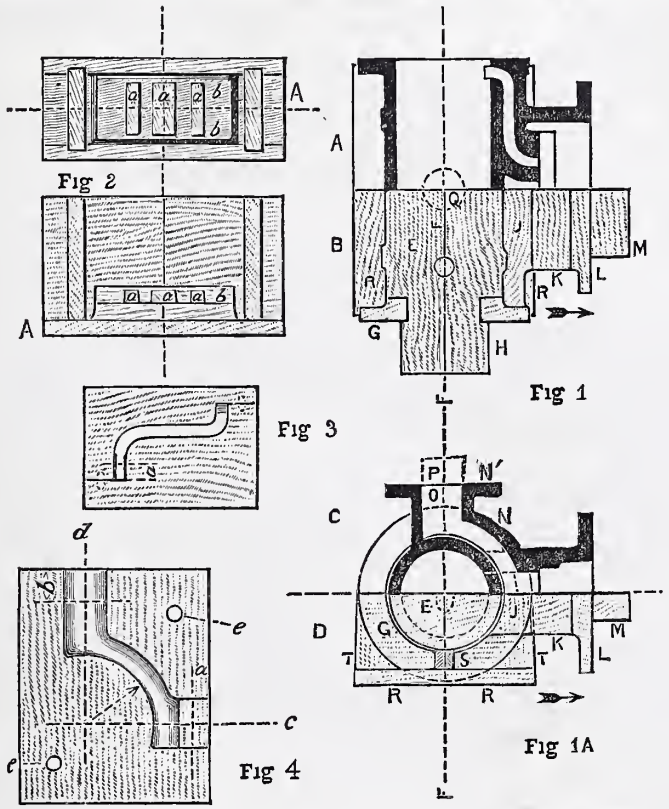
Lenses for Stereoscopes.—J. T. N. (*Dundee*).—Try Caplatzi, Chenies Street, Tottenham Court Road, who advertises in WORK.

Sharpening Plane Irons.—J. (*Whitehouse*).—Watch "Shop" for report upon this.

Flush Pipe.—J. M. (*Liverpool*).—Your letter has been forwarded to our specialist.

Bookcase.—CARDIFF BOY.—All your questions may be answered by a visit to a neighbouring cabinet brass-founder, as you apparently are fully acquainted with the manner in which all the parts work, excepting the catches. I should advise you to take a rough sketch with you. If you cannot succeed, write and tell us. Consult the French polishing articles in WORK.—J. S.

Steam Engine.—S. A. (*Oldham*).—You have not given me many dimensions, and have shown no exhaust-pipe. I have made a scaled drawing on the basis of your leading dimensions, and have put the exhaust branch on the top of the cylinder, where it also comes easiest for moulding. In Fig. 1, A is the sectional half plan of casting, taken through steam chest and passage; B is a sectional half plan of pattern, taken through centre; C is a half cross section decline of casting, taken through exhaust; D is a half cross section of pattern on the same line. A and C are self-explanatory; B and D I will explain; E is the cylinder body, jointed and dowelled on the line, F F. The flanges, G, are let into turned recesses in E. The print, H, is turned in one with the body, E, and smaller than the bored hole by the amount necessary for boring, say $\frac{1}{8}$ in., in this case. The passage block, J, is fitted to the sweep of the cylinder between the flanges, the steam-chest block, K, is screwed upon it, and the flange, L, with the steam-chest print, M, screwed to it is *dowelled* upon J. The pattern, therefore, moulds with the print M downwards, in the direction of the arrow. The exhaust branch, N, with its flange, N', and a print corresponding with the hole, O, the print being indicated by dotted lines, P, is next fitted to the centre of the cylinder, in the position of A in plan. The foot, R, jointed in the middle line, F, is connected by the rib, S, to the cylinder body, and to the flanges, G, by the brackets, T. The timber shading will render the arrangement of the stuff clear. We now come to the cue boxes. Fig. 2 shows the box used for taking out the hole in the steam chest. It fits into the print, M, in Fig. 1, and carries on its bottom board, A, the three prints, *a*, *a*, *a*, which take the passage and exhaust cues. The guide straps, *b*, *b*, for the slide-valve are put in this box. The method of framing the sides and ends together is that which is best adopted. Fig. 3 is the steam-passage box; *a* is the thickness which enters the print in Fig. 2. The opposite end is curved to fit the body cue of the cylinder, for which, of course, no box is required, the moulder using one of his standard boxes for that. Fig. 4 shows one-half the exhaust box; *a* corresponds with the print thickness in Fig. 2; and *b* with that in Fig. 1, P; c is the centre line of the steam chest; *d*, that of the longitudinal axles of the cylinder; *e*, *e* are dowels. If you want to know more, ask again.—J.



Steam Engine. Fig. 1.—A, Sectional Half Plan of Casting; B, Sectional Half Plan of Pattern; C, Half Cross Section of Casting; D, Half Cross Section of Pattern. Fig. 2.—Box for taking out Hole. Fig. 3.—Steam-Passage Box. Fig. 4.—One-half of Exhaust Box.

Unprotected Idea.—A. F. (*Ovenden*).—Our correspondent, it seems, has an "idea" which he has not "worked out," and does not appear to know whether it is novel, whether it can be made practical, or whether it is the subject-matter of a patent. In his present condition he is in no position to treat with anyone, inasmuch as he has nothing to treat with. People are not so ready to take up "ideas" unless there is some proof that they either are or can be made of some commercial value. The only course open to him is to work it out in a drawing, and then see what the result is. If it is sufficiently clear, then he should make a model so as to give practical proof, after which he should ascertain what has been done before on the subject, so as to decide what is new, and what he may do without interfering with others. Then he will be in the position to treat with someone who will find the means to obtain a patent; but here he will be in great difficulty as to finding someone who will not take advantage of his unprotected state. As to having a model made—not being able to do it himself—he should employ someone to do it who will fully understand that it is a secret intended to be patented; which, if such party were to take advantage of the information, and he could prove it, the law would very soon settle such person.—C. E.

Wire.—TIMA.—If you refer to page 55 in the third volume of WORK (issue for April 11, 1891), you will find a paper dealing with wire gauges, having annexed two drawings of those test appliances. This will be all you need, as one of the sketches illustrates a gauge denoting the diameters of the very thinnest of wire. It may be well to say, in view of the possibility of your needing the information, that the parallel openings, and not the round holes, in the shaded gauge indicate the diameters of the wire.—J. S.

Incubator.—G. M. (*Sunderland*).—Thermometers can be obtained of Mr. Stephenson, who advertised in No. 149 of WORK, price 3s. 6d. post free. The evaporating tray should be nearly full of water, level with the top of the overflow pipe (see illustrations on p. 610, No. 143, Vol. III.). The sides of case should not be "very moist" when working. If this is so, the embryo chicks would most probably be drowned. As I have before stated more than once, ordinary thermometers will not do. To go to work with improper appliances is only to court failure. Judging from your letter, insufficient heat seems to be your trouble.—LEGHORN.

Home Arts.—D. T. G. (*Holyhead*).—The Home Arts and Industries Association held an exhibition lately at the Albert Hall, South Kensington. The exhibits included wood-carving, metal and leather work, pottery, and embroideries. All information can be obtained from the Exhibition Secretary, Home Arts and Industries Association, Royal Albert Hall.—J. N.

Registration. — BRUSH. — In reply to our correspondent, the name he mentions to us could not be registered, as it would be held to be "descriptive," not "distinctive." As the article is patented, he is—if the patent is properly drawn, and the claims carefully and clearly made—sufficiently protected in his rights. If he marks the articles he makes "Patent," and applies the word mentioned with his own name following, it will do all he wants, and he will be safe from all except such unprincipled scamps as care nothing for right or wrong so long as they can gain anything. As there appears to be one individual only to carry on the business, it would be impossible to register it as proposed; but there is nothing at all to prevent our correspondent carrying it on as proposed without registration.—C. E.

Incubator.—J. T. (*Biggleswade*).—If the heat in machine is 105°, and the thermometer registers only 93°, it stands to reason that the latter is wrong. But how do you know the heat inside is 105°? If you are testing it with another thermometer, see that both bulbs are on the same level. Having the scale outside should make no difference in the reading, so that if you have 105° inside, your scale should show it.—LEGHORN.

Incubator. — INCUBATOR. — It is a bad job if "solder won't stick" to tin; but why use tin? If you get a flue and pan made by a coppersmith, and the joints properly turned up and sweated, soft soldering will be sufficient, especially if you use my new arrangement for water supply.—LEGHORN.

Electro-Motors.—ELECTRIC TYRO.—Your request for the theory of electro-motors, of which the one in Vol. III., No. 154, is a type, has been forestalled. In WORK No. 171, and on page 230, appears a short paper which treats of the why and wherefore of the rotary motion in motors of the Siemens "H girder" type; and the little "Model" motor is nothing more nor less than one of the H girder class. The armature has but one coil, with a two-part commutator; the only difference is, that the original motor, or dynamo, by M. Siemens, had its armature working lengthways between the poles of the field-magnet; and in my little model motor the armature works vertically before the face of the field-magnet; this was done in order that the construction might be as

simple as possible; but the laws of motion remain the same as in the H girder class of motors. If you have been successful in making a bell from the scrap you mention in your letter—upon which I congratulate you—I am sure you will be equally so with the little motor; and I trust you will find it what it was intended to be—namely, an instructive toy—and when you have made it I hope you will no longer be "enshrouded in mist" as to why it goes one way and then another, and from it learn the principles of all motors of its class. You will want 30 yards of No. 28 silk-covered wire for the field-magnet—which will cost you at the rate of 6s. per lb.; the wire (No. 36) for the armature will be about 14s. per lb., and try and get on about 20 yards. You will find it best to buy your wire by the reel—it is cheaper in the long run; or if you want a small quantity, make a bargain for the bit left on a broken bobbin: it is always handy to have if you do get a little too much.—J. B.

Developing Ferrotype Plate.—RASTUS.—The rapidity depends much more on the sensitised surface than on the developer. With a good guide-plate the development would not exceed the time mentioned with most of the ordinary developers used; but no automatic rapid method can be expected to work irrespective of temperature and light: on this account no automatic machine will work without more or less attention. The reason a wet collodion is preferable to a gelatine dry surface is in the greater rapidity of development. No *very* quick development is possible with a dry gelatine surface to produce good results. The following will be found an excellent developer for wet collodion ferrotypes: Protosulphate of iron, 1½ oz.; nitrate of barytus, 1 oz.; water, 1 pint; alcohol, 1 oz.; nitric acid, 40 drops. Dissolve the iron and barytus separately, mix the solution, filter, and add the alcohol. For all dry plates, special developers must be made to suit them. The new developer of Dr. Andreson's, "Rodal," or para-amidephenol, is one that suggests itself as generally suitable to gelatine surfaces for this purpose.—D.

Watch Spring.—RAW MATERIAL.—You will want a small screwdriver to take off cock (and name-plate if English lever or American); tweezers to take hold of screws and small pieces, etc.; a joint push or a stout needle to push out the pins from pillars, etc.; and to put in the spring you ought to have a mainspring winder, otherwise you will get the spring basket shape, and make it rub in the barrel. If the hook is in the barrel, you will simply make a hole in the end of the spring; but if the hook is in the spring (as it generally is in an English watch), then you want a pin-vice or slide-tongs to hold the wire to file up a hook.—A. B. C.

Blowpipe Solder.—H. H. (*London, E.C.*).—To make solder for use with the blowpipe for such work as small tin or compo pipes, take 2 lb. of lead, 2 lb. of tin, ½ lb. of bismuth; melt together in a ladle, and run out into thin strips about 15 in. long. Another recipe is nine parts tin, seven parts lead. Use only pure tin, clean sheet, or pig lead in making solder.—R. A.

WORK Wrapper.—R. G. H. (*Richmond, Va., U.S.A.*).—Thanks for note. Attack the postal authorities on your side, and say that no contraband matter ever finds its way into the pages of WORK.

III.—QUESTIONS SUBMITTED TO READERS.

**** The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Hydraulics.—DRIVER writes:—"Could anyone tell me if there is a book published on hydraulic work or hydraulic cranes?"

Fret Monogram.—C. H. D. (*Shepherd's Bush*) writes:—"Would any clever reader kindly give me an easy monogram, 'A. M. D.,' for fretwork or inlaying, about 1½ in. square?"

Hair Clippings.—HAIRCUTTER will be much obliged if any reader can suggest a profitable way of disposing of hair clippings, with a quick and inexpensive method of cleansing the same.

R. T. Monogram.—R. T. (*Glasgow*) writes:—"Will some kind reader be good enough to give me a design of my monogram, R. T., to cut in fretwood?"

Lifeboat Carriage.—E. K. (*Smethwick*) writes:—"I shall be obliged if any reader will give me information for making a carriage for a model lifeboat of the following dimensions: 9 in. long, 3 in. beam, and 2½ in. from top of air chambers to keel."

Gilding.—JEWELLER writes:—"Can any reader inform me how to make a gilding solution for use without battery? I have the following from two works on electro-plating and gilding:—Chloride of gold, 1 part; acid carbonate potassium, 31 parts; mix with acid carbonate potassium, 30 parts; water, 200 parts. I have asked at several chemists for acid carbonate potassium, and am told there is no such chemical. Should be glad to know what is meant; also correct proportions for 15 grains chloride of gold, and how mixed."

Ice House.—CARINO writes:—"I have just erected an ice or refrigerator house to keep butter; and although it is made of American white pine, there is a strong smell from the wood, and when the doors are shut for some little time and then opened, there is a very strong smell, which will, no doubt, taint the butter, as it is one of those things that easily absorbs foreign smells from its surroundings. I shall be glad if a competent reader will advise me what to do to get rid of this smell."

Spindles, etc.—J. J. H. (*Cardiff*) writes:—"Will someone kindly tell me if there is a book that will give full information on the working of spindle and four cutter moulding machines (wood), and also the different shapes?"

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Puzzle Brass Tobacco Box.—OLD HAND writes to J. T. (*Sunderland*) (see No. 159):—"Many years ago I saw a puzzle tobacco box, as per sketch. It was very nicely made, and with good joints, being hard to guess the secret. The pin of the

Puzzle Tobacco Box.

joint withdraws at A, which carries the end-piece of the joint. Let the interior of the box be *tinned*, and the outside corners slightly rounded. The size and proportions may be varied to suit the maker's fancy."

Crystoleum Painting.—M. (*Bishop Auckland*) writes to HANSOT (see No. 166, page 158)—"Instructions for this are given in Nos. 3 and 4, Vol. I. of WORK."

Enamel on Slate.—M. (*Bishop Auckland*) writes to H. A. H. (*Tunbridge*) (see No. 161, page 126):—"You might procure this from the Kingston Enamel Slate Works, Park Road, Hull."

Soap-making.—H. B. S. (*Liverpool*) writes to A. C. (*Manchester*) (see No. 166, page 158):—"Now the question is, do you want to make it on a small or a large scale? If the former, look up the indices of WORK, and you will find an article has already appeared on the subject; if the latter, consult the articles on Soap-making in Muspratt's 'Chemistry,' or in 'Chemistry applied to Manufactures and Arts.' The information is too lengthy for this column."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—REV. H. W. L. (*Sussex, New Brunswick*); C. E. S. (*Taranaki, New Zealand*); S. B. (*Rochdale*); G. W. (*Devizes*); AMATEUR; F. L. L. (*Richmond Hill*); TINKER; P. B. H. (*Southport*); DELTA; J. W. (*Dundee*); A. R. (*Moseley*); IN REQUEST; C. E.; W. H. T. (*Westminster*); EFF-BEE; J. W. H. (*Brackley*); COLNEITE; M. & Co. (*Middlesboro'-on-Tees*); F. A. D. (*Chapel Street*); H. H. (*Merthyr*); S. A. P. (*Bournemouth*); W. C. (*Wolverhampton*); TYRANYRE; B. J. (*Burnley*); H. C. G. (*Islington*); B. W. L. (*Leominster*); ON PLEASURE BENT; COMPASSES; J. W. W. (*Heckmondwike*); C. M. (*Hornsey Park Road*); H. H. (*Finsbury*); A. M. M. (*Holloway, N.*); G. A. W. (*Bayswater*); F. C. K. (*Mapleton*); CYCLE FITTER; W. F. (*Glasgow*); NIL DESPERANDUM; MASON; RUFUS; PRACTICAL (*London*); TOBIAS; SCREEN; H. J. C. (*Compton Bishop*); SIGNED LEARNER; SOAP; MORENO; D. F. (*Kincardine-on-Forth*); G. A. M. (*Nottingham*); PHONO; F. M. J. (*Bradford*); T. J. F. (*Brandon Colliery*).

"WORK" PRIZE SCHEME.

FIRST COMPETITION PRIZE WINNERS.

Subject—The Cycle: its Worth to the Nation.

THE Editor has the pleasure to announce the following as the result of the adjudication upon the Essays sent in for Competition:—

FIRST PRIZE (£3) for the Essay bearing the signature "Philolaus" (Rev. F. A. WODEHOUSE, Gotham Rectory, Kegworth, Derby).

SECOND PRIZE (£2) for the Essay signed "Endeavour" (ALEXANDER STEPHENSON, 3, Dixon Road, Govan Hill, Glasgow).

THIRD PRIZE (£1) for the Essay with the signature "Currus" (J. CHARLES KING, Burchett's Green Cottage, Maidenhead Thicket, Berks).

These Essays will be published in WORK and the Prizes remitted to the writers of such successful Essays in due course.

The Essays with the following signatures are deemed worthy of commendation:—"Pedlar," "Alpha," "Roti Wallah," "Pooskie."

NOTICE TO READERS.

The next No. of WORK (No. 175) will contain, among other important articles, the following:—

PHOTOGRAPHIC EXPOSURE;
HOW TO MAKE A GARDEN ROLLER;
SIMPLE STOVE SCREENS;
EVERY WORKER'S WATER MOTOR;
DRAWING OFFICE WORK;
DESIGN FOR AN UMBRELLA STAND;
etc. etc.

"WORK" PRIZE SCHEME.

SECOND COMPETITION.

For the three best suggestions for a new domestic appliance, household article, or labour-saving tool of general utility, the following prizes will be awarded—

First Prize, £3;
Second Prize, £2;
Third Prize, £1.

CONDITIONS AND RULES OF THE "USEFUL HOUSEHOLD ARTICLE" COMPETITION.

ALL Descriptions to bear the WORK Prize Coupon, cut from one of the numbers of WORK in which the Prize Scheme is announced.

Each Description to be signed with an original *nom de plume*, and to have the writer's real name and address securely attached to the manuscript in a sealed envelope.

Each Suggestion should be fully described in respect to its purpose, construction, and working, and, where possible, should be illustrated with a drawing of the article itself and its various parts to elucidate the description.

A Suggestion not illustrated will have an equal claim in the competition provided the description be sufficiently in detail to convey a full idea of the article suggested.

In the work of judging regard will be had to the practical nature and utility of the suggestions, and their prospective popularity.

The Prize Suggestions and Drawings, and any others, to be published, if desired by the Editor, in WORK, but the copyright thereof to remain with the authors.

Copies of MSS. and Drawings to be retained by the competitors, as in no case can the return of MSS. be undertaken.

The Editor of WORK will supervise the judging of the Suggestions, and the selection as determined upon is to be final.

All manuscripts intended for the "Useful Household Article" competition must be addressed to the Editor of WORK, c/o Cassell & Co., Ld., Ludgate Hill, London, E.C. They must reach him on or before SATURDAY, JULY 30, endorsed, "Useful Household Article" Competition.

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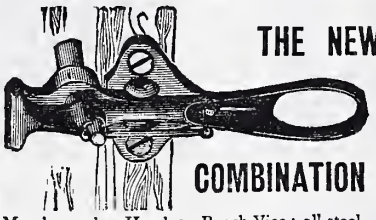

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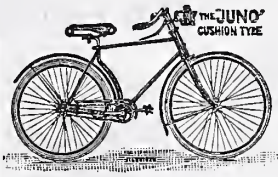

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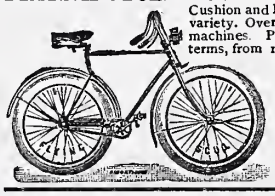

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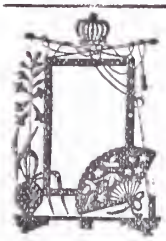

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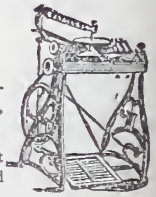

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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VOL. IV.—No. 175.] SATURDAY, JULY 23, 1892. [PRICE ONE PENNY.

WORK WORLD.

A QUARRY of stone of first-class quality for lithographic purposes has been discovered in Utah. Hitherto, the stone has been obtained almost exclusively from Bavaria.

* *

A form of ball-bearing has been applied to the spindles of textile machinery, and it is stated that, as might be expected, very high rotative speeds are practicable, up to 16,000 revolutions per minute, the usual speed being 8,000.

* *

Shortly a description will appear of an amphibious vehicle fitted to carry goods both on land and over water. The advantage of this contrivance is that goods can be carried from a factory, colliery, or elsewhere without transhipping. There is no insurmountable difficulty in the way with the present knowledge of construction.

* *

The latest invention as a war agent for troops and franc-tireurs is a vitriol gun to eject vitriol to 70 metres' distance in a dense spray. The French officer who invented it says it is not for white warfare, but to be used against African savages who are so reckless in their ugly rushes. We pity the "inventor"—not the blacks!

* *

Small electric lamps are coming largely into use. They have already been adapted to reporters' pencils, and now a Continental manufacturer supplies spectacles in the middle of which is a minute incandescent lamp shielded by a reflector; this lamp may also be had mounted on spectacle frames in which there are no lenses.

* *

Roller-bearings for railway cars are occupying attention in America. At high speeds very little is gained by the use of roller-bearings, as journal friction is a comparatively small item in the account of resistances at too great velocities. In starting a train from a standstill the roller-bearings will help, but will they stand the knocking about inalienable from railroad traffic?

Cooking by electricity may be as cheap as cooking by gas, and it is certainly more cleanly. The charge for the electric current is 3d. per Board of Trade unit, which is equivalent to gas at from 2s. 6d. to 2s. 9d. per 1,000 cubic feet. Therefore at the present price there is an advantage in favour of the electric grill and stove. A steak by electricity, however, is not within our gastronomic experience.

* *

It is said that engravers in Germany harden their tools in sealing-wax. The tool is heated to whiteness and plunged into the wax, withdrawn in an instant, and plunged in again, the process being repeated until the steel is too cold to enter the wax. The steel is said to become after this process almost as hard as the diamond, and when touched with a little oil or turpentine the tools are excellent for engraving, and also for piercing the hardest metal.

* *

It has been found that the cohesive strength of solid glue is equal to 4,000 lb. per square inch, from which we draw the conclusion that its application as a cement may be much improved. It must, however, be properly prepared, and it should be borne in mind that glue which has been stored for some time has a higher tenacity than that newly made. The newer and paler coloured glue is preferred by joiners as being less noticeable, but a good workman should so fit his work that the joint is imperceptible.

* *

For some years the superiority of mirrors backed with silver, instead of the mirror amalgam formerly used, has been recognised. A point of the greatest importance in this connection turns upon the method by which the silver is reduced. It has been found by experience that those processes which slowly reduce the metal and deposit it from the alkaline solution in cohesive masses of a leaf-like shape are most satisfactory. The old method of depositing silver gives it a bronzine tint.

* *

Japanese authorities are reopening a copper mine at Musashi, which authentic documents show to have been first worked 1,183 years ago. The galleries and levels are stated to be, in some places, in the same condition as that in which they were 700 years since. It will be of great interest to ascertain the changes wrought during this period on the ore by the access of atmospheric air to the galleries. This will be easily ascertained by comparing analyses of specimens at the gallery surfaces with others of those lying deeper in the strata.

* *

Cabmen have to pay £3 to the Government before they can drive out a cab, viz:—£2 for the number on the cab, 5s. for the badge, 15s. tax on every cab, and sometimes 1s. or 1s. 6d. for inspection of each cab at the police station before the number is granted, in addition to all of which, half a day is wasted in waiting about. It is quite time the £2 and the 15s. taxes were abolished, and the badge charged for at its value, which would not be more than 1s. Leaving the taxing offices, the cabman has to reflect upon a 100 mile drive to get his money back. This is oppressive, indeed, upon a useful and sorely-tried class.

* *

On long railway journeys great confusion arises at the stopping places from travellers, when hurrying back after taking refreshments, forgetting the number of their carriage. The Paris and Lyons Railway Company have resolved that every carriage on their lines shall have a distinctive sign, such as an animal or plant, executed in white enamel on a blue ground, so as to facilitate the finding of their carriage by the passengers. On English lines it would certainly be a boon if first, second, and third-class carriages were always recognisable by a distinctive colour, so that the search for a particular class might be easier. "First," red; "second," blue; "third," black. Why not this all the country over? Much loss of time and many accidents occur from passengers having to rush along platforms in order to find the whereabouts of the particular class carriage desired, and when seeking for this the intelligent traveller more often judges by the internal fittings of the compartments rather than by any external signs. Class sections of trains with distinguishable colours, agreeing with the tickets issued, would be a blessing for many reasons. This would, too, save much time and temper.

PHOTOGRAPHIC EXPOSURE.

BY G. P.

IMPORTANT POINTS—THE NECESSITY FOR CORRECT EXPOSURE—HOW EXPOSURE MAY BE ESTIMATED—AIDS TO EXPOSURE: WATKINS' EXPOSURE METER—THE ACTINOGRAPH—EXPOSURE FACTORS: LIGHT, SUBJECT, DIAPHRAGM, PLATE—HOW TO MAKE THE CALCULATION—TIMING EXPOSURES—RAISING THE LENS-CAP—EXPOSURE NOTEBOOK—CONCLUDING REMARKS.

Important Points.—I need not dwell on the subject of setting up the camera, or on the art of focussing; on the method of filling the dark slides, or on the necessity for keeping them from direct sunlight; on the mischief wrought by the slightest shaking of the camera during exposure, or on the advisability of covering the camera and dark slides with the focussing cloth. These points are all important, certainly, but the mere mention that care is necessary will be all that an intelligent reader—and none other need expect to become proficient in photography—will require.

The Necessity for Correct Exposure.—The novice has no doubt read and heard much about altering the proportions of the constituents of his developer to suit the exposure and the result required; and has very likely been told that he can make a wrongly exposed plate all right by careful development. From this he is led to suppose that exposure is a secondary consideration, and that his energies are to be applied to development almost entirely. No idea could be more injurious. It has been proved by Mr. Lyonel Clark in the course of his elaborate experiments on different developers, and has been confirmed by experiments of Messrs. Hurter and Driffield, and other gentlemen, that "the action of light is *absolute;* a certain amount of light will effect a certain amount of dissociation amongst the silver molecules that form the sensitive film, and any agent capable of developing will show a certain fixed amount of reduction. And whether we apply a vigorous or a weak developer, we shall never get out any more or less detail. There will, however, be a vast amount of difference in the time that will be necessary to get this amount of detail out." * This difference of time in the appearance of the image has, however, a very important bearing on the appearance of the plate as a whole: it is found to affect the gradations. That, in a word, is the nature of the difference between developers—a difference of gradation, and not in the maximum detail obtainable, provided that the action of the developer is continued for a sufficient length of time. It will thus be evident that an under-exposed plate is useless, as is also—to the beginner—an over-exposed one. By the application of bromide of potassium to an over-exposed plate, part of the exposure may be, so to speak, done away with; but the beginner can scarcely hope to cope with this successfully. The better plan is to give correct exposure, when operations are not only simplified, but more speedy success and less waste of material is assured. I cannot lay too much stress upon the importance of a correct exposure, for I believe that if this be given, no anxiety need be felt as to the resulting negative, whatever the developer, so long as it is well balanced.

How Exposure may be estimated.—That point being settled, the question comes to be: How can the correct exposure be estimated. This question is an easy one to answer, and a difficult one. Contradictory statements certainly, but nevertheless reconcilable, for, if my reader has 10s. or 15s. to spend, I can recommend to him an excellent *vade mecum;* if not, the question becomes a more difficult one, as will be seen presently.

Aids to Exposure: Watkins' Exposure Meter.—The difficulties I have referred to having become widely recognised, many attempts have been made to remove them by the publication of exposure tables, and by the designing of actinometers. Of the many that have already been placed before the public, I have no hesitation in saying that those actinometers invented by Mr. Alfred Watkins, of Hereford, and Messrs. Hurter and Driffield, and called respectively "Watkins' Exposure Meter," and "The Actinograph," are the most correct in principle and the most accurate in practice. The first of these instruments was noticed in "Our Guide to Good Things" in Vol. I. of WORK; but for the benefit of those unfortunate individuals who, owing to their procrastination, do not possess and cannot now obtain that valuable book, I will describe it here as briefly as possible. The meter consists of a brass cylinder 2½ in. long and 1¼ in. in diameter. One end of this forms a capped box, the lid of which is attached to the body by a chain 10 in. long (which packs inside), and thus when made to swing beats half seconds. At the other end is a tinted disc perforated with an aperture, across which is made to pass a strip of paper made so sensitive as in a few seconds to change colour under exposure to light, until it coincides with that of the disc. On the tube are six flat rings—two fixed and the others movable. All the rings are suitably graduated, and the four movable rings each carry a pointer which bears a letter indicating a particular exposure factor. Thus the first is marked A (actinic force of light falling on the subject); the second, P (sensitiveness of plate used); the third, S (the character and colour of the subject); and the fourth, D (the diaphragm used in lens). The sensitive paper is exposed to the light which falls upon the subject, and the time it takes to darken to the standard tint is noted, the pendulum referred to being used to facilitate counting. This done, the pendulum is replaced in the chamber and the A stop is turned round to the figure indicating the seconds; the other pointers are then set to the various factors as above, when the last pointer, E, which is joined to the same ring as the pointer, D, will indicate the exposure required. The instrument may be obtained from most dealers in photographic apparatus, or from the manufacturers, Messrs. Field & Co., Birmingham, for 15s.

The Actinograph.—This instrument is the excellent invention of Messrs. F. Hurter, Ph.D., and Vero C. Driffield, two gentlemen who have laboured hard for photography for more than twelve years, and to whom photographers owe much. The instrument is contained in a small box about 4½ in. long, 2¾ in. wide, and 1¼ in. deep, so that it is no encumbrance, and can easily be carried in the pocket. It consists of four logarithmic scales, two of which are fixed and two are movable, and which relate respectively to the *light*, the *speed of the plate*, the *lens*, and the *exposure*. The light scale is wrapped round a revolving roller, and in contact with this roller is a slide bearing the lens and exposure scales, and fixed in a particular position at the bottom is the speed scale. Sliding between the movable exposure scale and the fixed speed scale is an index bearing six marks; the five upper marks point simultaneously to five different exposures to suit five different atmospheric conditions, and the lower mark is set to the speed of the plate in use. The greatest success of Messrs. Hurter and Driffield is, I think, their method of determining the rapidity of plates, and I shall have a few words to say on this further on. The actinograph is made by Messrs. Marion & Co., and costs 10s. 6d.

It is not everyone, however, who can get cash in sufficient quantity to be able to produce 10s. or 15s. for this purpose on a moment's notice; and, so as not to leave those who may be in these circumstances in the lurch, I will, to the best of my ability, show them how a pretty accurate estimate may be got without an exposure meter.

Exposure Factors.—There are, broadly speaking, four factors that influence the duration of the exposure to give to a plate: viz., the quality of the light, the character and colour of the subject, the diaphragm in the lens, and the sensitiveness of the plate. Let us treat these in turn: a word on each.

Light.—This is at once the most important and the most difficult to overcome. The season of the year, the hour of the day, the state of the atmosphere, whether moist or dry, immediately after or before rain, clear or cloudy, even the direction of the wind—all these have an influence on the actinic force of the light falling on the subject. In December, at midday, the light is about one-fourth as actinic as at the same time in June; while at 3 p.m. in a day in midsummer the actinic force of the light is no less than sixteen times greater than at the same time in midwinter. It would be impossible to lay down any exact rule, but Dr. J. A. Scott's table may be taken as pretty accurate under ordinary circumstances:—

Hour. A.M.	P.M.	June.	May or July.	Apr. or Aug.	Mar. or Sep.	Feb. or Oct.	Jan. or Nov.	Dec.
12		1	1	1¼	1½	2	3½	4
11	1	1	1	1¼	1½	2½	4¾	5
10	2	1	1	1¼	1¾	3	5	6
9	3	1	1¼	1½	2	4	•12	•16
8	4	1½	1½	2	3	•10		
7	5	2	2½	3	•6			
6	6	2½	•3	•6				
5	7	•5	•6					
4	8	•12						

* More for a *yellow* sunset.

These figures may be affected in various ways. Thus, after rain or when the atmosphere is moist, shorter exposure is needed, as is also the case when there is water in the immediate foreground, or when taking photographs at the seaside; while in thundery weather or with an east wind longer exposure is necessary.

Subject.—I have prepared the following table from several standard ones, tempered by my own experience, with much care, and it may be taken as a pretty comprehensive and accurate one, containing the ratios of the exposures required for certain subjects, that required for an open landscape being the standard, and taken as 1.

* Mr. Lyonel Clark in his book "Development," which is well worth careful study.

Subject Table.

Landscape, open	1
Landscape, distant	½
Landscape, near, and buildings	2
Landscape, close	4
Landscape with heavy foliage in foreground...	6
Sea and sky	¼
Dark subjects under trees from	100 to 300
Interiors, fairly lighted	500
Portraits in diffused light out of doors...	8
Portraits taken in ordinary room	200

By "open landscape" is meant an ordinary landscape with nothing near the camera; by "distant landscape," a panoramic view; by "near landscape," an ordinary landscape with objects of interest in the foreground; and by "close landscape," a landscape in which the principal object is in the foreground is understood.

Diaphragm.—Most of my readers are, doubtless, aware of the various uses and the mode of using the stops or diaphragms which accompany all lenses. At any rate, space forbids my going into these points at present. Suffice it to say that all lens stops are graduated either according to the uniform system introduced by the Photographic Society of Great Britain, or according to the relation between the diameter of the aperture and the focal length of the lens. The former system of numbering is based on their relative *areas, together with* a corresponding numbering based on the proportion between the *diameter* of the diaphragm and the focal length of the lens, this latter being expressed as a fraction, with f (focal length) as the numerator, and the proportion which the diameter of the stop bears to the focal length of the lens as the denominator. The latter system is the same as the second half of the uniform system alone. The following are the series, the two together constituting the uniform system, thus: $\frac{f}{8}^4$; the lower part constituting the other, thus: $\frac{f}{8}$:—

1	2	4	8	16	32	64	128	256
$\frac{f}{4}$	$\frac{f}{5{\cdot}65}$	$\frac{f}{8}$	$\frac{f}{11{\cdot}31}$	$\frac{f}{16}$	$\frac{f}{22{\cdot}62}$	$\frac{f}{32}$	$\frac{f}{44{\cdot}25}$	$\frac{f}{64}$

It must be borne in mind that *the exposure varies as the square of the diameter of the diaphragm.* For instance, if the largest stop of a lens of 8 in. focus be $\frac{f}{8}$ and another stop be $\frac{f}{16}$, then the diameter of these stops will be 1 in. and ½ in. respectively, and the rapidity of the stops will be as $(1)^2$ is to $(\frac{1}{2})^2$: *i.e.*, as 1 : ¼, : *i.e.*, as 4 : 1; therefore with the smaller stop the exposure required is four times that required with the larger. It will thus be seen that stops numbered according to the uniform system each require twice the exposure of the one larger.

Plate.—The subject of the relative rapidities of plates is a difficult one, and one which cannot be satisfactorily settled. Some makers advertise their plates as being so many times (twenty times, thirty times, sixty times, etc.) the speed of a wet collodion plate. Apart from the fact that the majority of photographers of the present day have no experience whatever of wet plates, that these alleged speeds are otherwise most arbitrary and unreliable, and that wet plates themselves vary in speed, the system of referring one plate to another as standard is bad. Again, other makers state that their plates register such and such a number on Mr. Warnerke's sensitometer; but this is a most crude and unsatisfactory method of judging the speed of the plates. You may purchase to-day a plate of a certain maker and with a certain label, and you will find it to be of a certain speed; but this is no criterion that if you purchase another sample of what professes to be the same plate, in a few months' time you will find it of the same speed. The best plan is to expose two or three plates under the same conditions on an open landscape with no near foreground, the light at its best, and the lens with an aperture of $f/64$. The first plate might receive an exposure of 1 second; the second, an exposure of 1½ second; the third, 2 seconds; the fourth, 2½ seconds; and the fifth, 3 seconds. When developed with the *same normal* developer, mixed fresh for each plate but in the same proportions, the correctly exposed plate may easily be found. Make a note of the exposure it received, and call it the "normal exposure" for the particular brand of plates. Supposing the correct exposure has been found to be 2 seconds, the following might be noted down: "A's—plates require an exposure of 2 seconds when the lens is worked with an aperture of $f/64$, the subject being an *open landscape* with no near foreground, and the light at its best; therefore these plates will require an exposure of $\frac{1}{128}$ second, when the lens is worked at $f/4$, the light and subject being the same."

It was in a manner similar to this that Mr. Watkins found the exposure numbers of plates for his actinometer. Messrs. Hurter and Driffield determine the speed of a plate by estimating the amount of silver deposited after exposing the plate to a standard light for a standard time; in their case the sky light. This method is based on scientific principles, but space forbids further amplification at present. Suffice it to say that at the present time their method is attracting considerable attention, and at least one firm of plate makers have adopted it.

How to make the Calculation.—Now, when about to take any photograph, after you have set up your camera and are ready to expose, look up Dr. Scott's table (you could buy an extra number of WORK, cut out the tables, and paste them in your pocket-book, to be always handy) for the relative actinic force of the light at the time of exposure; multiply the number found there by that representing the normal exposure of the plate you are using. Having done this, consider the state of the atmosphere. If the sun be obscured by light clouds, multiply the answer found as above by 2; if it is "dull," multiply by 3; if "very dull," by 4; if "gloomy," by 5. Multiply this in turn by the number to be found in the Subject Table, and this again by the number of the stop according to the uniform system. To make this clearer, let us, *exempli gratiâ*, take the following:—

We are about to photograph a landscape with some object of interest in the foreground. It is in the month of April, about 2.30 p.m.; sun obscured by light clouds. We are using stop $f/45$, and a plate which we have already found to require $\frac{1}{128}$ second normal exposure. We find in Dr. Scott's table the relative actinic force of the light to be somewhere between 1½ and 1½. Let us take 1½. Our plate is $\frac{1}{128}$ normal exposure; therefore, so far, we have got $\frac{3}{2}\times\frac{1}{128}$; the sun being obscured, we must multiply by 2: $\frac{3}{2}\times\frac{1}{128}\times\frac{2}{1}$; on the Subject Table we find the factor 4; following instructions, we have $\frac{3}{2}\times\frac{1}{128}\times\frac{2}{1}\times\frac{4}{1}$; $f/45$ requires 128 times the exposure required by $f/4$; therefore we have $\frac{3}{2}\times\frac{1}{128}\times\frac{2}{1}\times\frac{4}{1}\times\frac{128}{1}$; cancelling, we get $\frac{3}{1}\times\frac{1}{1}\times\frac{1}{1}\times\frac{4}{1}\times\frac{1}{1} = 12$, which is the exposure required in seconds.

Timing Exposures.—A word on this subject. It will be found that every five counted as rapidly as possible give 1 second; or a stone tied to a string 10 in. long will swing from one side to the other in ¼ second, and will go and return in ½ second. A watch usually ticks five times during a second.

Raising the Lens-Cap.—When exposing, the cap of the lens should be lifted slowly up from the lower side, using the upper part as a hinge, and brought to a horizontal position above the lens; it should then be replaced by a reversal of the movement. By this means considerably more exposure is given to the foreground than to the sky—a very desirable thing.

Exposure Notebook.—An exposure notebook should always be kept, and the requisite notes made at the time of exposure. This will materially assist at the time of development, and also form a useful record of successful exposures, which will be found a great help in estimating future ones. Most dealers in apparatus supply these books, but one can be made by the reader himself, which will be quite as useful, if not more so. Spaces might be made for number of plate, date, hour and light, plate, subject, lens, stop, exposure, remarks before development, remarks after development. The remarks before development might be on anything which would facilitate that operation; those after development on the most suitable printing process, etc.

Concluding Remarks.—In conclusion, I may say that the tables and data I give here are not put forward as infallible. Infallibility is impossible in any instructions in photography, although it is possible to give information which will help the novice on the road to success. This information I claim to be contained in the above; the rest is learned by experience, which, says Carlyle, "does take dreadfully high school wages, but he teaches like no other." I ask my readers to study the above instructions most carefully, when they will find that they are not so elaborate as they may appear at first sight. I may add that the exposure should be sufficient for the deepest shadows, and that it is always preferable to over- rather than to under-expose. Two plates should be exposed on any particular subject, the one receiving considerably more exposure than the other; if, then, the shorter exposed one be developed first, a clue will be gained to the treatment of the other.

HORSE-SHOES.

LIGHT shoes for horses save their legs. The heaviest horses may have fore-shoes 1 lb. weight each; hind shoes 12 oz. each. If 4 oz. are added to each shoe in weight, then, as a farm horse walks from ten to twenty miles a day—with a ½ lb. more on his fore feet—he lifts 660 lb. in a mile, or 9,900 lb., or nearly 5 tons, in fifteen miles. By using aluminium shoes, a horse would lift only half what he does now with iron shoes. The shrewd racing men are putting aluminium shoes on their racers.

SIMPLE UTENSILS FOR THE GARDEN.

BY C. MAYNARD WALKER.

A Garden Roller.

It would be superfluous to enlarge at any length upon the value or the usefulness of some sort of a roller in a garden for the purpose of keeping the walks and grass up to that degree of neatness which all lovers of gardens soon learn to aim at; but a roller is a somewhat expensive article, hence comparatively few persons possess one. Now, the making of the garden roller shown in Figs. 13 and 14 is a job which any intelligent amateur may undertake with confidence, even though he may have never touched similar work before. Figs. 13 and 14 represent a garden roller with an iron frame and a roller made of artificial stone, in making up which one can hardly go wrong, for the iron frame, to begin with, is made up with what is known as "iron barrel," and this can be bought in the required lengths, already screwed, and also the various elbows, T's, etc., so that one has only to take care to order the correct sizes to ensure a strong, true, and easily-fitted frame. This gas barrel can be obtained through any local ironmonger, or direct from Messrs. Treggon & Co. The proper sizes and fittings are given further on. The roller itself is made of artificial stone—a material which is easily made, and when properly so, is very hard, and practically of unlimited durability. The one represented in Fig. 13 has a cylinder 17 in. wide by 15 in. diameter: a size which I apprehend will commend itself to most people, the frame and handle measuring 3 ft. from the centre of the roller. Now, as part of the barrel is used in the construction of the roller, it should be ordered at once. Fig. 14 costs about 1s. 3d. less in material and a trifle in time, and although it may not look so much like the conventional roller, is every bit as effective, and really stronger: ⅜ in. barrel will answer the purpose; but should it be desired extra strong, ½ in. may be used, costing about one-third more; so that, assuming Fig. 14 to be decided upon, we shall require to get one length 18½ in. for the centre, two ditto 12½ in., two ditto 20 in., two ditto 9 in., one ditto 18 in., four ⅜ in. equal elbows, and two ⅜ in. equal T's. Fig. 14 will show the respective places for each piece: the barrel, when bought, will have a socket on one end; this must be taken off, and put aside, except one which we shall use to connect up the frame at the point C. One of the 9 in. pieces should be ordered with a long screw, or "connector," for this purpose. Now for the roller itself. The materials required will be two pecks of Portland cement and one and a-half bushels of builders' sand: it is well to get as much as this to provide against any mishap; and, moreover, if any is left over it may be used for rock-work, as described in the second of the present series of articles. The roller is to be made in a mould (Fig. 15), for which purpose prepare some rough boards and make a platform (Fig. 16), about 2 ft. square—if larger, so much the better; from the centre of this cut out a circle, 15⅛ in. in diameter, with a keyhole saw, and in the centre of the circle so cut out, bore a ⅝ in. hole; get a sheet of thin iron sufficient to roll up a cylinder 19 in. long by 15⅛ in. diameter; insert one end of this into the hole of the platform. Two cross-pieces should be nailed upon the underside of the platform, to prevent the iron going too far through. Now plane off from the circular piece of wood about $\frac{1}{16}$ in., to enable it to fit inside the iron; push it well to the bottom. The top of the hollow iron must also be fitted with a circular piece of the same diameter, and bored with a ⅝ in. hole in the centre, and must also be cut away in places to enable the concrete to be put in and rammed. Having fitted these up straight and true, tie up the iron cylinder with strong wire, and the mould is then ready for use. Before proceeding to make the stone, sift the sand through an ordinary cinder sieve, and put aside the coarser part, which will be used towards the centre of the roller in preference to the outside; mix the cement and sand up together in its dry state, in the proportion of four parts sand to one of cement, with plenty of elbow grease. When well mixed, add water until the whole mass is thoroughly incorporated, and just about the thickness of ordinary mortar, or a trifle less; put it into the iron cylinder (the barrel being in the centre) a little at a time, *and well ram it home* with a wooden rammer; neatly smooth the top, when filled, by working the top wood round. If ¾ in. boards are used, the gas barrel should be flush with the top of the board when finished, so that when the roller leaves the mould the axle will project ¾ in. at each end from the stone. The method of connecting the frame will be readily understood from Fig. 14. The threads of the ends of the axle are filed off smooth, so that they run easily, and do not bite in the sockets. Assuming, then, that the frame is put together with the exception of the cross-piece, C, we spring the sockets of the elbows over the axle ends; then, by putting in the connecting-piece, C, and screwing up the running socket, we bring the two together, and the frame is taut and rigid. Leave the stone-work for a few days before taking off the mould, and do not use it until quite *hard and dry*.

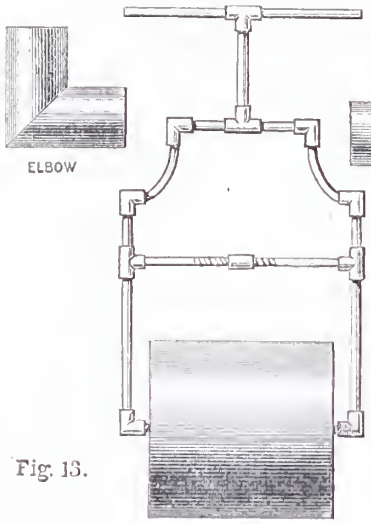


Fig. 13.

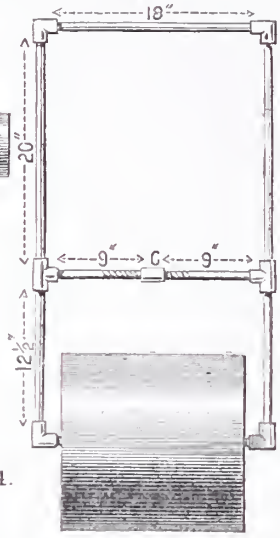


Fig. 14.

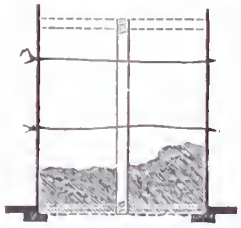


Fig. 15.

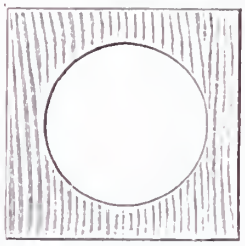


Fig 16.

A Garden Roller. Figs. 13 and 14.—Roller complete. Fig. 15.—Showing Method of forming Concrete Cylinder. Fig. 16.—Platform.

IRON BRIDGE MODELLING IN CARDBOARD.

BY FRANCIS CAMPIN.

Composition of Arch and Tie—Of Uprights—Of Cross Girders—Of Rail-Bearers—Cover Plates—Mode of constructing the Arch and Tie.

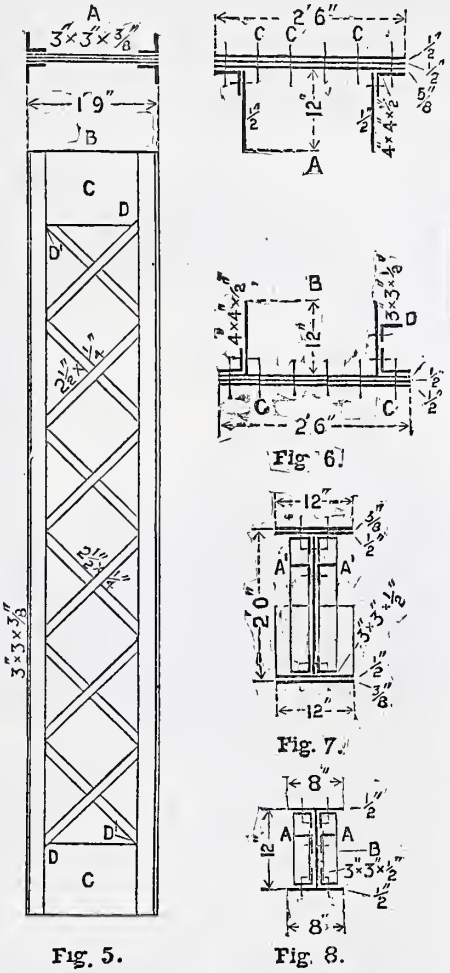
In Fig. 6, A shows a cross section of the arch, and B a similar one of the tie, which latter is composed in the same manner as that of the former, but it is reversed in position: there are six rows of rivets. It is not to be supposed that in making a model to scale we can follow the variations of thickness in the plates; but this will not be apparent so long as we have the right number of plates represented in card. It will be seen that the sections are each made up of three horizontally placed plates 2 ft. 6 in. wide, and two vertical plates 12 in. wide, the latter being connected to the former by the 4 in. by 4 in. angle irons. Fig. 5 shows at A a cross section, and at B a front view of one of the uprights, E (Fig. 1). It is built up of four angle irons, 3 in. by 3 in., connected together by a lattice-work of flat bars 2½ in. wide, and stiffened at the top and bottom by plates (C) riveted in between the angle irons. A cross section at the centre of a cross girder is shown in Fig. 7, and one of the longitudinal rail-bearers at Fig. 8. In these last figures the angle irons, A, A, are provided to carry the buckled plates which form the floor.

We must now decide upon the scale to which the model is to be made, and this will depend upon the room it is desired that it should occupy. If one-half of an inch to a foot is adopted, the total length of the model arch will be 52 in., and this seems a convenient size—at all events, for a first attempt—as all the parts are well within the control of one person, and yet the details will not be inconveniently small to handle, as the small angle bars will be ⅛ in. wide. Should it be desired to use forceps or small pliers to put the smaller pieces in place, the insides of their jaws must be made smooth, to prevent them from making dents in the cardboard.

The flange plates are made in lengths from 16 ft. to 20 ft., and require to be connected by cover joint plates, placed as shown on the enlarged detail, Fig. 9. A single cover plate is used in making the joints in the transversely horizontal plates, and the joints in

the side plates are secured by thinner plates inside and out. The joints in the three superposed plates are near together, and each set is covered by a $\frac{5}{8}$ in. plate 2 ft. 6 in. wide, and 8 ft. 8 in. long. The inside radius of the side plate is 118 ft., and the outside radius 119 ft.; so the actual size to which these parts are to be cut will be $56\frac{1}{24}$ in. and $56\frac{13}{24}$ in. On account of the limited sizes in which the Bristol board is made, these plates will have to be cut in short pieces and joined—say, about 10 in. long; the outlines may be marked on with a beam compass carrying a fine pencil, and the line so made followed carefully with the knife, or a knife may be fitted to a sliding socket on the beam compass; the instrument described above is not suitable for such large arcs, or a short template may be cut out of zinc and used to cut the different pieces of the side plates by. The vertical limbs of the top angle irons will also be similarly marked and cut; the inner radius will be $\frac{1}{6}$ in. less than the outer. There exists a temptation to cut curved edges with scissors; but this should not be done, as the edges left are not so good for taking the glue or cement used for uniting the parts. The cover plates, A (Fig. 9), will be equal in depth to the side plate less the depth of the angle iron, but the covers inside will be the same depth as the side plates. The ends of the lengths of the side plates must be cut off to a truly radial line. The extreme ends of the arched side plates are to be cut off horizontally and joined to the side plates of the tie, D, with covers on each side; these covers, when used on both sides of the joint, may be made of thinner card than the pieces they join, in order to avoid the appearance of clumsiness. So that accuracy may be secured in joining up the side plates, the outline of the side should be drawn on a board, the pieces laid in position upon it and weighted, and the covers then glued on one side; when they are dry, the work is turned over, and covers are glued on the other side.

The main angle irons are 4 in. by 4 in.; the curved vertical limbs are to be cut to the full depth, $\frac{1}{6}$ in., and these fastened on to the side plates, so that the convex edges coincide. Should there be any irregularity in the edges, it may be removed by glass-paper, prepared as follows:—Get a sheet of the finest glass-paper procurable, and glue a piece of it on to a perfectly smooth flat strip of wood of a convenient size for the hand; when dry, rub this down with another piece of the glass-paper until it is nearly smooth; the instrument thus made is applied lightly as a file to remove slight inequalities. Should the cutting knife slip away from the template, and so make a bulge, it is not always easy to re-enter the line without causing a notch, and in such cases a cabinet-maker's fine chisel may be found of service; this tool is also of use in clearing out square corners, as in cutting out the centre part from a buckled plate fillet. The top and bottom members will be made in six lengths, so there will be five cover plates 8 ft. 8 in. by 2 ft. 6 in., ten covers 2 ft. 8 in. by 1 ft., and ten, 2 ft. 8 in. by 8 in.; the last come on the outside of the side plates for each member. The actual sizes of these covers in the model will be respectively $4\frac{1}{4}$ in. by $1\frac{1}{4}$ in., $1\frac{1}{3}$ in. by $\frac{1}{2}$ in., and $1\frac{1}{3}$ in. by $\frac{1}{3}$ in., but these dimensions should be taken from a properly divided engineer's scale of half-an-inch to the foot. What is called a "universal" scale, with all the scales in common use marked upon it, is very convenient, as not only does it contain

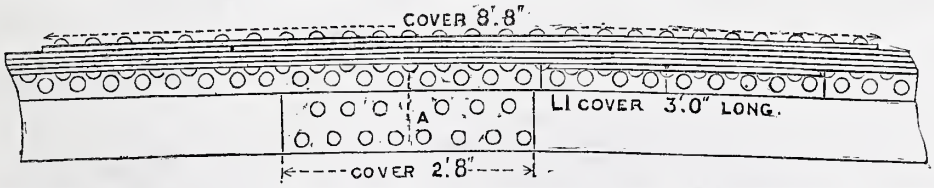


Iron Bridge Modelling in Cardboard. Fig. 5.—A, Cross Section of Upright; B, Front Elevation of ditto. Fig. 6.—Cross Section of Arch and Tie. Fig. 7.—Cross Section of Cross Girders. Fig. 8.—Cross Section of Rail-Bearers.

any scale required, but the smaller scales are very handy, as giving sub-divisions of the larger. These scales may be had in box-wood or ivory from any dealer in drawing instruments; 1 ft. long is the most convenient size for use.

While the side plates, their covers, and the vertical iron limbs upon them are drying, it is presumed that the flange plates remaining and their covers are cut out. The horizontal limb of the angle iron is narrower than the vertical by the thickness of the cardboard, whatever that may be. Lines are marked on the inner tier of plates, and the horizontal limbs of the angle irons accurately attached. In the example these run along the edges of the plates, so that no lines are requisite, the said edges forming the necessary guides; the parts thus attached are then lightly weighted for a short time; these should not have time to quite set before being attached to the side plates, as the joints may have to yield a little in bending. All remarks about the arch apply also to the tie, with the obvious exception that this member is straight. The positions of all uprights and other connections are marked upon the outsides of the side plates before the latter are joined to the top or bottom plates, and if rivet heads are to be shown, they must also be drawn on the side plates, angle iron limbs, and outside top and bottom plates. The heads in this case are $1\frac{1}{2}$ in. in diameter, and fine pliers will be found most convenient for putting them on; and great care must be taken to have very little glue on them, so that they will not slip; for although rivet heads properly placed give an excellent effect, if irregular they destroy it, and make the whole work look slovenly. The rivets are 4 in. apart, centre to centre; their positions may be indicated by small pencil circles put in with a pair of spring bow compasses; the heads are cut out of the card with a clean leather-punch of the nearest convenient size; the actual diameter on the model should be $\frac{1}{16}$ in. All the marking on the side plates is to be done before their connection with the top and bottom plates, and the rivet heads should also be put on before these joints are made. The best method of marking these places will be from a diagram showing the under side of the arch and upper side of the tie, and all the work lying between them, then the markings will coincide in all parts, and the work will be kept square and true. In marking the rivet centres from which the circles showing their positions are to be described, the dividers should not be stepped along the line the whole length with one rivet pitch—4 in.—but should first be divided off into larger spaces, corresponding with the various points and connections; otherwise, an error, microscopic at first, may become painfully apparent towards the end of the line—the grain of the card may tend to throw the points of the dividers out of the true position. In weighting parts glued together, only sufficient pressure to keep them in close and even contact should be used; any excess will almost certainly cause one part to slip upon another.

The horizontal limbs of the main angle irons having been secured to the inner flange plates, the edges of the side plates are to be touched with glue, and the inner flange plates applied to them so that the limbs of the angle irons fit, and held until the glue holds. To facilitate this part of the operation, blocks of wood may be placed between the side plates to ensure their parallelism while the glue is setting. During this part of the work it is advisable to have the member laid on its side on a flat board, the lower side plates being packed up so as to keep the flange plates at right angles to the board upon which they are laid; this will ensure the straightness of the members. The inner tier of plates having been thus secured to the side plates, the outer tiers and covers are to be superposed; of course, the first layer should be allowed time enough to become thoroughly set—in fact, if glue is



Iron Bridge Modelling in Cardboard. Fig. 9.—Cover Plates for Flange Plates, Side Plates, and Angle Irons of Arch and Tie.

used these should not be touched for twelve hours; by that time great solidity of the joints will be ensured. The arrangement of the flange-plate joints under the covers is shown at Fig. 9, where also is shown the arrangement of rivets in the side plates. The positions of the rows of rivets in the flange plates are shown by vertical lines, C, in Fig. 6. The outside rows are each $1\frac{3}{4}$ in. from the outer edges; the spaces between these are equally divided.

It may be of some utility here to point out that in angle and T irons the rivets are placed in the centre of the clear part of either limb: thus, if there is a 4 in. by 4 in. by $\frac{1}{2}$ in. thick angle iron, the clear width on either limb is evidently $3\frac{1}{2}$ in., and so the centre lines of the rivets will be $1\frac{3}{4}$ in. from the outer edges. In a T iron 6 in. by 3 in. by $\frac{1}{2}$ in. thick, the clear width on each side of the central rib is $2\frac{3}{4}$ in., and therefore the central line of rivets will be $1\frac{3}{4}$ in. from the nearest edge of the T iron. We think it as well to mention these matters, as the amateur modeller may get drawings upon which some of the dimensions are not figured, which would leave him at a loss as to the practice in this matter. While on this subject, it may be mentioned that the centre of a rivet should never be further in from the edge of the work than one and a half diameters: that would be $1\frac{1}{8}$ in. for a $\frac{3}{4}$ in. rivet; but where there is room, two diameters should always be allowed. While the arch and tie are drying, blocks of wood should be kept between their side plates, and more especially at their ends, in order that they may fit exactly together without any straining on either part. When thoroughly set, they are to be placed in exact position over a diagram, and connected by cover plates, F (Fig. 3, page 266), on the outside; when these have set, other covers may be inserted in the inside and the space between them, and enclosed by the lower edge of the arch and the upper one of the tie, filled in with a card packing of the same thickness as the side plates. The main angle irons have covers 3 ft. long.

A RUSTIC CARRIAGE ENTRANCE.

BY ARTHUR YORKE.

RUSTIC GATES AND FENCES—MATERIALS—CONSTRUCTION.

Rustic Gates and Fences.—In a former paper (Vol. I., p. 247, No. 16) I gave illustrations of various designs for rustic fences for garden purposes, and it may be presumed that it is through some such fence as those there shown that the present entrance gates will open. The intention is, of course, that the rustic archway above them shall be more or less clothed with climbing plants. It is for roses that the structure will be best adapted, though clematis or honeysuckle will look well upon it. Ivy would look too heavy, and if neglected, might even prove too heavy in other respects.

It must not, however, be inferred that the arch, under any reasonable stress, will want for strength. Light as it may appear, the four posts grouped to form the turret on either side are so tied and braced together as to be, to all intents and purposes, a solid pillar, 30 in. square, and fully equal to resisting any outward thrust of the rafters. The design is, of course, fantastic, but that it should be so is allowable, and, indeed, expected, in rustic work, to an extent not to be tolerated in more solid materials.

In the elevation (Fig. 1) I have, to avoid confusion, given no indication of the work forming the farther side of the arch, though something of it would necessarily be seen

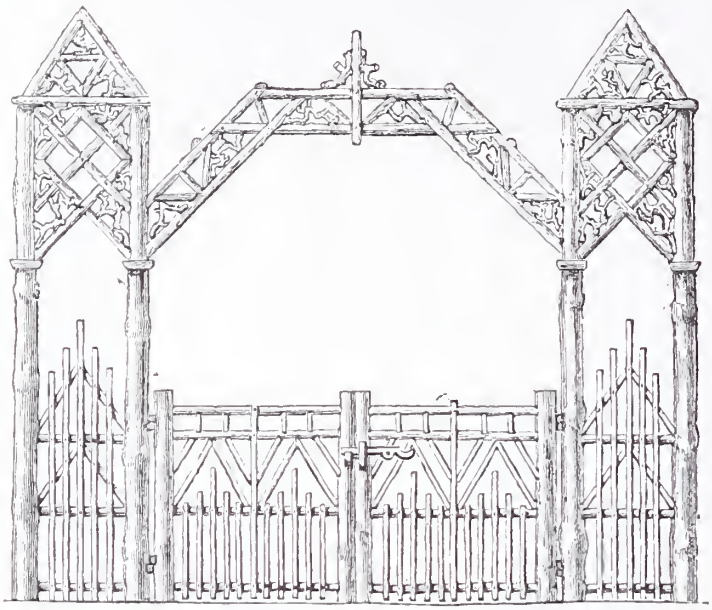


Fig. 1.—Elevation.

from the front; the two sides will be alike. Nor have I shown much of the work which connects the two sides, and which is of the same breadth as the turrets—viz., 2 ft. 6 in. The two illustrations are drawn to a scale of $\frac{1}{2}$ in. to the foot.

Materials.—The posts, and at least all the more important straight pieces, should be of larch. The particular kind of wood chosen for filling-in will not be particular, provided it has picturesque forks and contortions. Small oak bangles will, perhaps, be most appropriate.

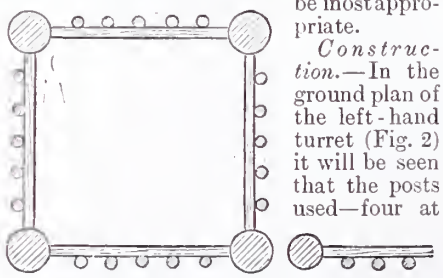


Fig. 2.—Plan of Left Side.

Construction.—In the ground plan of the left-hand turret (Fig. 2) it will be seen that the posts used—four at each end—are some 5 in. or 6 in. in diameter, and that the largest is selected as hanging-post for the gate. From centre to centre they are set 2 ft. 3 in. apart. They are 13 ft. long—that is, 10 ft. 4 in. above ground and 2 ft. 8 in. below. The rafters of the arch (if it may be called an arch) spring from them 7 ft. from the ground, and at this point each post is surrounded by a cap, formed of four pieces of quartered stuff nailed upon it. The rafters are not mortised into the post, but if, instead of being merely nailed, they are attached by a bolt and nut, a stronger joint will be made.

The upper rafters, back and front, are connected by five straight cross-pieces, of which the ends show in Fig. 1. The spaces between these are filled up very much at random with crooked stuff.

The four posts of each turret are bound together close beneath their tops by cross-pieces nailed outside them, whilst from their tops, and nailed down to them, slant four short rafters, which meet pyramid-wise in the centre. The filling up of the upper parts of the turrets, as well as of the front and back of the arch, is with a mixture of straight and crooked stuff, the arrangement of which is clearly shown in the elevation (Fig. 1).

In the lower parts of the turrets and in the gates the practical end of excluding animals has to be kept in view, and the palings are so arranged as to leave no space between them wider than 3 in. The rails of the gates should, of course, be mortised into the heads and hinge-trees.

ORNAMENTAL AND EASILY-MADE UMBRELLA STAND.

BY G. TOUT.

HALL furniture is not generally thought so much of as that of any other part of the house. All the rooms, from the drawing-room to the kitchen, have designs innumerable, both for use and ornament; but we find in many houses the hall contains only a few hat and coat hooks, and the umbrellas and sticks standing in a corner, unless the umbrellas have been brought in wet, then they are nobody knows where to dry.

I think the readers of WORK will find the umbrella stand here described useful and somewhat ornamental, and if they care to set about it, not difficult to make. I have so designed it that any ordinary carpenter or cabinet-maker, amateur or professional, can do all the work required himself (there being no turned work in it) except the zinc or tin trays, or pans, to catch the drippings from the umbrellas. These I got a plumber to make for me at a very trifling cost. Something could, no doubt, be got at an ironmonger's, ready made, for about 4d. or 6d. each. The holes in the bottom could be cut to receive any size pan. The pan should be left loose, that the drippings may be emptied.

Referring to the perspective view, you will see in the middle I have formed a small table for card or letter tray, or to rest a parcel, or stand a plant or fern pot. Under this is a drawer for brushes, gloves, etc., and each side an open space for umbrellas and sticks.

The back above the table is made in five divisions, in which are fixed ornamental tiles. If you are acquainted with a builder, he would, perhaps, give you a few odd ones. That is how I got mine. The front legs are worked out of one solid piece, on three sides only; the back outside legs are stop-chamfered, and the two vertical pieces, of mullions, are left square.

Fig. 1 shows the front elevation of front legs and part of table top, A. The top is made 1 in. thick, 12 in. wide, and 17 in. long. The drawer B, is 3 in. deep,

and as long and wide as space will permit. The rail, C, at bottom of drawer, is 1 in. thick and about 2 in. wide. It should be tenoned into the legs about $1\frac{3}{4}$ in., and well glued. The arch, D, below this is cut out of a board $\frac{1}{2}$ in. thick, 4 in. wide, and a small chamfer made round it. It is grooved into the rail and legs about $\frac{3}{8}$ in. deep. The bracket, E, is made from stuff $1\frac{1}{8}$ in. thick, $5\frac{1}{2}$ in. long, and 2 in. wide. I have moulded the top part of it, as shown in E (Fig. 2), and done a little amateur carving on the bottom. The front rail, F, for holding umbrellas, is octagon in shape, $1\frac{1}{4}$ in. in diameter, tenoned into legs at one end, and into bracket or arm (Fig. 6) the other.

Fig. 2 shows side elevation of front leg and bracket, with part of rail which encloses drawer. This rail, G, is 1 in. thick, 4 in. wide, and tenoned into front legs and into the vertical pieces, or mullions, at back. The tenons in this case may come through back and front, and be glued and wedged, as the brackets, E, planted on the front legs will hide the ends of tenons, and the back will not be seen. It will make a much stronger job than "stump," or short tenons. The position and a section of front rail, F, are also shown.

Fig. 3 shows a vertical section through drawer and tiled panels. The top rail, H, is $2\frac{1}{2}$ in. wide by $1\frac{3}{8}$ in. thick, moulded on top edge, and grooved $\frac{1}{4}$ in. deep on bottom edge, to receive the tiles. The bottom rail, J, is 2 in. wide by $1\frac{3}{8}$ in. thick, grooved on top edge for tiles. The tiles, K, are 6 in. square and about $\frac{1}{4}$ in. or $\frac{3}{8}$ in. thick. The drawer front, M, is $1\frac{1}{8}$ in. thick, with raised front, as shown on larger scale in Fig. 9. The bottom, N, is $\frac{3}{8}$ in. thick; the back, O, $\frac{1}{2}$ in. thick. The runner, P, is tenoned into the rail, R, and screwed to the sides. The rail, R, is described in Fig. 1.

Fig. 4 shows section through lower part of stand. The front rail, S, is 1 in. thick by 2 in. wide, tenoned into front legs. The back rail, T, is same size, and tenoned into back legs, and mortised to receive the two mullions. The top, V, is $\frac{3}{4}$ in. thick, with the top front edge chamfered.

Fig. 5 shows horizontal section through tiled panels. The mullions, W, are $\frac{3}{4}$ in. by $1\frac{3}{8}$ in., grooved on each side for tiles, and the front edge stop-chamfered. The legs, X, are $2\frac{1}{4}$ in. by $1\frac{3}{4}$ in.

Fig. 6 is an elevation of the arm, or bracket, for holding umbrellas. This has two tenons through the back leg, and, well glued and wedged, makes a strong job.

Fig. 7 shows a cross section of the drawer. Most of the parts shown here have been described in Figs. 2 and 3. A is a section of runners, B of the rails enclosing drawer, C the sides of drawer, and D the blocks glued to bottom and sides to strengthen it.

Fig. 8 shows section lengthway of bottom part. The end rails, E, are tenoned into back legs and tongued into front rail, as shown in Fig. 10. The bearers, F, are tenoned into front legs and back rail.

Fig. 9 shows an enlarged section through front of drawer, as described in Fig. 3.

Fig. 10 is described in Fig. 8.

Fig. 11 shows an elevation of arch under drawer. It is a little different from that shown in the perspective view, being struck from four centres instead of two. It makes a little more work, but looks better.

I have made this stand with some good old oak, but mahogany or other hard wood would do, or even deal, if well cleaned up, and stained and varnished, or polished; but hard wood, of course, is best, and wears best. It gives more satisfaction generally.

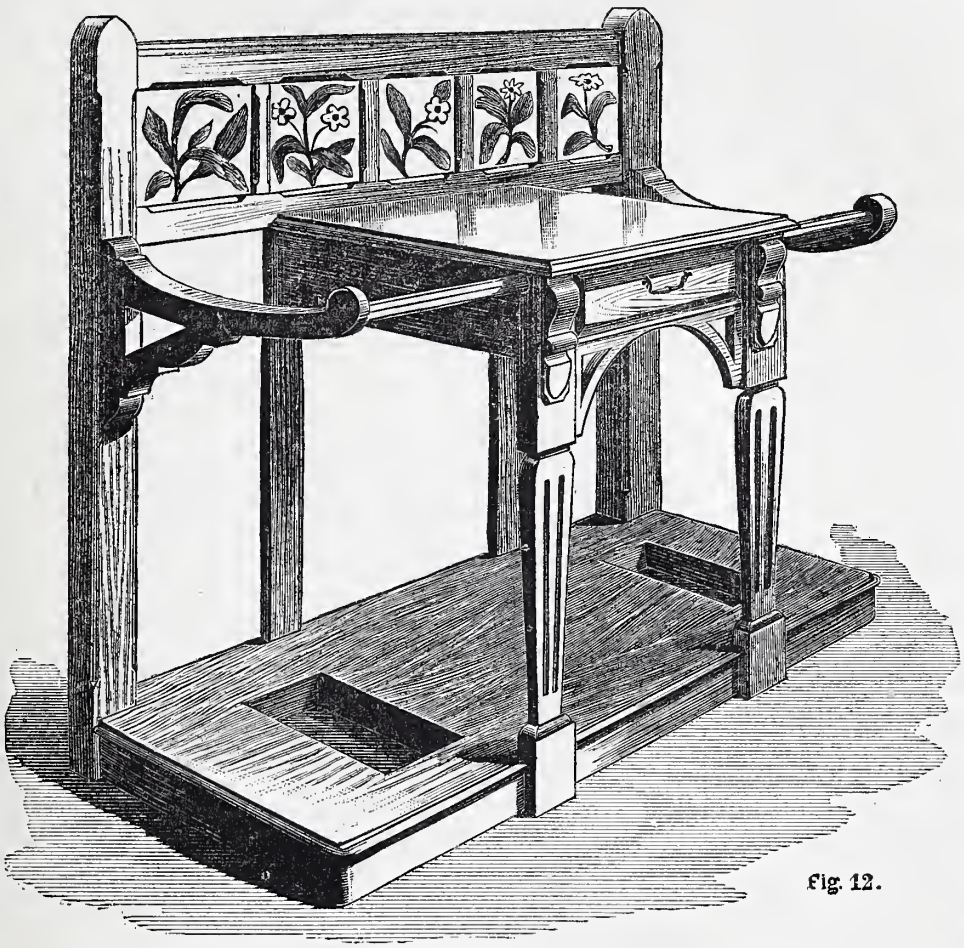


Fig. 12.

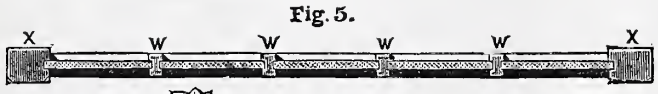
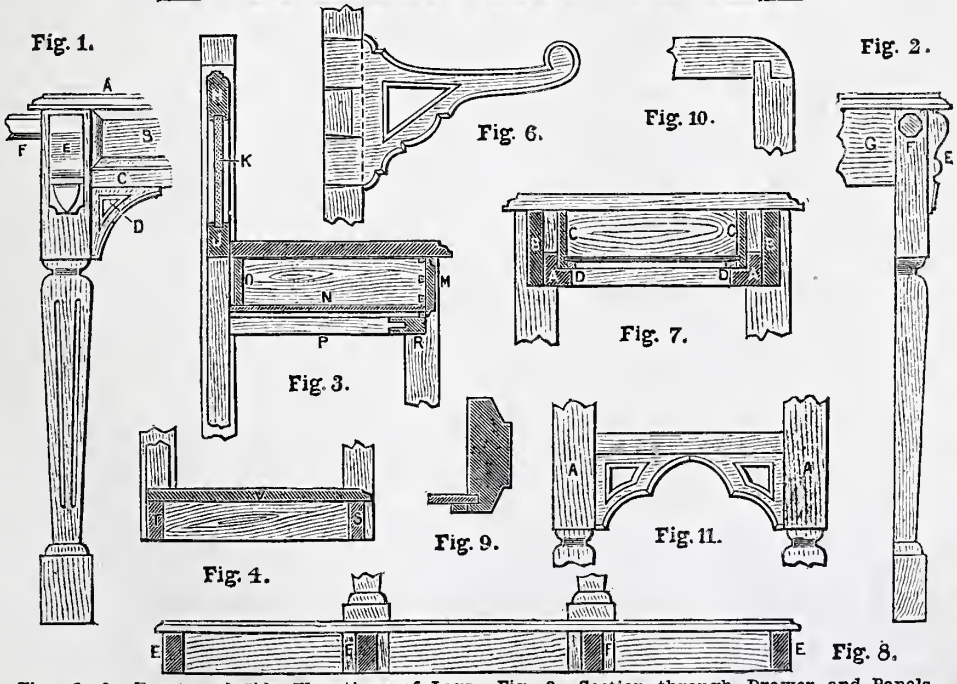


Fig. 5.



Figs. 1, 2.—Front and Side Elevations of Legs. Fig. 3.—Section through Drawer and Panels. Fig. 4.—Section through Bottom. Fig. 5.—Section through Panels. Fig. 6.—Elevation of Arm. Fig. 7.—Cross Section of Drawer. Fig. 8.—Section lengthway of Bottom. Fig. 9.—Section through Drawer Front. Fig. 10.—Angle Joint. Fig. 11.—Arch. Fig. 12.—Perspective View.

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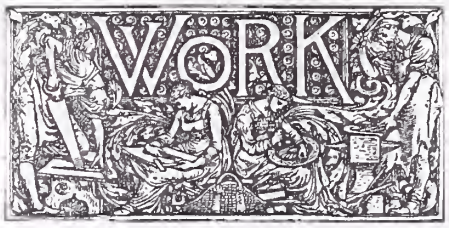

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PHILANTHROPY TOWARDS INVENTORS.—It has been said that one of the characteristics of the present day is intense selfishness, and a great indifference to the necessities and requirements of other people. Any person having heard these views enunciated would, no doubt, be considerably puzzled to reconcile this idea with what he can read in relation to inventors and intending patentees, combined with proposals to render them assistance on various terms, even so far as proffering advice for *nothing!* We have watched from time to time some of the most noteworthy, and propose here to deal with a few of them, in order that inventors and others may get an idea of the benefits as likely to accrue to them from such, and realise what such things may amount to, and thus prevent loss and disappointment. It is time some enlightenment should be given to the question, and we trust that what we shall say will be found beneficial to the interests of those who might otherwise be so unfortunate as to find them out by experience. One philanthropist will obtain provisional protection for four guineas, a second will do the same for three, a third will do it for forty-five shillings, a fourth for twenty-five shillings, a fifth for one pound! Another undertakes to give "full particulars and advice" about patents free on enclosing two stamps for pamphlet of information! And yet another will give advice free, and send pamphlet *free of charge.* Can any inventor or intending patentee be disposed, after ascertaining these facts, to admit that this is a selfish age? We trow not. Next we find "trusts" for the "benefit" of inventors and establishments for the purchase and sale of patents, but whether "limited" or not we are not enlightened. Lastly, associations have been, and are being, registered to take up inventions with a view to their development. It may be remarked that this is by no means a novelty, and so far as our knowledge of the performances of such undertakings goes, they have not been found beneficial to the interests of inventors, it generally resulting in the kind of division illustrated by the clown in the pantomime. In regard to patents and what has to be, and should be, done in preparing all that relates to them, we cannot do better than refer our readers to the article on this subject contained in No. 44, Vol. I., of WORK, p. 694, which, if carefully read and understood, should open the eyes of inventors and intending patentees to the risks and dangers they have to encounter through ignorance and want of care in occupying themselves with inventions and patents. An American writer of great experience in patent matters, and the proceedings and dodges in vogue for the "benefit" of inventors, says: "There are so many sharp schemes practised upon inventors—and it is usually those who can least afford the loss that are caught—that the only safe plan is to deal with attorneys who are recommended by people you know, or have some other equally reliable endorsement. Beware of the man who wants to sell your patent if you will only pay twenty or thirty dollars for advertising expenses. Beware of the man who, in a flaming circular, offers to do professional work for almost nothing. You can be assured he has some sinister motive in making the proposition, and before you get through with him you will find him dear enough. It would no doubt be a very valuable and useful contribution in the interests of inventors and intending patentees, if those who have "gone through the mill" would contribute the results of their experience. Forethought and common sense require to be more largely patronised by inventors and intending patentees than has yet been the case; and we hope in the interests of patent agent firms of standing and inventors alike that our remarks will receive the careful and thoughtful attention due to so important a subject. As we pointed out in the article referred to, an inventor with a good thing will have no difficulty in finding a respectable and reputable practitioner prepared to make the best of a patent at a fair remuneration for his services. Men of ability and experience do not work for amusement, but very properly request a fair return for their skill, experience, and labour. We add this in justice to many patent agents of undoubted integrity.

TRADE CLASSES AND YOUNG WORKMEN.—Continuing the remarks we made in our No. 173 issue, we would ask—What is to be expected from the young workman, and why does he not more fully avail himself of his opportunities to obtain useful and paying knowledge? We know that to join a class means, very often, choosing a troublesome but courageous course, for by electing to improve one's self against the advice of many that are too much enamoured of old and known customs, there is often great courage wanted. But should inconvenience or ridicule deter any single one from joining a class wherein he can benefit his position in his own trade? We say it should not; nor will it if there be a bit of "real grit" in the fellow. Opposition or ridicule can and does come from quarters where we should not expect it, and this opposition—on the part of so many trade members to apprentices and others taking advantage of opportunities that they did not themselves have in their young days—is a fruitful source of annoyance, at any rate, to those who allow themselves to be annoyed by it.

HOW TO LEARN DRAWING OFFICE WORK.

BY ARTHUR BOWES, A.M.I.C.E.

Pocket Compasses.—To save the inconvenience of carrying about a complete set of drawing instruments when the draughtsman is called upon to prepare or copy a design away from his usual drawing office, various descriptions of pocket sets of compasses have been introduced, combining in a portable form several of the most useful instruments, and fulfilling the purposes of a more complete set with considerable success. Some of them are remarkably compact, and serve very well for occasional necessities; but it is not to be expected that they will serve their manifold uses equally as well as an ordinary set of instruments, where each is specially designed for its own purpose and no other. The following are the principal varieties of the pocket sets:—

Tubular Compasses.—The construction of these will be readily understood from Fig. 39. The changes from pen to pencil-points, or to needle-points to act as dividers, are effected by reversing the revolving parts which are fitted to the tubular legs. A spring catch holds the revolving part in position when once adjusted. It is a commendable feature in this form of pocket compass that there are no loose parts to be mislaid.

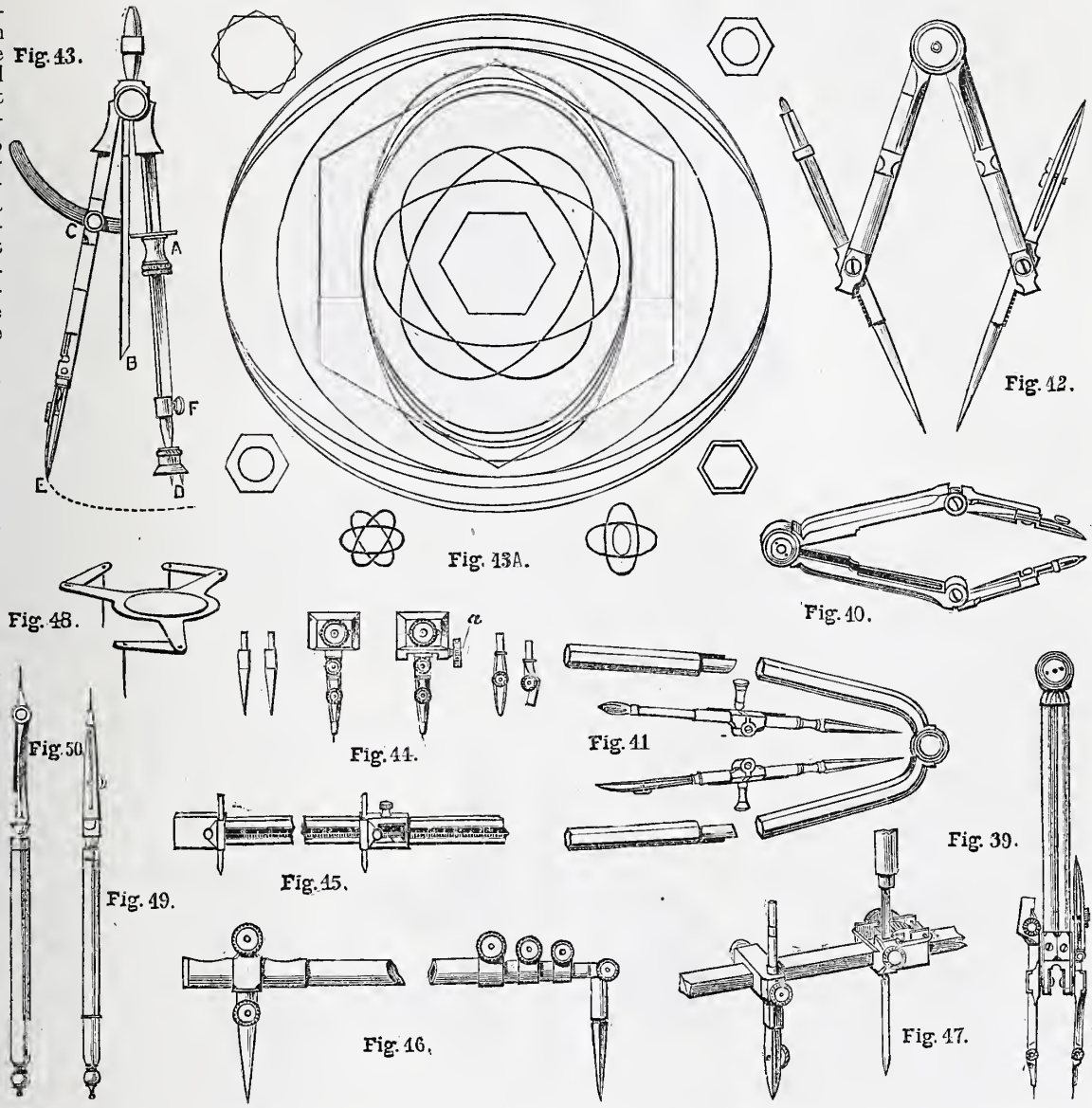
Napier Compasses.—A more compact form of pocket compass is the one known as the Napier (illustrated in Fig. 40). The method of changing the instrument from pencil to pen is the same as in the tubular compass; but the addition of the joint in the middle of each leg enables the points to be folded inwards, so as to make a portable little instrument, which can be carried in the pocket without inconvenience.

Pillar Compasses.—These are illustrated in Fig. 41. The changing points in these compasses, instead of rotating, pull out from the tubular portion of the instrument, and form separate pen and pencil compasses of a smaller size. By adding the two lengthening bars shown in the figure a still larger instrument is produced, so that the various modifications produce no less than eight separate instruments—viz., pen, pencil, and dividers in the largest size, the same in the intermediate size, and pen and pencil compasses in the smallest size.

Sheath Compasses.—A very strong and useful form of pocket compass is shown in Fig. 42. In this the points rotate, and when not in use a metallic case or sheath is screwed over the lower half of the instrument to protect it.

Geometric or Bennett Compasses.—This is a novel form of instrument introduced a few years ago for the purpose of drawing geometrical outlines, such as ellipses, hexagons, and other polygonal figures. Fig. 43 shows one of the forms in which it has been produced. The leading principle on which the instrument depends is the reproduction of the outline of a template, which is slipped on to a portion of the centre leg which does not revolve. Against this template (marked A in the illustration) a central bar, B, is continually pressed by a spring, which is hidden in the joint and cannot be seen in the figure, while the leg carrying the pen or pencil is adjustable at various distances from the central leg. It is obvious that figures of the same shape as the template can be produced with this arrangement; but by raising or lowering the template, at the same time adjusting the distance of the pen point, the shape of the figure drawn can be materially altered, straight lines being drawn, convex or concave, from the same template. Fig. 43A shows some of the results obtained with this instrument.

Beam Compasses.—For drawing curves of larger radius than can be taken in the ordinary compasses, recourse is had to a beam compass fitted with trammel heads, such as are shown in Fig. 44, carrying interchangeable pen and pencil points and dividers, and secured to the beam by adjusting screws, which bear against a loose plate on the inside of the trammel head. The beam itself is usually a flat lath of hard wood, but when using this for a long radius considerable inaccuracy may be caused by the deflection of the beam sideways, and to remedy this it is advisable to make the beam of T section. In using the Beam compass the heads are adjusted approximately to the required distance and clamped in that position by the screws mentioned above; the exact distance is then adjusted by means of the



Drawing Office Work. Fig. 39.—Tubular Pocket Compasses. Fig. 40.—Napier Compasses. Fig. 41.—Pillar Compasses. Fig. 42.—Sheath Pocket Compasses. Fig. 43.—Geometric or Bennett Compass. Fig. 43 A.—Figures produced with the Geometric Compass. Fig. 44.—Heads for Beam Compass, with Loose Pen, Pencil, and Needle-Points. Fig. 45.—Graduated Beam Compass fitted with Vernier. Fig. 46.—Telescopic Beam Compass. Fig. 47.—Patent Beam Compass. Fig. 48.—Triangular Compass. Fig. 49.—Needle-Point. Fig. 50.—Needle-Point.

fine adjusting screw lettered *a* in the figure.

When the Beam compass is in constant use for accurate work the beam is graduated, and to the head which carries the fine adjustment there is also fitted a vernier scale, by which the adjustment can be made to the greatest nicety. Fig. 45 shows a Beam compass of this pattern, as used in the Ordnance Survey Department, and with which it is claimed the distance between the heads can be regulated to the hundredth part of an inch.

Telescopic Beam Compass.—In order to make the Beam compass less cumbrous when not in use, the telescopic form shown in Fig. 46 has been produced. It is made of several tubular parts sliding one within the other, and, by means of the clamping screws, can be fixed at any desired length.

Patent Beam Compass.—One of the most useful instruments in the drawing office is the Beam compass illustrated in Fig. 47. It is extremely light and convenient to handle, consisting of a square beam of hard wood, about ¼ in. square, carrying the two heads. One of these is clamped to the beam by a set-screw, and serves to carry the pencil-point, which, when reversed, forms also the pen. The other head, instead of being fixed tightly to the beam, is held in position by the pressure of the fluted roller shown above the beam in the illustration. This is constantly pressed against the beam by a strong spring, and, by turning the milled head attached to the roller, the head carrying the centre-pin is caused to travel along the beam. The beams are so simple in construction, and of such little monetary value, that two or three can be kept at hand of various lengths, ranging from 8 in. or 9 in. to 4 ft. or 5 ft., or larger if necessary.

Triangular Compass.—This appliance, also known as the "station pointer," is used for transferring various points from one drawing to another in making a copy. It consists of triangular or three-legged central portion, as shown in Fig. 48, having arms jointed to each of these projections, and a needle-point attached vertically to each arm, as shown. When two points on the drawing are obtained, and it is desired to transfer the position of a third, the arms of the compass are adjusted to coincide with the three points on the drawing that is being copied; it is removed to the incomplete drawing, two of the arms placed on the two points already obtained, and, without altering the relative position of the arms, the needle-point of the third arm is pressed into the paper, and marks the position of the third point.

Another type of this compass consists of what may be described as a pair of three-legged dividers—that is to say, it is an ordinary pair of dividers with an additional leg jointed on, so as to move at right-angles to the movement of the other two legs. The three legs can thus be spread out so as to form a pyramid, the manner of using being the same as in the compass just described.

Pricker or Needle-Point.—This is useful for marking points on the paper from a scale in work where considerable accuracy is required; also in pricking through a drawing placed over a sheet of paper for the purpose of duplicating the drawing, as will be explained in the chapter on "Copying Drawings." The best form of the instrument can be made out of a sewing-needle and the handle of a crochet-hook, or even half of a wooden penholder; but if a more showy, though not more effective, instrument be required, the instrument makers have produced several varieties to choose from. Two forms are shown in Figs. 49 and 50, in both of which the needle can be removed and replaced with another. In the pricker shown in Fig. 50 the needle is clipped between two jaws, which are pressed together by the screw. As mentioned before, some drawing-pens are made so that the steel part of the pen unscrews from the ivory handle, uncovering a short needle-point which is attached to the handle.

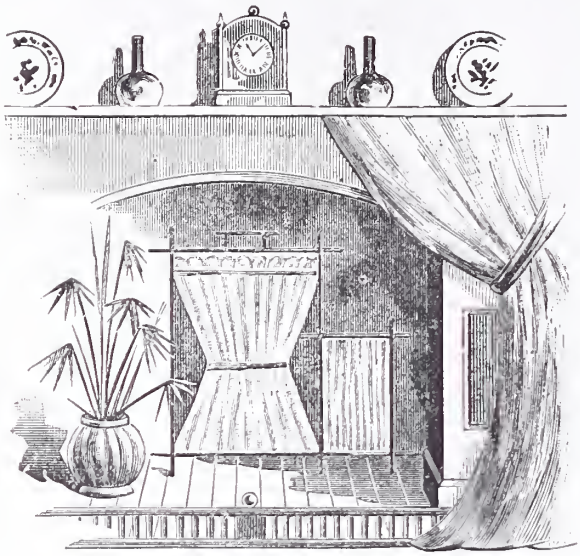


Fig. 1.—Screen as used.

SOME SIMPLE STOVE SCREENS.

BY "OMADAUN."

At this time of the year, when we hope—for some time, at all events—to have done with fires, the adornment of the fire-grate claims our attention once again. We are no longer content with the fearful and wonderful arrangements in tissue-paper and tinsel of former days, which now seem only associated in our minds as being part and parcel of seaside lodgings; and, as we aspire to something better, I trust the sketches accompanying this article may prove acceptable.

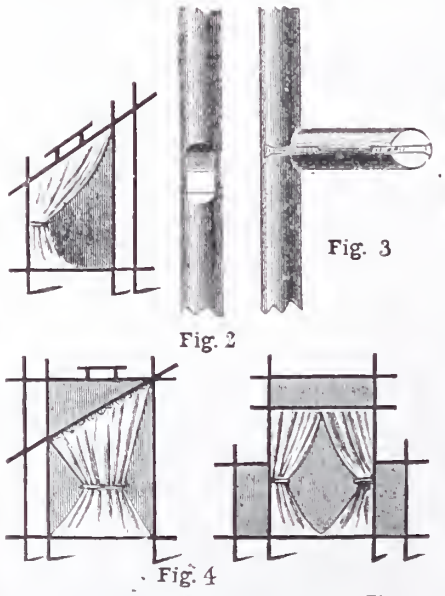


Fig. 2.—Halved Sticks. Fig. 3.—Joint. Fig. 4.—Alternative Drapings.

I do not propose to describe the construction of any elaborate piece of work, but rather suggest how a pretty and effective screen may be easily made, and at a price very considerably below what it could be bought for. In Fig. 1 I have endeavoured to show the effect of a screen when in use; the other sketches are only given as suggested varieties of forms.

The designs, it will be seen, all consist of a light framework, which may be constructed of various materials according to taste, such, for instance, as oak, white wood, or enamelled picture moulding; but I advise the use of rustic sticks. Very excellent ones for the purpose can be bought at one penny each, of well-seasoned ash, such as are used for "single-sticks," and when enamelled with "Aspinall," or some of the Ardenbrite metallic enamels, the result is very pleasing. The sticks should be halved where they cross one another, as shown at Fig. 2, and will be sufficiently well held together if a panel pin, or small French nail, be put through at the junction, and in some cases the parts may be wired together, and tied with a bow of ribbon. Where two of the sticks meet at right angles, but do not cross, they can be easily joined by means of a screw or nail, as shown at Fig. 3. A prop must be arranged at the back to support the frame in the same way as to an artist's easel, though in some cases this will not be found necessary. I have not drawn the sketches to any scale, as the sizes can, of course, be varied, and the sticks, which are about 3 ft. long when bought, will be found quite long enough for all requirements.

A great deal of the artistic effect of the screens will naturally depend upon the draping. I have shown one or two alternative methods, and no doubt various others will suggest themselves to the reader. Remnants of plush, silk, brocades, etc., can well be pressed into service here. Taking Fig. 1 as an example, the framework might be gilded, making the curtains of silk, old gold or lemon yellow, and the panel of a golden brown or electric blue plush: it is, of course, only necessary to cover with the plush so much of the panel as will be visible so as to economise material. There is no difficulty in fixing the drapery by means of small tacks put in at the back, and the panels are easily arranged by cutting a piece of card to the required size and tacking it to the frame after covering with the plush, etc., which can be either sewn on or fixed with a little glue and paste. A little gold tinsel twist may sometimes be stretched across a panel with effect, whilst some might like this done in the form of a cobweb, with a "Japanese" spider as a centre.

With these few suggestions, I hope some of my fellow-readers will be enabled to make a thing of beauty, which, if not a joy for ever, will, at least, be so until the chill October evenings make us glad again to replace it by a cheerful blaze.

Fig. 4 shows some alternative drapings.

[There can be no doubt that the ornamentation of the usually hideously, ugly fireplace is a subject which commands the best attention and ingenuity of the mistress of the house—especially in the summer months—and we shall hope to receive some good suggestions from the wives of workers in this direction.—Ed.]

EVERY WORKER'S WATER-MOTOR.

BY J. THOMPSON.

There are some cases in which a small power-motor may be of utility in driving a small lathe, fan, etc., and where there is not suitable convenience for a steam engine; if a supply of water with a fair amount of pressure be on the premises, a water-motor may be adopted.

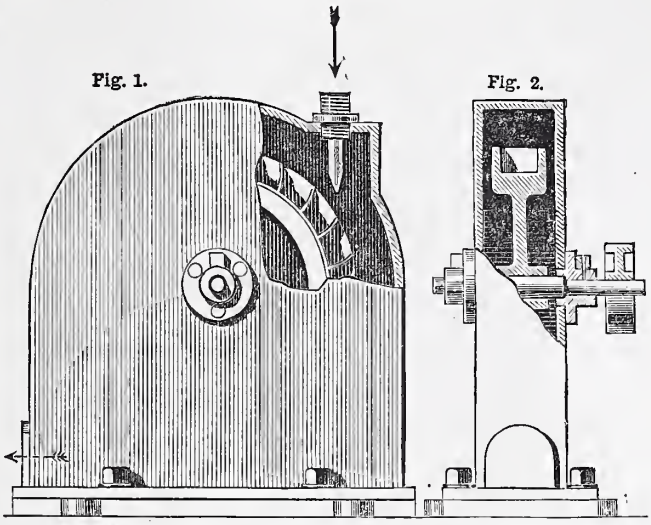
The motor now to be described will, with a pressure of about 60 lb. per square inch, and with a ¾ in. supply pipe, develop about ½ horse-power. It is small and compact, and only requires fixing on a level foundation, and a waste pipe or drain to carry off the waste water; it is also available at any time by merely turning on the water.

Fig. 1 is a side elevation, with a portion of the case removed, showing the water-wheel, buckets in section—which are thirty in number—and the water supply jet. Fig. 2 is an end elevation, showing a cross section of water-wheel, bearing, and driving pulley one-fourth full size. The castings consist of case, base plate, water-wheel, and driving pulley in cast iron, two bearings and water connections in brass; the price is 20s., and they can be obtained from Messrs. S. Simpson & Son. The case is in one piece, with a flange round the lower edge; this is levelled, and bolted down to the base-plate with four bolts, the joint being made water-tight. Four lugs are cast on the base-plate; these must be drilled for bolting it down on the foundation.

A steel shaft, ¾ in. diameter, must be turned for the water-wheel; it is shouldered down to ½ in. diameter at each end at the inside of the bearings. One end is made a little longer for the driving pulley; the full length is about 8 in.

The water-wheel is 10 in. in diameter, and must be keyed on the shaft so that it runs quite true. The bearings are of brass, bored and turned, and an oil cup formed on the top of each, with a small hole drilled for lubrication; the bearings are bolted to the sides of the case, with three bolts in each. They must be lined and set so that the water-wheel runs parallel with the case inside.

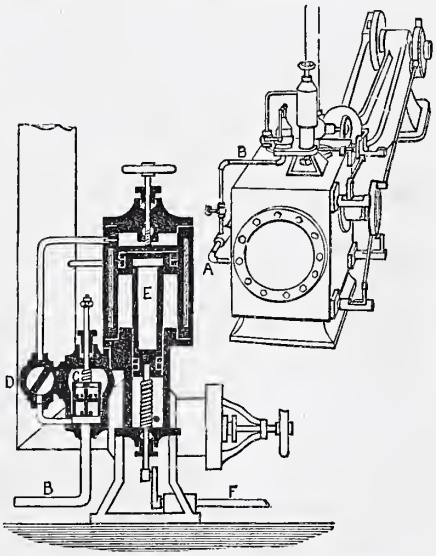
The driving pulley is bored and turned, and a key-way cut in it and the shaft, and fixed on with a key. A screwed brass connection is fitted to the top of the case, as shown in Fig. 1. For a ¾ in. supply pipe a ⅛ in. jet is screwed inside this connection; a waste pipe must be taken from the outlet to a drain, to carry off the waste water. The base-plate must be bolted down on a strong wooden foundation 3 in. or 4 in. thick. Paint all the parts not finished bright with two or three coats of paint.



Water Motor. Fig. 1.—Side Elevation. Fig. 2.—End Elevation.

IMPROVED STEAM-ENGINE GOVERNOR.

A governor which is positive in operation, and designed to admit steam quickly and in proper proportion to overcome the resistance of any load carried, as well as to shut off the steam and prevent undue increase of speed after release of the load, is shown in the accompanying illustration, and has been patented in America. The ends of the engine cylinder are connected with pipes leading to a valve casing in which is a valve stem, sliding longitudinally on seats in the casing, and the latter is connected with a pipe, A, from which leads the valved pipe, B, opening into a cylinder containing an equalising valve, C. The lower end of the latter cylinder is connected by a pipe through the valve, D, controlled from the equalising valve, with the upper end of a cylinder, E, containing a piston whose upward movement is limited by a screw-rod. The piston has on its under side a piston-rod extending into a cylinder of less diameter, connected by a pipe with the steam supply



McIlhenny's Steam-Engine Governor.

pipe, while the stem of the piston-rod, extended through a stuffing-box, is connected with a crank arm on a shaft, F, carrying arms connected with valves regulating the supply of steam. The equalising valve is provided with an auxiliary valve, which permits the steam to escape from above the valve at the time the engine cuts off and steam is expanding. By this improvement the initial pressure in the engine cylinder operates a piston which controls the movement of the steam inlet valve. The cylinder of the governor is preferably steam-jacketed, as shown in the sectional view, and the governor is intended to be set on top of the engine cylinder, as shown in the small view in perspective. The device is designed to be equally applicable to high or low pressure, stationary or marine engines.

NOTES FOR WORKERS.

About 250 men and 130 girls are employed at the Vaseline works in Brooklyn, U.S.A. Vaseline was first produced by Mr. Cbesebrough in 1869 or 1870, but it did not "take" till 1876, and now the demand exceeds the supply. Sixteen tons of bone-black are used every day for its purification.

The rubber cement used by leather shoe manufacturers is unvulcanised Para rubber dissolved in benzene. It is also used by photographers, after being thinned with more benzene.

A very general stain for microscopic sections is bæmatoxylin, or logwood, which stains the nuclei of cells much more strongly than the other parts.

There should be no paint or varnish inside an aquarium, as both are injurious to the fish.

Professor Adams, who died early this year, sbares with Leverrier the honour of discovering Neptune.

A factory has been started at Ambato, in Ecuador, for the manufacture of rope from the agave fibre.

SCIENCE TO DATE.

Phosphorus Sulphoxide.—This is a new compound discovered by Messrs. Thorpe & Tutton in their researches on pbosphorous oxide—P_4O_6. They find that sulphur acts very violently on this oxide at a temperature of 160° C., producing the new sulphoxide. It is a pale yellow solid, which melts at 102° C., and boils without decomposition at 295° C. When sublimed in vacuo it forms large colourless tetragonal prisms. Its vapour density agrees with the formula $P_4O_6S_4$. It is deliquescent, and is decomposed by water, with liberation of sulphuretted hydrogen gas and formation of phosphoric acid.

Great Sun Spot.—Recently one of the largest sun spots hitherto observed appeared on the eastern side of the sun's disc. It disappeared round the western side, and again passed the central meridian of the sun. Later it had assumed its greatest area, and, according to measurements made, this area reached the astounding dimensions of 3,360,000,000 square miles. Its greatest length was 150,000 miles, and its greatest width 75,000 miles. Sun spots usually cause magnetic and auroral disturbances. This was no exception.

Measurement of High Temperatures.—According to Professor Roberts-Austen, reliable results can be obtained in measuring high temperatures by means of a thermo-couple formed by twisting together the ends of two wires, one of platinum and the other of a platinum-rhodium alloy containing 10 per cent. of the latter metal. By this means an accuracy of 1° in 1,000° can be obtained. If it is required to measure temperatures between 1,000° and 2,000°, two wires of iridium and iridio-platinum with 10 per cent. of platinum may be employed. The apparatus, consisting of the thermo-couple and a D'Arsonval galvanometer, is calibrated by placing the couple in some material whose melting point is known, and noting the deflection obtained.

Glacial Drift.—Hitherto the patch of boulder clay at Finchley has been considered the most southerly representative of the glacial drift in Britain. A similar deposit has been lately discovered in Essex on the line of the Grays and Upminster Railway. This brings the drift 3 miles further south.

Flexibility of Rocks.—A microscopical examination of specimens of flexible limestone from the cliffs at Sunderland, Durham, shows that the flexibility is apparently due to minute cavities lying along the bedding planes, and accompanied by a slight interlocking of the grains of dolomite.

TRADE: PRESENT AND FUTURE.

*** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

COTTON TRADE.—Manchester spinners have experienced a little revival of trade, but it is still dreadfully dull. Our Rochdale and district correspondent cannot report any improvement. Many of the companies, in stock taking, are coming out on the wrong side, a state of affairs which will not be improved by the stoppage of a large firm of cotton brokers at Liverpool.

OIL TRADE.—Palm-oil, holders have had more inquiry, having accepted 5s. decline, and about 100 tons have been sold at £19 10s. per ton. Small sales of Lagos are reported at £20 15s. Tallow, a fair amount of business has been done at 23s. to 24s. 6d. for North, and 26s. 6d. to 27s. per cwt. for South, American. Olive oil, fair sales have been made at £33 to £38 per ton, and Neapolitan is offering at £35 10s. to £36, Malaga at £35 to £36, and Smyrna at £33 to £35 10s., per ton. Linseed oil meets with a moderate demand at 20s. 3d. to 20s. 6d. per cwt. Cottonseed, refined, 19s. 6d. to 20s. per cwt. Turpentine, 23s. 3d. per cwt. Rosin, 4s. to 4s. 1½d. per cwt. for common.

COAL TRADE.—Prices are unchanged. Contracts for gas coal are not all entered yet. Some of the gas companies are holding back in the hope of better prices.

SILVER TRADE.—In Sheffield there is little change to note. Paris orders are for special goods, chiefly of the cheaper kinds of Britannia metal goods.

IRON AND STEEL TRADES.—There is still a steady demand for railway material, but buyers are looking for a decline in the market. The armour-plate makers are still working full time.

CUTLERY TRADE.—The workmen employed by Messrs. Joseph Rodgers & Sons are on strike upon a reduction of wages question. This firm has never before been at issue with its workmen on the subject of wages. To the United States the value of steel and cutlery exported in 1889 (March to June) was £144,678, while from March to June of 1892 the value only reached £122,427, showing a steady decline to the lowest on record.

ENGINEERING TRADE. — Although, generally speaking, the condition of the Lancashire engineering trade is showing no signs of improvement, yet there are one or two firms of machine tool makers who have recently booked orders of some moment, and it is considered that the prospects of a change for the better in this branch of the industry are slightly greater than have obtained of late. Stationary engine builders have very little work on hand, however, while boiler makers are not nearly so well off for work as they have been for months past. Locomotive builders report no improvement, and, generally, the manufacturers of railway plant of all kinds are becoming exceedingly slack. No move has yet been made in the Mersey shipbuilding trade, but in the Barrow district both engineers and shipbuilders are busily employed on new work and repairs, and have also some good orders in prospect. The iron market has for a time been disorganised by the elections, and the small amount of business that was being done a week or two ago is now still further restricted. Independently of this, however, there is a marked want of tone in the iron market, and buying is, for the most part, confined to immediate requirements. The belief is general that rates must fall, but as the present prices are certainly not remunerative, it would appear that any reduction must be accompanied by a substantial decrease in wages and in the price of fuel, and of this there is at present no indication. Lancashire boiler makers are almost as badly off as the rest. Our Rochdale correspondent writes:—Engineering trades are in a bad state. One large works has shut up lately, and others are short of orders.

GOLD THREAD TRADE.—The gold thread trade is in a depressed condition. Latest advices from Madras, Bombay, Delhi, and Rangoon report the markets stocked with threads of French and German manufacture, of high and of low qualities. The purchasing value of the rupee has fallen concurrently with the price of silver, and this has intensified the poverty of the people of India. Prices have had, in consequence, a downward tendency for several years, and continental manufacturers have been closely competing with each other in a falling market, with the result that it is now overstocked. Prices have also a downward tendency in the home market, where only a limited quantity of gold lace threads are in demand. Scarcely anything is being done in imitation gold threads, warps, and braids, of which home manufacturers hold large stocks.

PLUMBING TRADE.—This trade is very quiet, most of the firms working short hours, and many men are "playing" them.

FLANNEL TRADE.—This is not doing well, though better than the cotton trade.

BUILDING TRADE.—The building trade of Bolton is at a complete standstill, as the whole of the men are locked out, owing to a strike of plumbers, which has already extended over nine weeks. The points in dispute are as to the time of starting in winter and the allowance for country money. Lancashire building trades are fairly busy. A strike of the Sheffield masons has thrown out the bricklayers. Stone used in the erection and extension of the New Central Board Schools is brought from quarries in the neighbourhood of Huddersfield, where it is dressed and trimmed. The masons urge that this is against the understanding with their employers. In the Rochdale district the trade is fairly busy, principally on speculative buildings. Liverpool bricklayers are busy. This is one of the towns where almost everything is built of brick. The wages for bricklayers are 8½d. per hour, but as much as 9½d. is offered for North Wales.

CYCLE TRADE.—Trade is still flourishing, although, the season being well advanced, most riders have provided themselves with machines, new or old. Very many are taking to cycling by means of the hiring system. The use of the tricycle has been somewhat in abeyance since the Safety became so popular. It is gratifying to notice that the three-wheeler is again coming to the front. About Berwick-on-Tweed numbers of ladies are taking to the tricycle, and the formation of tricycle clubs is talked of.

SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

I.—LETTER FROM A CORRESPONDENT.

Destruction of the Broad Gauge.—CIVIL ENGINEER writes:—"The world has lately been favoured with an unparalleled exhibition of wilful destruction of property, and a useless waste of money, for the achievement of an assumed benefit, but to extenuate which there cannot be the shadow of a reasonable justification advanced. We allude to the wilful destruction of the broad gauge system, which for so many years has been the delight and comfort of travellers who have had to proceed to the West of England and Cornwall. There can be no doubt that the existence of the broad gauge was a great impediment and drawback to all through traffic to other lines which had to pass from it to the narrow, and if a simple and ready means of overcoming the evil could not have been devised, it would have been quite right that it should disappear. However, some years since a ready means of overcoming the difficulty was arrived at by inserting a third rail between the two broad gauge metals, so as to enable the traffic passing on to other lines to be worked over it; and this has been done for many years with perfect success. The total length of the broad gauge from London to Penzance was 226 miles 24 chains, and it has been considered by the 'enlightened Board' that it would be a cheaper proceeding to destroy the broad gauge than continue the addition of the third rail over the entire system below Exeter, by means of which all goods, coals, and other minerals, etc., could be carried in narrow gauge trucks, and so the evils of break of gauge avoided, whilst the direct western passenger traffic and goods, etc., loaded at and to be delivered at broad gauge stations, would have gone on as before, and the enormous waste of money and sacrifice of expensive and costly rolling stock avoided. It seems, however, that the 'bump of destructiveness' became strongly excited in the heads of these 'enlightened directors,' and a most interesting and important link in the history of railways has been ruthlessly destroyed. Having, as it were, both systems of their own, and to make both complete only needed the third metal to be extended to the points not then reached by it—which common sense would show was the cheapest step to be taken—they prefer the more wasteful and expensive one of destroying the existing road, and sacrificing a vast quantity of rolling stock, in the shape of engines, tenders, coaches, trucks, etc. Their conduct can only be compared to that of the man who because he had *two* coats, thought one would be enough, and therefore tore up the other! What the shareholders can have been about to allow these directors to saddle them with nearly a million of expenditure, to gain nothing, is more than can be conceived; but there is no doubt the names of these 'enlightened' and 'enterprising' individuals will descend to posterity with anything but an unqualified approval; and justly so. We saw the last of the fast through trains to Penzance leave the station at Paddington, consisting of seven vehicles drawn by an engine built in 1846—the 'Great Western'—and it is to be questioned if any other railway in the kingdom could put on an engine designed and built so long ago to take such a train at express speed over the distance, and keep time. It is to be hoped that reflection and experience will not cause directors and shareholders to repent of this unreasonable performance."

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Speed of Saws.—F. W. G. (*Poplar*).—Your questions are not so explicit as they should be, but perhaps I can help you out. The speed at the points of the teeth of your circular saw should be from 8,000 ft. to 9,000 ft. per minute. As your saw is 13 in. in diameter, this accords with from 220 to 25 revolutions of saw per minute. The pulley on the saw-spindle should not be less than one-third of the diameter of the saw—say, therefore, 5 in. in this case. Your engine runs 180 revolutions per minute, so the ratio of the pulleys on the engine-shaft and saw-spindle must be, for the lower speed, $\frac{22}{18}$ =1·222. This would give for the pulley on the engine-shaft a diameter of 6 in. If you have a 12 in. pulley on the engine-shaft, you must put a 10 in. pulley on the circular saw spindle, unless you have an intermediate shaft. If you are going to cut hard wood—such as elm, ash, beech, etc.—your surface speed should not exceed 6,000 ft. per minute. The band saw should run at a slightly higher speed than the circular saw.—F. C.

French Timepiece.—H. J. G. (*No Address*).—The spring at the back of the clock is to hang the pendulum on; it is usually two strips of steel ribbon with a little piece of brass fixed to the ends, through which is passed a pin on which the pendulum is hooked. If the clock will not go when the pendulum is hung on this pin, it may be that it is not in beat, or that the spring is bent or buckled, or one of the ribbons is broken. See that the spring is perfect and that it beats or ticks level, and that it swings to and fro with a smooth, steady action; if it wobbles, throw the spring away and get a new one fitted: any clock-maker will do it for a few pence. If it still refuses to go, something more is wrong, but as it goes without the pendulum, I am inclined to think it is one of the foregoing faults.—A. B. C.

Woollen Machinery.—KERRY LAD.—We know of no periodical of the kind you require.

Re-graining Woodwork.—W. G. G. (*Hornsey*).—If the old work is very rough or blistered, this must be removed by "burning off" or "pickling off" with a paint solvent. If in good condition, rub down the surfaces with pumice-stone and water. Paint one coat of "sharp" colour, then stop holes and crevices, and "ground" with the desired colour. The paint had better be mixed for you at any oil and colourman's to the required shade; have it made up thick, and then dilute a portion with turpentine only for the first or "sharp" coat; then for the "ground" use the remainder with equal parts oil and turps. Upon this ground you spread the semi-transparent graining colour. This you must also purchase, and it is possible you may be able to decently spread it, and then "plain comb" it with steel or leather graining combs. A coat of varnish is the last operation. If you are in earnest, study the exhaustive series of articles on Graining in Vol. II. If you want a hobby requiring as much study and practice as the violin, you will find such in the art and practice of graining.—DECORATOR.

Limewash.—TYRANYRE.—Russian tallow, beer washings, raw linseed oil, and boiled oil are amongst the many articles used in different localities for adding to limewash for exterior walls. The simplest addition of the first-named—say, 1 lb. to the gallon of colouring—is a useful and inexpensive combination. Another recipe is the addition of alum and soft soap, 1 lb. of each dissolved and well mixed into two gallons of wash, or in these proportions. Two good coatings of this should give you a pleasing and fairly durable exterior finish. For cream or buff tones add dry ochre to the lime before the addition of the other ingredients. This colour combined with dry umber, makes a series of soft drab tints; ochre alone makes a rather harsh and "staring" tint. For neutral grey or slate colours, add the pigment termed "blue-black." All these colours are cheap, the two former about 1½d. per lb., the latter from 4d. to 6d.—F. P.

Marine Engineer.—J. F. (*Appleton, Widnes*).—If our correspondent will refer to WORK, No. 125, Vol. III., page 331, and also to No. 126 of same vol., page 349, he will there find the information he seeks, which he should carefully read and consider to see how he is situated in regard to being able to meet the required conditions. If this does not give him the information he seeks, if he will let us know his difficulty, perhaps we may be able to put him right.—C. E.

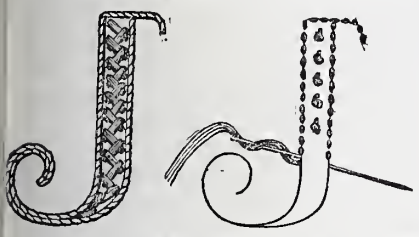
Heraldic and Inscription Engraving.—W. J. B. (*Londonderry*).—This subject is coming on in WORK.

Electrical Engineering.—SUSPENSE.—At present the prospects of this profession are good, as it is certain there will be a development of this branch of engineering in the near future for purposes of traction as well as lighting. If a man is already working in the engineering shop of a firm as an ordinary workman, he may, by showing exceptional ability, be able to rise to higher grades; but the usual mode of entering the profession is as a pupil to an electrical engineer. Pupils pay down a sum varying from £100 to £300, and sign an agreement for three years. Your best plan will be to write to several of the most eminent firms, stating your requirements, and ask them to give you a chance when a vacancy occurs.—G. E. B.

Oxygen Generator.—OXY.—I cannot oblige you with detailed instructions on the way to make an oxygen generator and accessory apparatus for

gic-lantern work. The necessary illustrations d details would take up too much space in hop."—G. E. B.

Stitch for Texts.—INDOMITABLE.—If you want give a good effect to your work without spending much time over it, I would advise you to em- oider the letters in the style shown in Fig. 1. tline the letters in gold, and fill in with fancy tches. Many different sorts of gold can be used, t the most inexpensive is the Japanese gold, hich can be purchased at any art needlework op, the price for each skein varying from 3d. to It is laid on the material like a cord, fastened wn with overcasting stitches in thin yellow silk a nice distance from each other. Then fill up space between the gold with herring-bone or ther-stitches in four or five threads of filoselle k. Letters in this style are very quickly worked,

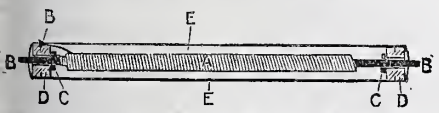


g. 1.—Gold-bordered Lettering. Fig. 2.—Dotted and Cross-backed Stitching.

d give a good effect; but great care must of urse be given to the colours. Bright gold with lk in a shade of "old rose" would look very well your satin. If you find it difficult to obtain the ld, or prefer to vary the style of work, another sy way of embroidering the letters is to do them crossed back stitches, as shown in Fig. 2, and en work a row of French dots down the centre. this style is chosen, I should advise you to do em in two shades of silk: for instance, a dark rra-cotta for the outline, a pale tone of the same lour for the dots. With good taste for colouring, d with a little fancy in the way of choosing the itches, a good result can easily be gained; but u must remember that if the letters are to look ally well, the tracing must be firm and clear, and, ove all, every line must be perfectly straight.—N.

Automatic Model Engine.—A LEEDS FITTER.—You will require clockwork in the box to work e engine; and I suppose you will regulate it to n a certain fixed time for a penny—say one minute. hen if you get a clock movement with a seconds and arbor, and put on it a wheel with one pin on s face, this pin may be held by an ordinary detent ith a long tail beneath the slot at which the coin aters. The penny falling on the detent-tail raises s point and releases the wheel, but immediately eturns—by a light spring, if necessary—and arrests e wheel when it has made one revolution, and so emains until another penny is introduced. The ngine will require a pulley on the shaft driven by cord which passes down into the box and round pulley on one of the motion spindles. The clock ovement must be regulated by a conical pen- ulum—not by one that swings—or its speed may e controlled by the friction of the model, to drive hich you will require a powerful spring. If you ant the model to run for longer periods, the stops ust be put on slower-moving wheels; thus, if you ish it to run five minutes at a time, twelve stops n the minute arbor wheel would control it. I do ot know of any book on this subject; but it is very imple, the detent being the only addition to the lock movement.—F. C.

Faulty Blind Rollers.—E. C. S. (*Stoke Bishop*).—You would never make a satisfactory job of a pring blind with elastic. What you want is a pro- er "spring roller blind." These are made with a ouble spiral spring on a round iron rod going hrough the whole length of the roller, and squared t each end to fit into the blind brackets. One end f the spring is secured to the iron rod; it then vinds up the rod to within about 4 in. of the other nd. Another and larger spring is then secured to



ection of Outer Case of Spring Roller Blind, showing Double Spiral Spring.

his end of the spring, and winds back over it, as it vere, and the remaining end is fixed in a turned vood block, turning freely on the iron rod at the ame end from which the spring started. Another corresponding wood block is then passed on to the ther end, and a brass washer is jammed tightly on he iron rod at each end to keep the wood blocks at he proper distance apart. A tin tube is then passed ver the whole, and secured to the wood blocks at ach end. A brass cap is then fastened to the ends f the wood blocks for the sake of appearance. The lind material is sewn tightly round this tin tube, nd the action of pulling the blind down winds up the spring. It is then secured at the bottom, and when released, of course, springs back again. The sketch given shows the roller, with the outer tin case partly removed to show the spring: A, double spiral spring; B, iron rod squared at ends; C, brass washers jammed on iron rod; D, wood blocks; E, inside of tin case. When a spring blind is used for an ordinary window, there is a small lever arrangement, catching on a cog-wheel attached to that end of the iron rod where the spring is held, and this prevents the blind springing up when it is pulled down until the lever is raised by means of a cord. If the spring of the blind does not quite roll it up when it is released, it must be "charged"—that is, you roll the blind once or twice round the centre iron rod in the same direction that it goes when it is pulled down, and this, of course, winds the spring up, in addition to the winding it gets when the blind is pulled down. Spring blinds for an ordinary window working with a cord always require "charging," but this is done in a slightly different way on account of the lever before mentioned. I think I have said enough to convince you that it would be cheaper to buy a blind of this description than attempt to make one, unless you are used to this class of work, for you would have to buy nearly everything separately before you could make it, and you would find that you had paid more for the different parts than the whole blind would cost you. There is a cheap class of spring blind roller, sold for about 1s. per foot run, at nearly all large ironmongers. I think it is made in America, and, although it is not to be compared with the sort I have described, I fancy it would be just the thing for the inside or outside of your doors. The only thing is, it might not be possible to get the exact length you want, but I have no doubt it could be shortened. If you watch the "How to Do It" series, in Vol. IV., there will be an article on all kinds of blinds.—E. D.

Enginewright.—C. E. C. C. (*Chesterfield*).—To be a qualified enginewright—*i.e.*, a man capable of setting out and executing the work required in the making of steam engines—he should have served a regular five or seven years' apprenticeship to an engineer or firm engaged in work of this kind, and his certificate is the *indenture* under which he served his time, and by means of which he is distinguished from the mere "handy man," driller, cock-turner, or shovel man, who, though perhaps capable at what they have been accustomed to, are *not mechanics*, nor capable of using the tools on jobs of this kind. We see no way by which "an engineman of twelve years' experience" can be qualified as a mechanic, and he would be too old to serve his time to make him one. The term "nominal horse-power" is of no significance in regard to the power an engine will or can be made to develop, inasmuch as it takes no account of pressure, speed of piston, number of revolutions, or length of stroke, and, amongst engineers, is considered obsolete. There is no fixed rule by which every maker abides on this question. One will reckon 10 circular inches of piston as equal to one nominal horse-power; another, less; another, more. Some years ago we completed a set of drawings for a horizontal engine with a 12 in. cylinder by 2 ft. stroke, which would be called a 12 or 14 horse-power; but when she was set to work with 80 lbs. steam, and running at 200 revolutions per minute, gave by indicator exactly 100 horse-power! Where was nominal horse-power in this case? Some makers also calculate so many square inches of piston per horse-power in place of circular inches. To calculate the square inches in a piston, multiply the number of inches in the diameter by itself, divide the product by fourteen, and multiply the quotient thus obtained by eleven, which gives the number of square inches in the piston; and this number, divided by the number of inches allotted to the horse-power, will give what you want, but which is of no use as regards the actual horse-power.—C. E.

Latin Inscription.—DEVONIAN.—"Merito, non gratia:" By merit, not by favour; "Non gratia sed merito:" Not by favour, but by merit; or "Meritum ante gratiam": Merit before favour. Any of these three will do.—F. B. C.

Cheap Electric Lamps.—C. J. (*Redhill*).—Lamps of 10 c.-p., with holder complete, at 6s. 6d. each, cannot be said to be cheap. They ought to be obtainable for half that sum, and could be profitably produced at the lower figure if healthy competition was not strangled by selfish monopolists. I cannot recommend the 5 c.-p. lamp at 3s. without seeing and testing a sample lamp. If your friend (Mr. Wells) will send me a sample, I shall have pleasure in reporting to the Editor my opinion of its value.—G. E. B.

Organ Building.—T. D. (*Liverpool*).—Write to Messrs. Beales & Son, Organ Builders, Limes Road, Croydon, Surrey.

Silver-plating Solution.—H. E. (*Eastbourne*).—The best solution for silver-plating is that of the double cyanide of silver and potassium dissolved in distilled water. The solution should contain 5½ oz. of the double salt in each gallon of water. Double cyanide of silver is formed by adding cyanide of potassium to a solution of silver nitrate as long as a precipitate is formed, washing this in water, and dissolving the wet salt in a strong solution of potassium cyanide. Full directions were given in No. 112, page 118, Vol. III. of WORK, and may be found in the "Electro-plater's Handbook," advertised on page 8, Vol. IV. of WORK.—G. E. B.

Electric Tricycle.—CYCLIST.—I am not yet in a position to describe an electric tricycle. Another electric tricycle has just been made and patented by a young man of Crewe. If CYCLIST could procure his address, possibly he might be disposed to give him some information on the subject.—A. S. P.

Mechanical Escritoire.—D. B. (*Ayrshire*).—You display considerable mechanical ability in your invention, and as the details may prove useful to some of our readers, I will reproduce them, adding lettered references and a further explanation as I deem correct. In the present sketches, A is a door, to which is attached a bar, B, that in turn being secured to bar C. Bar C is pivoted to the side of the escritoire within. To the top of this last-mentioned bar is fastened the ends of two cords, one passing over a reel, D, under reel, E, connected to one end of spring, F, and finally passing from the other end of the spring to the bracket, G. The remaining cord passes from the bar, C, over reel D, down the back of the job; then a spring intervenes, and finally it passes under reel H and to the foot, I. Another cord passes from the lower end of bar C, over reel J, under reel E, then turns in a diagonal direction horizontally, and finally to the end of bar K (plan, Fig. 3), which bar is pivoted under the board, L, its opposite end travelling in a quadrangular groove formed by a bent wire, as in Fig. 4, the wire being

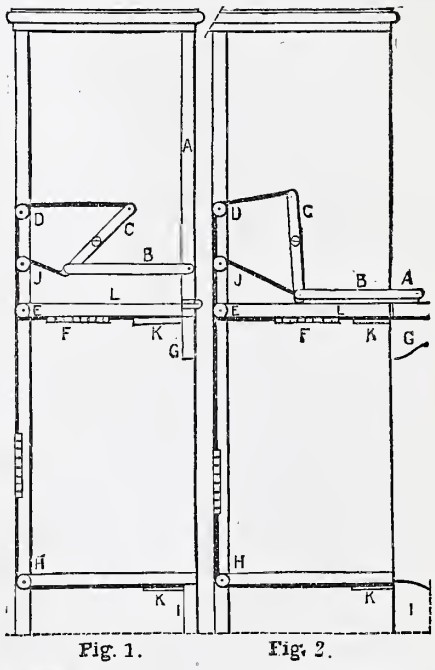


Fig. 1. Fig. 2.

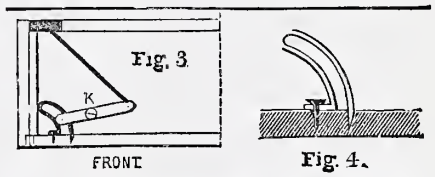


Fig. 1.—Door and Parts. Fig. 2.—Door and Levers. Fig. 3.—Cord Plan. Fig. 4.—Bent Wire, ⅛ in. thick, with Eye for Screw, the other end penetrating the Wood.

attached to the bracket, G. Another cord passes from the lower end of the lever, C, over reel J, down the back of the job, under reel H, and is finally secured to parts exactly resembling those just described in Fig. 3, and connected to the feet. Upon opening the door, A, the levers are adjusted as shown in Fig. 2 (which, you will observe, is an added diagram to facilitate explanations), and cords are pulled which move the upper and lower bars, K, they opening brackets and feet to support the door and maintain the job's stability respectively. You say that the brackets and feet are pulled back by the spiral springs, but I do not quite understand their utility. I will tell you why. When the job is opened, the brackets and feet would pull the cord attached to them and the top of the bar, C, respectively, and as bar C gives way at its top, I should have thought that upon replacing the door in its vertical position—the top of the bar, C, then returning to the position shown in Fig. 1—the cords themselves would be sufficient to withdraw to the carcase the brackets and feet. I have tried your arrangement by means of cut-out pieces of cardboard, and should say that it proves very effective for its purpose.—J. S.

Paint-grinding Machine.—PATENTEE.—I much regret my inability to assist you, since the ordinary

paint mill is probably of the kind you are acquainted with. At the same time, I see no reason why *paste* paint could not be ground in such. Are you certain it would "set before you received it"? I think not, unless you add a strong drier to the oil and red lead. In any case, you would get a *finer* product from a grinder than any home milling. Write Wilkinson, Heywood & Clarke, Caledonian Road, N., varnish and colour makers, for a quotation; or to Crowden & Garrod, Borough, London, S.E., if you *must* mill at home. They may be able to help you get a machine. Mention WORK if you write them.—LONDON DECORATOR.

Philomela.—ANXIOUS ONE.—If you will refer to the article in No. 161, you will see that I indicate approximately the size of the instrument. Roughly speaking, you have only to consider the pitch of the open strings, and if you follow my directions and take your chief measurements from a tenor (or viola), you will not be far out. I think I am correct in saying that the proper dimensions for the latter instrument were given in the admirable papers on Violin Making which have already appeared in the pages of WORK, but not having the volumes at hand at the moment, I cannot refer you to the specific number or page. As regards the *outline* of the body of the philomela, much remains in the way of scope, and you may make it any shape you please, *provided you make provision for boxing*, in the shape of a "waist." For this reason, common sense will tell you that the mandoline shape you suggest would not answer. You may certainly make it guitar shape if you wish—indeed, many violins are made of that form in Italy—but you will, in doing so, escape very little, as the ribs have still to be formed, and it is as easy to make them to one shape as to another; a mould must, in any case, be first made. I shall be pleased to hear that you have succeeded, and shall be glad to answer any questions you may find it necessary to put to me.—OLD TEACHER.

Shorthand.—H. E. H. (*Bridgnorth*).—You are right; it would not be wise to throw up a certain situation for an uncertainty. I should advise you to write and state your case to the Emigrant's Information Office, 31, Broadway, Westminster, London, S.W. This office has been established by Her Majesty's Government for the purpose of supplying useful and trustworthy information on the subject of emigration to the British Colonies, and it is under the direction of the Colonial Office.—F. B. C.

Improvement on a Patent.—F. C. B. (*Blandford*).—In reply to the question of our correspondent, we cannot do better than place before him what the law has laid down on this subject. Justice Tindal has said:—"When a party has obtained a patent for a new invention made by his own ingenuity, it is not in the power of any other person, simply by varying in form or in other immaterial circumstances the nature or subject matter of that invention, to obtain either a patent for it himself or to use it without the leave of the patentee, because that would be in effect and substance an evasion of the right." Vice-Chancellor Malins has held that "No doubt a man may make an invention which is partly covered by an existing patent, but he cannot use it *without the licence of the patentee*. He may wait for the expiration of the patent, and take out one himself if his invention be novel, and the patent will be valid"—assuming, of course, that it possesses all the points required to make it one. The only course we can advise our correspondent to follow would be to ascertain if the patentee would grant him a licence to use an improvement or to apply it to the apparatus, and on what terms, taking care *not to describe the improvement* so that the patentee would know as much about it as the inventor, and then, when he had ascertained this fact, he might put his matter in the required shape to apply for a patent.—C. E.

III.—QUESTIONS SUBMITTED TO READERS.

**** The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Magic-Lantern Sheet Frame.—B. N. (*North Seaton*).—Could any of the correspondents of your valuable paper inform me how to make the above, so that it can easily be fitted together, and at the same time be light to carry about?"

Hairdressing.—T. D. (*Newcastle-on-Tyne*) will thank any reader to be so kind as to give him the address of some firm who would supply what is necessary for fitting-up and opening a hairdresser's shop, and who would tell him exactly what would be required.

Racing Cutter Yacht.—F. C. B. (*Glasgow*) writes:—"Will any reader oblige by giving me instructions how to make and rig, from a solid piece of wood, a racing cutter yacht, about 3 ft. 6 in. long?"

Gondola.—CONSTANT READER writes:—"Will any reader kindly give me a design, with parts, for building a gondola for a small stream of water?"

Plate Chest.—COUNTRY CARPENTER will thank any fellow-reader of WORK for particulars and diagrams for constructing a plate chest.

Type-Writers.—CLERK writes:—"I want to purchase a type-writer, and shall be glad of opinions as to the best machines."

Banner.—E. M. S. (*Brighton*) will be obliged to any reader who will give her the design for a Purity League banner.

Half-Plate Camera.—A. G. (*Lambeth, S.E.*) writes:—"I wish to make a good half-plate camera, folding tripod stand, dark slides, printing frames, and other requirements for a photographic outfit such as a carpenter could make. A few practical hints would be gladly accepted; also the best book of instructions suitable for a beginner."

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Bird Kite.—J. W. B. sends H. N. (*Ipswich*) (see No. 164, page 126) the following directions on how to make a bird kite which will fold up like an umbrella, viz.: Procure a thin piece of calico 2 ft. 8 in. by 3 ft. 9 in., and cut into the shape of a bird, as in Fig. 1, and paint it as you desire. Fig. 2 shows the framework on which the calico is stretched. Procure a stick of common deal an inch square (A A) 2 ft. 8 in. long, and split it up middle from bottom 1 ft. 9½ in. (A to B); then tie it there with fine twine, to prevent it splitting any further. Place a small piece 1 in. long 3½ in. below the tie at C, to keep it open and form the tail. Now get two pieces of cane 2 feet 2 in. long and 1 in. in circumference or ½ in. in diameter (D to D and E to E). Cut a shaving off whole length of each, to allow them to lay flatter. Rivet both canes to centre stick 8 in. from top at F, and 4 in. from the ends of each cane, so that they may overlap each other 4 in., as shown in Figs 2 and 3. Shave them down at overlapping sides so that they may lay flatter, and to secure them from slipping, as in Fig. 3, get two rings of cloth elastic, and slip them round the cane ends, as shown at D¹ E¹. Next make two canvas pockets; sew one to each end of wing of bird to hold ends of crossed canes. At the widest parts of wings place a strip of thin cane; glue it to calico, and glue over it a narrow piece of calico (H H, Fig. 4). To attach it firmly to wings, fasten a piece of string between ends of wings and top of kite. Shape the head and beak of bird with some small wire, making a little notch in centre stick for it to fit neatly into, and tie it to the centre stick with fine twine. In cutting out the calico, remember to leave about 1 in. over to glue and lap round the wire of head frame, as indicated in the diagram—Fig. 4. The tail portions of kite are fixed to uprights by pieces of thin canvas about 8 in. long and 2 in. wide glued over them, and also over the split parts and wedge, as shown by the marks in Fig. 4. The loop to which the string is attached is passed through centre stick 3½ in. from top and 11 in. from each tip of tail. Tail cups are best for this kite, as shown in Fig. 5. They are made of thin calico 3 in. in depth and 3 in. in diameter, like jelly-bags; a piece of thin wire forms the ring. Fasten them 6 ft. apart, and four cups will be sufficient for this kite. Square, folding, or other kinds of kites may be made in a similar way with a few alterations."

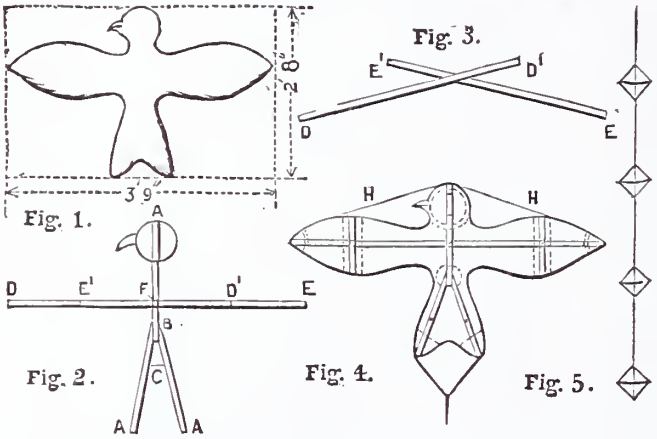


Fig. 1.—Bird Shape. Fig. 2.—Framework. Fig. 3.—Cane Pieces. Fig. 4.—Gummed Calico Arrangement, etc. Fig. 5.—Tail.

Pitch.—M. (*Bishop Auckland*) writes to J. J. (*Barrow-in-Furness*) (see No. 171, page 238):—"The following recipe is given in Vol. I. of WORK: 9 lbs. of emery or fine brick-dust and emery in equal parts, 2 lbs. pitch, 1 lb. resin, 1 candle, or its equivalent in tallow."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—READER OF "WORK"; J. B. (*Manchester*); A. F. (*New Ross*); H. K. (*Hulme*); E. B. (*Bexhill-on-Sea*); D. W. H. (*Dukestown*); W. G. (*Leeds*); A. M. (*Glasgow*); T. W. D. (*Glasgow*); R. G. (*Neath*); J. W. B. (*Huddersfield*); H. R. R. R. H. (*Ashby-de-la-Zouch*); W. C. (*Harlow*); J. B. (*Glasgow*); J. G. (*Edinburgh*); D. G. (*Wallsend-on-Tyne*); W. H. S. (*Southampton*); R. D. T. (*Marylebone*); S. (*Lower Clapton*); R. A. R. (*London*); A YOUNG READER; G. & G. (*Southport*); R. W. B. (*Harebell St.*); READER OF "WORK"; S. R. (*Nottingham*); J. H. A. (*Southwark*); H. T. H. (*Thirsk*); DYNAMO; G. P. (*London*); BIRKBECK COMPANY; HEATHFIELDS; J. L. (*Wimborne*); J. W. N. (*Glasgow*); E. E. (*Northampton*); A. F. (*Halifax*).

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A Suggestion not illustrated will have an equal claim in the competition provided the description be sufficiently in detail to convey a full idea of the article suggested.

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The Editor of WORK will supervise the judging of the Suggestions, and the selection as determined upon is to be final.

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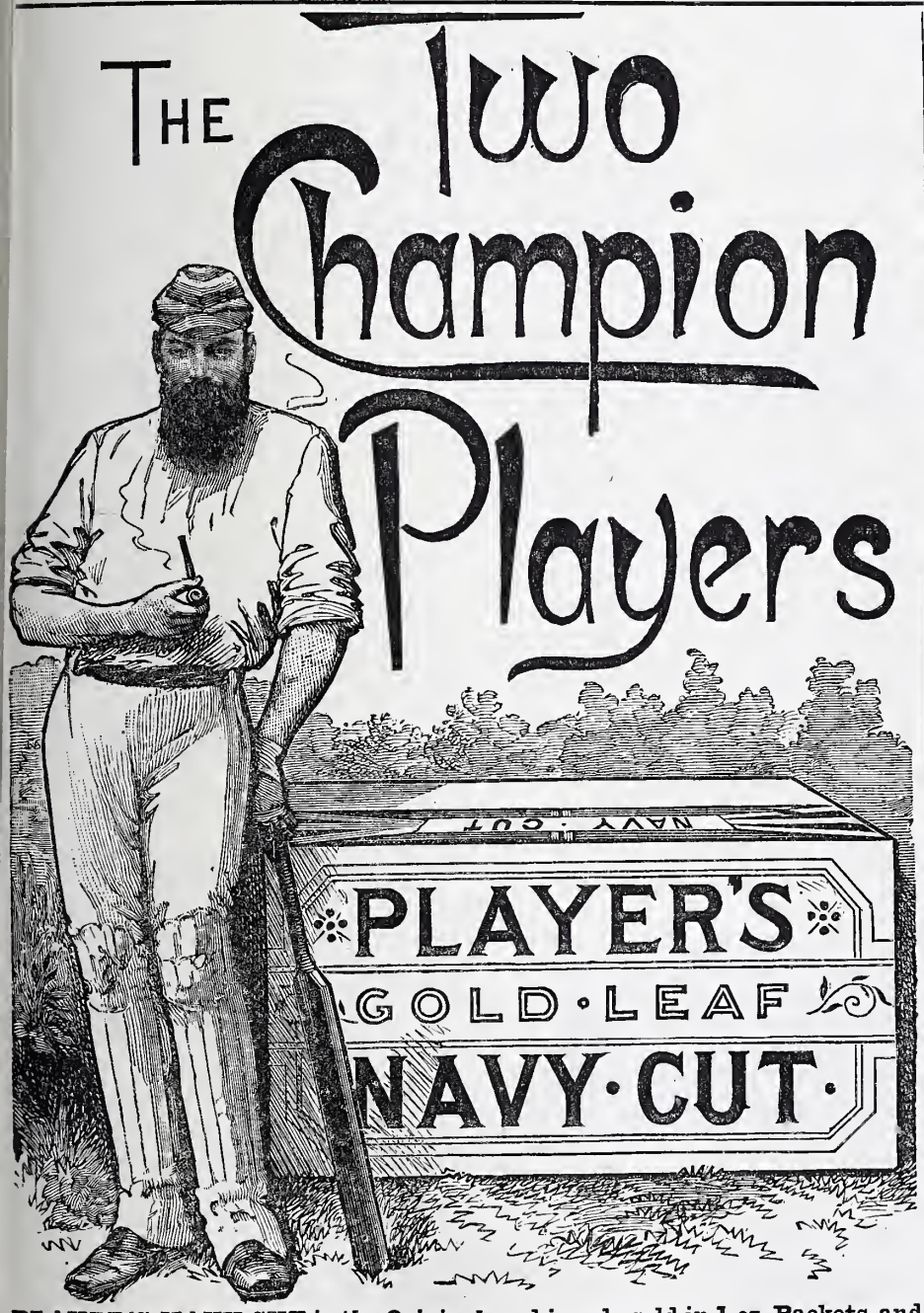

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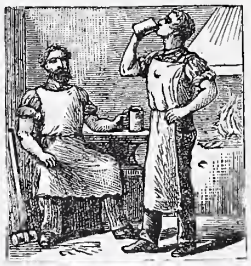

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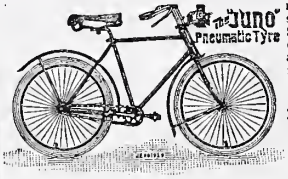

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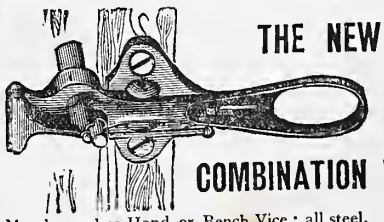

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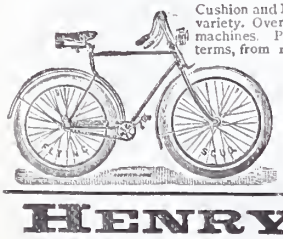

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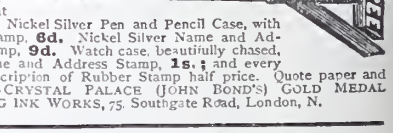

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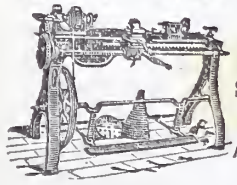

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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Vol. IV.—No. 176.] SATURDAY, JULY 30, 1892. [Price One Penny.

WORK WORLD.

A new vibrating sheep-shearer has been constructed, and an extensive plant put down in Sheffield for the manufacture of the appliance. By its aid a long-woolled horned sheep, one of the most difficult animals to shear, can be denuded of its wool in from two and a half to three minutes.

* *

A carpet costing £200,000 decorates the treasure room of the Maharajah of Baroda. It is about 10 ft. by 6 ft. in size, and is made entirely of strings of pure pearls, with a centre and corner circles of diamonds. This useless article took three years to make, and was one of the mad freaks of Khande Rao, who intended to send it to Mecca to please a Mohammedan lady.

* *

The superior conductivity of mercury over water renders it more rapid in action as a cobling agent, and it is, therefore, suggested as a medium for quenching small drills and other tools when heated for hardening; the object plunged into the liquid metal must be held down in it, as, if released, it would float, mercury having about twice the density of steel.

* *

As a proof of the Japanese aptness as engineers, we note a recently invented patent recoil mounting for three- and six-pounder Hotchkiss breech-loading guns. Two prominent English engineers have been trying for the last three years to perfect an invention for answering the same purpose, viz.—operating the breech mechanism so that the gun is unloaded automatically.

* *

Engineers, gaugers, and others when testing for hole accuracy, frequently smear the mandril gauge with a fine film of oil, and, in testing, find the hole to be rather small. If the gauger would use clean tallow—which is a better lubricant than oil—he would find that the same gauge that did not go through the hole and oil will work easily with a tallow lubricant—an important difference where minute accuracy of boring is involved.

For drilling glass a drill may be made out of steel wire, getting the cutting edge like that of a stone drill, with the corners square and sharp. The drill is heated to a white heat, and dropped into cold water. It is then rotated in a drill-stock, with the cutting edge kept wet with a solution of camphor in turpentine. By this means a hole can be cut through glass ⅜ in. thick in about one minute. If the glass is thin, fix writing paper on each side with ordinary gum.

* *

Fibre has been tried on a tramway as a material for the gearing, the wheel teeth of the train connecting the electro-motor with the running axles being arranged to run in oil; this, however, has resulted in failure through the disintegration of the fibre, and metal wheels have been substituted. The object of using the fibre was to avoid noise. It might be worth while to try hornbeam for the teeth of the gear wheels.

* *

An electric railway is projected from St. Louis to Chicago, 250 miles. This road will follow a straight line between the two cities, and will be constructed in six months, at a cost of $6,600,000. The cars will run on the trolley system by electricity, each car having a machine with a man in attendance. The speed is to be 100 miles per hour, the distance from St. Louis to the World's Fair being thus covered in two and a half hours.

* *

Bolts which have to sustain any great tensile strain should have their threads properly cut in the lathe. Threads formed by stocks and dies get their form partly by the cutting action and partly by the compression of the dies, hence the threads that are cut in the lathe *out of the* solid, as it were, are the best on account of the fibre of the material remaining intact. This would not be the case where part of the thread had been pressed into shape. The same rule should be observed with nuts that have to bear a great shearing strain in comparison to the sectional area of the thread.

* *

A fly-wheel that recently burst in America from the effect of centrifugal force upon its rim has been replaced by a wooden one. Wood has the advantage of possessing a greater tensile resistance, weight for weight, than metal, and it is found—after making allowances for additional weight of junction bolts and loss by joints—that the ratio of the limiting, or bursting, velocities of wheels made of ash is to that of iron as 2·63 to 1, and the ratio for hornbeam as 2·95 to 1. The disadvantage of wood for this purpose lies in the amount of labour consumed in building up the wheel. Steel is twice as strong as cast-iron in its resistance to centrifugal force.

* *

Satisfactory experiments have been made on copper-plating sheet zinc for building purposes. The zinc combines well with copper, and can be coated by either galvanic or ordinary process. One part of refined verdigris and twelve parts tartar are dissolved in twenty-four parts of water, and, when boiling, three or four parts of Spanish white are added. The dark blue liquid is filtered off from the precipitate formed, and can be used either as a bath for the sheet zinc or for the production of a copper-plating paste. To coat an immovable zinc object with copper, the article, after being cleaned, is painted with the copper solution and chalk compound, and, after drying, brushed.

* *

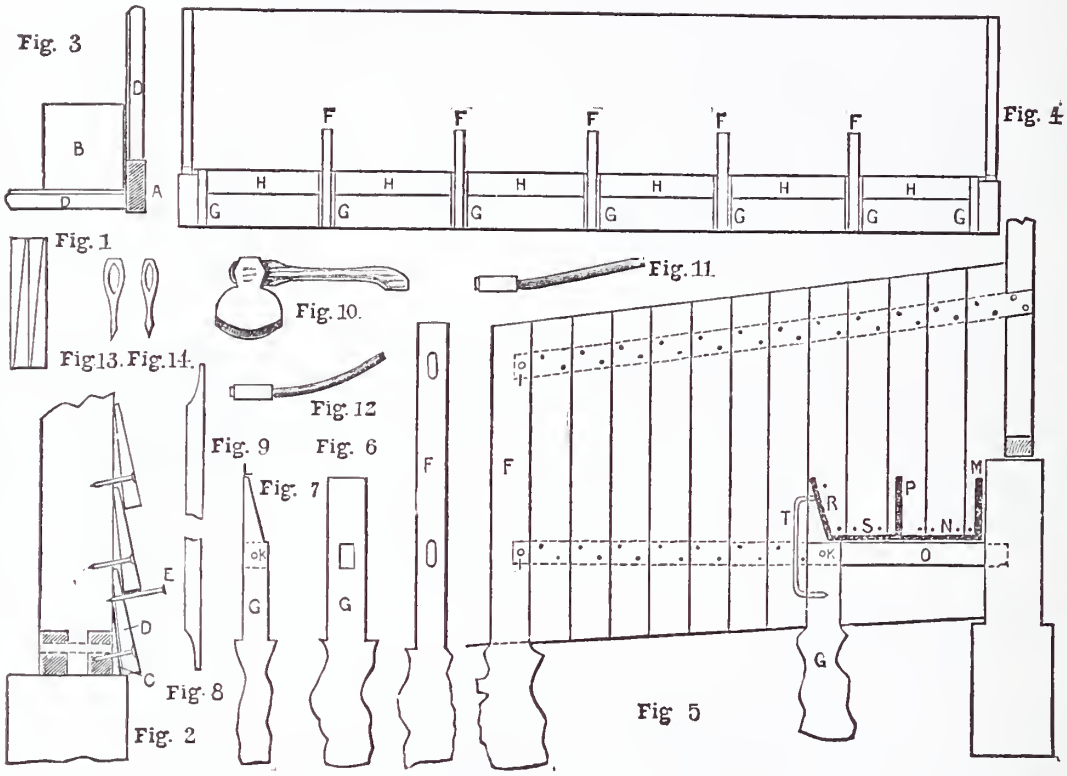
Instantaneous photographs of the lips of a speaker, reproduced so that a deaf-mute can understand what has been said, are to be improved by a process and an invention called the "phonoscope." The changes of the lips in speaking are so rapid that fifteen photographs a second are required to give a good result. Moreover, several sets of images for the same phase are taken, so that nothing essential should be omitted. The whole head and bust of the speaker is photographed so as to get the benefit of the expression. In the phonoscope the positives are arranged around the periphery of a disc which is rapidly turned by a handle. A second disc, having a single window in it just opposite the plates, is also rotated by the same handle, but at a much higher speed than the other. A beam of sunlight illuminates the plates from behind. This all perfected, we shall possess veritable "speaking likenesses"; the family album will contain photographs which will not only smile, but speak, or appear to speak.

COUNTRY CARPENTRY: A COW LODGE OF WOOD.

BY CHOPSTICK.

In my paper in No. 169 I described the framing of cow lodge, and I cannot do better than devote this chapter to the inside fittings of the same; but before commencing on them we will cover the woodwork outside, as it was left as a skeleton. This can be described in a few words, as it will be weather-boarded, as it is called; and though familiar enough to the country carpenter in the south, my northern readers will most likely never have seen it. And I would recommend them to adopt the fashion at once, as there is nothing to beat it for warmth, dryness, cheapness, or durability.

The boarding is cut feather-edged, as it is called—that is, about 1 in. thick at one edge and only ¼ in. at the other. The usual way is to cut it out of 7 in. by 2½ in. battens (red deal, mind; not spruce), each batten making four boards, by cutting it as shown in Fig. 1, which is a section of batten after being sawn. Before commencing boarding, the "stops" must be put on each post. These are shown in section in Fig. 3 at A, B being the post. They are usually about 3 in. by 1½ in.; and by nailing them on the post, so as to project 1½ in. over one side, they form the stops for the boards running both ways. Having fixed all the stops, cut out some taper pieces about 6 in. long, tapering from ¾ in. to nothing, and nail them on the sills at intervals of about 18 in. These are to cant out the bottom board (one is shown in its place at C, Fig. 2). When these are fixed the bottom board can be nailed on, keeping the side which is square with the thickest edge inside—that is, towards the framework—and placing the nails about 1 in. from bottom edge only. Do not nail the top edge. Of course, the boards will need splicing, as they will not be long enough to reach the whole length of building: a square butt-joint will do, but it must be on a quartering, so that both ends can be nailed securely; and do not splice two following boards at the same place. We have now fixed one board the whole length of the lodge (as D, Fig. 2). Now measure up 5¾ in. from bottom edge of board, and stick in a nail temporarily (as at E, Fig. 2) at three or four places in the length of lodge, having one about 1 ft. from each end, and the others about equal distances between. These are called "tack" nails, and are used to lay the next board on while it is marked to the length, and afterwards nailed. Each successive board is put on in the same way, drawing the "tack" nails out as we go up; and when you once get into the way of working, it is astonishing how much ground—or, perhaps I should say, how much framework—can be covered in a day. In nailing the boards on, the nails should be placed so as to just clear the edge of the board underneath, as if they are driven through both boards, and then the boards shrink, one or both is bound to split; whereas, if only one is nailed through, it gives a chance for them to shrink or swell without doing any damage.



Cow Lodge of Wood. Fig. 1.—Batten cut into Weather-boarding. Fig. 2.—Detail of Weather-boarding when fixed. Fig. 3.—Plan of ditto, showing Stop. Fig. 4.—Elevation of Stalls and Manger. Fig. 5.—Side Elevation of Pen, showing Section of Manger. Fig. 6.—Pen-Post. Fig. 7.—Manger-Post (Front). Fig. 8.—Ditto, ditto (Side). Fig. 9.—Rail, showing Ends. Fig. 10.—Broad Axe. Fig. 11.—Right Shape of Handle (Sideways). Fig. 12.—Wrong Shape of ditto. Fig. 13.—Section of Axe, showing Edge ground the wrong way. Fig. 14.—Ditto, ditto, with Edge ground the right way. A, Stop fixed to Corner-Post; B, Corner-Post; C, Taper Piece to cant Bottom Board; D, Weather-board; E, Tack Nail; F, Pen-Posts; G, Manger-Posts; H, Manger; I, Pins in Pen-Posts; K, Ditto in Manger-Posts; L, Bevel on Manger-Posts; M, Back-board of Manger; N, Bottom of Back Manger; O, Bottom Rail; P, Division Board of Manger; R, Front of Manger; S, Bottom of Front Manger; T, Iron Slide.

I think this is sufficient instructions for the weather-boarding; so we will proceed with the inside stalls and mangers, which, though simple enough to those who have been brought up to it, as I have, would be rather perplexing to a novice who had to take his instructions from one of the old style of farmers, whose opinion of him would not be very flattering if he did not understand at once what was required of him.

The lodges are usually divided into spaces to hold two bullocks each: about 5 ft. being the proper distance, though some will have larger stalls. They should not be smaller, at any rate; and as the lodge under consideration is 30 ft. long, it will make six stalls of 5 ft. each, thus requiring five "pens," as the divisions are called. Fig. 4 shows the lodge divided into six stalls, F being the pen-posts, G the manger-posts, and H the manger. Fig. 5 shows one pen, and also a section of manger. It is not shown to scale, but will give a good idea of the look of the thing itself. The first thing will be to prepare the posts, and these I will suppose to be sawn out; though, as they often have to be chopped up, my paper on fencing will suffice for all jobs where that is the case, and I will not enter into it now. Therefore, take one of the long posts, and set out a mortise at 6 in. from the top, and another 2 ft. lower down (2 ft. between the mortises); then run a centre line down the *edge* of post, and bore two 1¼ in. holes for each mortise, placing the point of auger on the centre line, and letting the hole just touch the cross lines; then cut out the wood between the holes, and the mortises are finished (see Fig. 6). The size of mortises must be obtained by measuring width of rails, which is usually 4 in.; but do not get them too tight. All the long posts must be mortised in the same way, and a ¾ in. hole bored through each mortise (see Fig. 5, I, which also shows how far the posts should be mortised in).

The short posts must now be prepared. First measure the width of manger-board, which will most likely be 11 in.; if so, make the mortise that distance down from the top, and through the posts flatways—not in the edge, as before. These mortises must also be large enough for the rails to slide through easily (see Fig. 7). When all these are mortised, and pin-holes bored (K, Fig. 5) through centre of mortise, they must be cut as in Fig. 8. The bevel should be about 3 in. and the top edge at L about ¾ in., letting the bottom come what it will. The bevel in all the posts must be alike, or the manger will look bad when finished. The dotted lines in Fig. 8 show the mortise. Besides the five posts for pens, we also require two smaller ones for the ends, to fix the manger to. These must be mortised in the same way, but with small mortise, as in the pen-posts, F; but the top will require cutting the same as the other manger-posts. The rails must now be cut to the right length (the top ones) and "ended"—about 6 ft. 6 in. will be right—and they are chopped (as in Fig. 9) with the axe; but it must be noticed before doing this where the pens come, as some of the rails may come to mortise into

the quartering, and some to nail on. These latter will only require "ending" at one end. The bottom rails will fix in the brickwork at one end, so that they need not be cut yet to length, but can be "ended" at one end only. A few words as to how this "ending" should be done will not be out of place here, as, though it is easy enough to do it right, I never yet saw a novice who could do it properly. When done as it ought to be, the rail should fit the mortise the whole distance in, which it will do if cut as I have drawn it; but the tendency of most people is to cut it wedge-shaped, which is never so well, as there is a danger of splitting the post when driving it on, and, at the same time, it fits the mortise only at the extreme outside, and the consequence is, the pin has to bear the stress which should be borne by the rail. Another thing is, that while it is quite possible to make a bad job with a proper tool, it is quite impossible to make a good job with a bad tool. I have therefore, in Figs. 10 to 14, shown the difference between a good and a bad tool—in this case the broad axe, one of the most necessary tools for the country carpenter. The proper shape of this tool is shown in Fig. 10—both the handle and the axe itself; the weight of the latter should be about 5 lb., and the length of the former 2 ft. over all. The handle should be bent sideways (as in Fig. 11), the bend being close to the axe-head, and *not* a continual curve (as Fig. 12); the blade of axe should be ground on both sides (as in Fig. 14), and *not* on one side only (as Fig. 13).

I will not take up more space with the reasons for this here, as they will be given in a future paper; but I think it as well to just give an idea what a proper axe is while showing how to end the rails. The holes for posts should now be dug—the top rails will give the right distance from back of lodge; one long post should then be placed in its hole, which should be deep enough to leave 4 ft. of the post out of the ground; then level across from the bottom mortise to the brick foundation, to find the place to cut the hole for that end of bottom rail. All the holes can then be cut, the courses of bricks forming a guide for height, as they will most likely be level. After these holes are all cut, measure up 3 ft., and make the mortises in quartering for top rail, where they come right; but if none of them come right for mortising into the quartering, a line must be made along the whole length, to serve as a guide to nail them to. The two pens nearest the ends of lodge can now be put up. Place the manger-post in its hole first, then slide the bottom rail through the mortise into the hole in the brickwork made for its reception; then put the pen-post in its hole, and put the top rail in its mortise at back of lodge, and push the pen-post forward, guiding the rails into the mortises at the same time. See that the post is upright both ways, also that the rails are square with back of lodge, or parallel with end of lodge. The hole can then be filled up and rammed tightly, especially at the bottom of the hole, after which the pin-holes can be bored through the rails and the pins inserted. The bottom rail must also be wedged tightly in the brickwork, keeping it out of winding with the top rail.

The manger-post can now be fixed by pinning to the rail, keeping it the right distance from the back of lodge, so that the manger-boards come right without any cutting; for instance, if the boards are 11 in. by $\frac{3}{4}$ in., as is usual, the post must be just a full 2 ft. from the brickwork to where the front of manger is fixed at the bottom. This post can now be rammed up as before, though it is not obliged to be fixed so tightly as the other, as it is impossible for it to move.

This pen is finished, and the other end one must be put up in the same way. These two will then form guides for fixing the others, so that all the posts are straight along the front and all the rails level with each other at the top. The two small manger-posts can now be put up at the ends, with a short rail on a line with the other bottom rails for bottom of manger to lay on.

The manger can be fixed next—the section in Fig. 5 is nearly sufficient explanation for this—the back-board, M, being put in first, and fixed by driving a few nails into the joints of brickwork. The bottom, N, must then be fixed close up to M, nailing it firmly to the rails, O, then the central division, P; this can be nailed to the edge of N. Now the front, R, must be nailed to the posts; and, lastly, the bottom board, S, must be fixed to the rails, and the front must also be nailed to it along the bottom edge. This last piece will require bevelling on one edge to fit the front, as it is necessary that they should fit fairly well, or the corn will fall through the joints to the ground. It will be necessary to splice all the manger-boards, as they will not be 30 ft. long. M should be spliced just in front of the rails, so that when the boards are nailed on the splicing is covered; P the same; the others can be spliced anywhere on the rails and posts respectively. End pieces must be fitted into the mangers at each end only, as the pen-boards will form the divisions.

The pen-boards must be nailed on next, commencing each pen at the long post and finishing at back of lodge. Small cleats must be nailed to bottom of manger to fix the ends of boards to. The space under manger may be left open, as it is no use to waste time and stuff in boarding it. In nailing the boards on, do not place all the nails in a line along centre of rails, but put one at the top and one at the bottom of rail in each board, as I have shown in Fig. 5. There will then be no fear of the rail splitting, which it would be likely to do in the former case. Do not cut each board to the length as they are put on, but fit them to the bottom, and leave them about 1 in. off the ground; and when all the pens are boarded, mark them off with a straight-edge and cut them all at once. This is rather hard work, but it is much the best and quickest job. The slides, T, can now be put in. They are made of round iron, and have a ring on them to which the bullocks are tied. The ring is then free to slide up or down with the movement of the animal, thus keeping the chain tight and saving many a broken leg. Two of these slides will be fixed in each pen, one in each manger-post, so that in the lodge under consideration there are twelve required.

One thing I have omitted to mention—that is, all the posts and rails should have the sharp edges chamfered off where there is nothing coming to them, as sharp edges are dangerous for cattle to lie down on.

The cow lodge is now ready for occupation, as far as the carpenter's work is concerned; and I hope that the perusal of this paper may be of some assistance to those who, like myself, have removed far from where they learnt their trade, and who find, as I have done, that they almost need to be apprenticed again, so much does the work and the methods of doing it differ in various parts of the country.

In my next paper I shall deal with the preparation and putting up of rough or farm-yard fencing; and, as I have said, I will give any needy one advice in the "Shop" columns, if they will only ask for it.

HOW TO BIND BOOKS.

BY "U. S. TINKER."

How often is it that we amateurs wish that that paper-covered book or pamphlet had a stiff cover so that it would stand up in the book-case as other books do, and also a label on its back so that we could find it without having to handle over a pile of papers, pamphlets, etc., and in a great many cases it is the bottom one! My method of binding is very simple, and a cheap paper-covered book can be made to look quite as well as the cloth-bound books; and as cheap editions of a great many desirable books (with paper covers) are now published, the amateur can easily and cheaply bind such.

My experience has proved that the best paste to use is made from "gum tragacanth," to prepare which it is only necessary to fill, say, a two-ounce wide-mouthed bottle with the gum, and then fill up with water, and let it stand a day, when you will have a paste that will spread easily, keep well, and *stick*.

The first thing to do is to remove the paper covers from the book very carefully, and also the part that covers the back which contains the label or name of book. Then take some good print or book paper, and fold it to make two or four leaves exactly the size of book. Place similar fly-leaves on front and back of book, and paste the edge (back) on the book. Then take an awl, if book is not over $\frac{1}{2}$ in. thick, and put two or three holes about $\frac{3}{16}$ in. from back; or if it is put together with staples, as is quite common now, put the holes at same distance from back as they are. If the book is up to 1 in. thick, bore holes with a small broad gimlet or twist drill.

Now thread a large needle with some strong tow string, and draw it through each hole, letting it project about $1\frac{1}{2}$ in. in front and back of book; fray out each end, and paste it down to fly-leaves. Procure some straw- or paste-board about $\frac{1}{16}$ in. thick, and cut it exactly the size of book lengthways, and wide enough to just come to the holes through which the strings pass; then paste one on each side of book. For the back you will require some sized curtain stuff, which can be procured for a very few pence per yard, and window width. Red colour suits my fancy, as it looks well, but the taste of others may be different. Take a piece about 2 in. longer than the book, and wide enough to reach round back of same, and lap on each cover about $\frac{3}{4}$ in. Fold each over 1 in., or enough so that it will be exact length of book, and paste them. Then paste inside of book well, and place around back and into sides. Trim the paper covers so that they will fit front and back covers nicely, and paste them on; and if you succeed in saving the title from back of book, if it has one (if not, write one neatly and paste it on same), and then place between two smooth boards, and, with a heavy weight, press it for at least forty-eight hours until it is thoroughly dry, you will have a bound volume of which you need not be ashamed, and it will stand on its end in case as more expensive books.

Sometimes, when I have books in press, I

cover the edges with dyes, such as are used for colouring cloth; the neatest colour is red. Dissolve the contents of package in a four-ounce bottle, and you will have enough to last you several years, as it requires but a small quantity to colour the edges of an average-sized book. Put the colouring on with a camel-hair brush.

BOOT AND SHOE MAKING.

BY WILLIAM GREENFIELD.

THE WAY TO FIT THE WELTS—METHOD OF MAKING THREADS.

The way to fit the Welts.—With regard to the welts, you have them already divided into two long strips, and quite wet. I will here explain their further preparation.

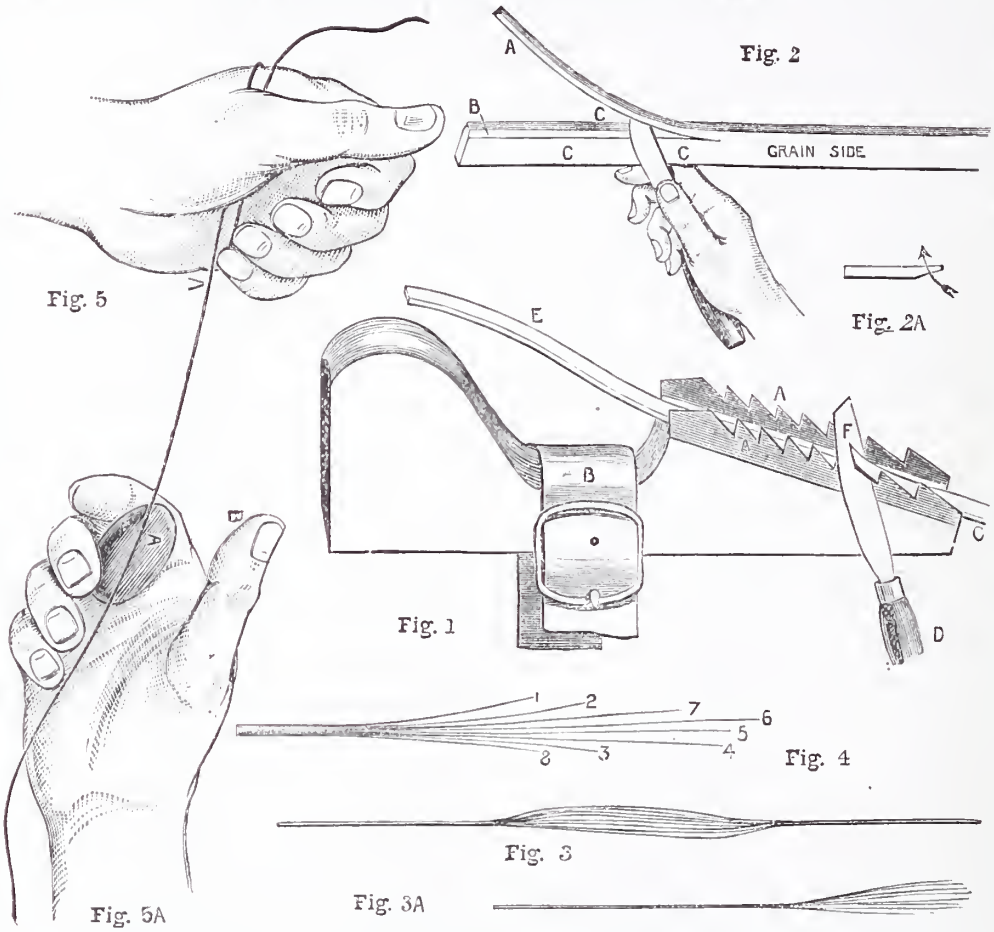
You first want what is called a welt mill. This is a tool that does not cost much, is a very handy one, and would be rather hard to make. Both sides of it have graduated steps, which must be equal one with the other on each side. It is a piece of brass or zinc, on a block of wood, having the brass standing up on each side and formed into steps, as shown at A, A (Fig. 1). It is placed upon the knee, and the strap must then pass under your foot, over your knee, and over the mill at B. Then, by heavily pressing down the toe, you will be able to hold the mill firmly on your knee. This is generally done on the left knee. Then you want your quite sharp knife, with a keen, not a rough edge. The welt must be laid on the flat of brass, between the two racks A and A, grain side downwards, with about a couple of inches hanging over the front, as at C. You then pick two of the ratchets, one on each side, and lay the knife in them, the edge being in their deepest corner, holding it there very firmly or you will blunt the knife should the pulling at the welt shake it about.

You pick the ratchets high enough to just admit of the blade of the knife pressing into the welt, in order that you may take off only the smallest possible shaving at a time. This is done by holding the knife, D, with the right hand, and pulling the welt, E, with the left until the shaving is taken off at F to C. Then reverse the welt, take C in the left hand, place the knife in the same position, and take a shaving off the remaining portion of the welt.

For most work, it is well to take the finest possible layer off the grain side, and this is very easily done by repeating the above process, this time with the grain upwards, and with the least possible extra pressure on the knife.

If the welts bought are of the proper substance, this will be all that it is necessary to take off of them; but if you want them lighter take them down from the flesh side by the same means as above described, going down a rack at a time (one each side) till you get them the required substance.

The welts next need to have an angular piece taken off from the grain side the whole way down. This is about two-thirds of the way through and about $\frac{3}{16}$ in. wide (as A in Fig. 2).



Boot and Shoe Making. Fig. 1.—Welt Mill, showing how to thin Welt down to Substance required and Position of Knife. Fig. 2.—Welt, showing Position of Knife, stuck in Board to take the Strip off one Side. Fig. 2 A.—Transverse Section of same, Arrow showing place for Stitch. Fig. 3.—Flax or Hemp, with Fibres untwisted ready to break asunder. Fig. 3 A.—Strand broken off ready to form Taper. Fig. 4.—Eight Strands, showing the Position they occupy in forming a Taper. Figs. 5, 5 A.—Showing how the Thread is waxed, and the Position of both hands in doing so.

This proceeding will show the welt when turned over—that is, grain side down—with an end (see Fig. 2A); and this is the position in which it is held while it is being sewn in for the boot. The arrow indicates where the sewing-awl has to pass through.

If this piece be skived for about 2 in. at B (Fig. 2), the best way to take the remainder off is by digging the point of the knife into the cutting-board, at such an angle that the welt can pass between it, the board, and the first and second joint of the forefinger of the right hand. Then, when the welt is pulled at B, with the left hand, this angular piece will come clear off. The position of the knife, hand, and welt can be seen in the diagram.

Now suppose the boot to be between your knees, toe towards you, you start sewing in the welt at the left corner of the seat, up the waist. If it be the right boot, this side of the waist (the inside) will be the longest. Whichever it is, it must be measured from this point—namely, with the welt—to just the corner of the joint of the sole. Then, marking the joint at this point, in order to know the length it is to be in the waist, you skive the welt down for this distance to about half the substance, taking the skivings off from the grain side. Then the welt is ready for sewing in.

Method of making Threads.—In what I have already written referring to threads (or waxed ends, as they are so often called), I have spoken of "No. 9 Patent" flax. It is well to mention here that this is very nice for stitching, or any light sewing. Hemp cannot well be used for such work, although for very heavy work hemp is best. There are many kinds of hemp, all cheaper than flax. As my readers will constitute many novices, and practised hands know the uses of hemp, I shall deal only with No. 9, it being both the easiest to make the threads with and also the easiest to use after.

You need a small tin box—any box will do, so long as it has a lid and is large enough to take the ball of flax. It must have a small hole in the centre of the lid, and previous to putting the ball into the box you must push out the centre of the ball, in order that you may find the end of the flax. Then put this end through the hole in the lid, and fix the lid on to the box. Do not start a ball of flax or hemp from the outside, or before it is half used up it will get into a tangle and be spoilt.

I will first describe how to make welt threads. The stitching and heel will be made in the same way, but their number of strands (which I will explain later on) will be different. For sewing gents' boots (if they are of a medium substance) you will need about fifteen strands; if ladies', about twelve; if stouter work, then eighteen and fifteen; if lighter, thirteen and ten.

Place the box at your right-hand side whilst sitting. Take the end in the right hand, and run all flax (as you want it) through the thumb and fingers of the left, so that if any irregularity presents itself you can take this out or throw it away. If it be only a small lump it can be picked out with the teeth, holding either side with each

hand. To start, hold the flax about 6 in. from the end with the left hand; lay it on your thigh about 9 in. from the right knee, and roll the end down to the knee with one long sweep of the right hand. When at the bottom, press it tightly on to the knee, and give the flax a jerk with the left hand. This untwists the fibres. When asunder each end will be quite flossy (see Fig. 3), and when smoothed down will be as shown in Fig. 3 A.

The end piece is thrown away, and you measure off the length the thread is required to be. This is generally about three yards long; less is better, as of course every time they are pulled through to set a stitch it helps to wear them away.

The length can be judged by putting out the two arms nearly as far as they will go, and then again about half the distance, or from one hand to the nose. At this place untwist and break as before, this time putting the two ends together, but not exactly level with each other. You now draw the two strands through the left hand, leaving the same on your left side, while you again unravel and break it; and this is repeated each time you add a strand, breaking it off at irregular distances at each end so as to form the two tapers which are to receive the bristles. By looking at 1, 2, 3, 4, 5, 6, 7, and 8 (Fig. 4), you will see how the taper is made; for when you have sufficient strands this will twist into a very fine taper.

A wetted and twisted thread is not so strong as a waxed and twisted one; but a wetted thread is very even to use and easy to wax; therefore, I would advise first the making of one or two in this way. Draw the thread through a little water and then through the thumb and finger, to take the surplus water off; put the centre of the thread over either a hook in the wall or a smooth nail in the window-sill, then stand up, and, with your right foot on a stool or chair, and holding one end or taper of the thread with three fingers of the left hand, leave the thumb and forefinger free, and with these hold the other end, about 8 in. or 9 in. from the point. You put the point on your knee, as you did in casting* off the thread, and twist it in a similar way, holding it while you twist it by the pressure of the right hand upon the knee. Then let go, with the thumb and finger of the left, that the twisting may go quite up the half.

Do not twist too much—about a dozen times ought to be enough—and this you repeat exactly on the other side, being careful each time not to tangle the tapers or twist them so near the end as to twist them off.

This done, put one end in each hand, letting the left go forward and the right backward; then reverse them so that about two feet pass round the nail or hook, and that the centre of the thread may take a little of the twist from each side, and retain it itself. Then put the two ends together and hold them in the left hand very tightly, while briskly rubbing them down with a piece of old white rag. This should make it smooth and rather wiry. A limp thread is not nearly so nice to work, and is caused either by the thread not being wet enough when rubbed down or not twisted enough, or it may be that it was not rubbed till dry.

In taking it off the hook, see that it does not get twisted up and tangled; and when off the hook, just pass it through the thumb and finger to rub out any surplus twist, which it would otherwise hold and give trouble while waxing.

The waxing is not difficult to learn, though rather unpleasant until you get the knack, since it sticks to the hands. I will tell you the way (without holding the wax in a piece of leather) that you are most likely to obviate this.

Now wind the thread once round the left hand, and let one end hang over each side as at Fig. 5, in which A should be about two feet long. Then lay the wax (a piece a little larger than a walnut) on the first and second finger of the right hand, as illustrated at A. Put the left hand well up in front of you and the right just underneath it. Lay the end of the thread on the wax at A; place the thumb, B, over it to keep it steady, and pull the right hand down, letting the thread pass over the wax while it is in that position until you liberate the thread at the taper. This you do two or three times, until it is nicely covered with wax.

Now take it off the hand and wind the part round that has been waxed, and do the next two feet, and so on till the whole is done; but every time you draw the wax down you will find it best to just lightly rub the wax on the knee—not sufficient to take the hardness out of it, but enough to prevent it adhering to the fingers.

For a waxed and twisted thread, you cast it off as shown above. Do not wet it, but wax it instead, and then twist as above explained, and rub it down, not with rag, but with a piece of upper leather. A piece of calf is best for this purpose, as it has oil-dressing in it enough to make it work easy and well over the thread. This you rub, up and down, the length of the half or double thread. Separate the two ends and rub the twist out as with the wetted one; and when you have seen that the tapers are well waxed, you can twist their extreme ends a little more on the knee, and they are ready to receive the bristles. This point I want you to well understand, in order that you may not be troubled every stitch with one or the other bristles coming off.

* The process of putting the strands of hemp or flax together. When the last strand is in it is "casted."

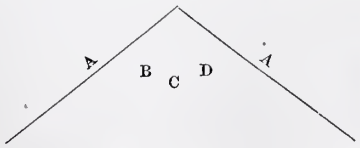
PHOTOGRAPHIC EXPERIMENTS.

CURIOUS, AMUSING, AND INSTRUCTIVE.

BY WALTER E. WOODBURY.

Photographing a Crowd of Three—Frost Pictures—Photographing Colours correctly—Pictures in any Colour—A Simple Method of Enlarging—Distorted Images—A Picture in a Bottle.

Photographing a Crowd of Three.—For this purpose two large unmounted mirrors, at least 8 ft. high, are required. The best plan is to take your camera to some manufacturer of large mirrors and obtain his permission to make use of two on his own premises for a short time. In a well-lighted room place the two mirrors (A, A) at right angles to each other as shown in the accompanying sketch,



and arrange three persons (B, C, D) in the recess thus formed. The effect is immediately apparent to the eye. The three individuals will be multiplied into a crowd of thousands and thousands, increasing in number as they are apparently distant away. The camera is then brought into position, and a lasting photograph can be made of this peculiar sight.

Frost Pictures.—The beautiful and fantastic designs made by King Frost are too well known during cold winters to need any description. The following is a method by means of which lasting pictures can be made of the beautiful but fleeting designs. On a very cold, frosty day, coat a glass plate with a plain collodion, and when set immerse it in water containing a little salt until all greasiness has disappeared. Then place the plate in a cold place until a frozen image forms itself. When this takes place, fix the plate on to a board covered with black velvet, and make a negative with a slow and thickly coated plate.

Similar crystallic designs can be made at any time by coating a plate with a saturated solution of Epsom salts, and allowing it to dry, which it does in the most beautiful crystalline forms.

Photographing Colours correctly.—The principal defect in modern photography is its inability to reproduce colours with their correct relative value. Thus, for instance, with a light yellow disc on a dark blue ground, the yellow appears to be considerably lighter than the view, but in a photograph it would appear dark on a light ground. In photographing coloured objects the following method of isochromatic photography is greatly to be preferred. Take an ordinary dry-plate, and bathe it for a couple of minutes in a solution of—Liquor ammonia, 1 part; water, 100 parts. Then without washing immerse in—Erythrosine, 1 part; water, 10,000 parts; ammonia, 100 parts.

The isochromatic effect is considerably enhanced if a stripped collodion film containing a small quantity of aurantia dye be interposed between the lens and the object photographed, or a piece covered over the diaphragm slot. Great care must be taken in developing plates of this kind, as they are thus rendered sensitive to the yellow and red rays.

Pictures in any Colour.—These can be produced by what is known as the powder or dusting-on process. The principle of the process is this:—An organic, tacky substance is sensitised with potassium bichromate, and exposed under a reversed positive to the action of light. All these parts acted upon become hard, the stickiness disappearing according to the strength of the light action, while those parts protected by the darker parts of the positive retain their adhesiveness. If a coloured powder be dusted over, it will be understood that it will adhere to the sticky parts only, forming a complete reproduction of the positive printed from. Prepare—Dextrine, ½ oz.; grape sugar, ½ oz.; bichromate of potash, ½ oz.; water, ½ pint.; or, saturated solution bichromate of ammonia, 5 drachms; honey, 3 drachms; albumen, 3 drachms; distilled water, 20 to 30 drachms.

Filter, and coat clean glass plates with this solution, and dry by a gentle heat over a spirit lamp. While still warm, the plate is exposed under a positive for from two to five minutes in sunlight, or from ten to twenty minutes in diffused light. On removing from the printing frame, the plate is laid for a few minutes in the dark in a damp place to absorb a little moisture. The next process is the dusting on. For a black image Siberian graphite is used, spread over

with a soft flat brush. Any coloured powder can be used giving images in different colours. When fully developed, the excess of powder is dusted off and the film coated with collodion. It is then well washed to remove the bichromate salt. The film can, if desired, be detached and transferred to ivory, wood, or any other support.

A Simple Method of enlarging.—If we have an ordinary gelatine negative, say, of half-plate size, and require to enlarge it to a whole-plate, the simplest plan is to thoroughly wash it and immerse in a solution composed of citric acid, 2 oz.; hydrofluoric acid, 1 oz.; acetic acid (glacial), 1 oz.; glycerine, ½ oz.; water, 20 oz. The action of the hydrofluoric acid will be to detach the film from the glass, while the other acids will cause the film to spread out considerably; the action being even all over, the image is completely enlarged. It is then carefully removed and washed in plenty of clean water, after which it can be transferred to a larger piece of glass. The action is sometimes to weaken the negative in density; it is therefore occasionally necessary to intensify it.

Distorted Images.—Take a portrait negative that is no longer of any use, and immerse it in a weak solution of hydrofluoric acid. The film will leave the glass. It is then washed and returned to the glass support. By stretching the film one way or the other, and allowing it to dry in this position, the most amusing prints can be made.

A Picture in a Bottle.—Get a glass-blower to make an ordinary shaped wine-bottle of very thin and clear class, and clean it well. Next take the white of two eggs and add to it 20 grains of ammonia chloride dissolved in 1 drachm of spirits of wine, and ½ oz. of water. Beat this mixture into a thick froth, and then allow it to stand and settle. Filter through a tuft of cotton-wool, and pour into the specially made bottle. By twisting the bottle round, an even layer of the solution will deposit itself on the sides. Pour off the remaining solution, allow the film in the bottle to dry, and again repeat the operation.

The next operation is to sensitise the film with a solution of nitrate of silver, 40 grains to 1 oz. of water. Pour this in and turn the bottle round for a few minutes, then pour off the superfluous solution and again dry. Hold the neck of the bottle for a few seconds over another bottle containing ammonia, so as to allow the fumes to enter it. Printing is the next operation; this is accomplished by tying a film negative round the bottle, and covering up all the other parts from the light. Print very deeply, keeping the bottle turning round all the time. Toning, fixing, and washing can be done in the ordinary way by filling the bottle up with the different solutions. The effect is very curious, and can be improved by coating the inside of the bottle with white enamel.

REPAIRING SHEET METAL AND OTHER HOUSEHOLD ARTICLES.

BY J. L.

Sheet metal articles and their repairs are legion, and they need a fair amount of knowledge of many trades; they ought, therefore, to be exactly suited to the manipulations of the amateur. It is nevertheless a fact that the houses of the latter individuals are not by any means notable for absence of dilapidation. The drawing-room is often full of pretty and well-executed specimens of turnery and fretwork, but handles are off doors, kettles innocent of lids, and water-cans deposit part of their contents upon floors and tables. Now, such things are easily remediable, but not being exactly pleasant and interesting work, and often being, in addition, rather unclean work, it is very generally shirked, and eventually falls into professional hands.

Of the several operations necessary for household repairs, the use of the soldering iron and manipulation of sheet metal stand prominently forward. It is an easy matter to acquire the necessary skill, and yet easier, maybe, to make a very ill-looking and bungling job of this particular kind of work. The way to perpetrate a bungle is to use a soldering-iron insufficiently heated and badly tinned. I know of no surer method of wasting solder and temper and doing thoroughly bad work.

At best, it must be confessed that a soldering-iron is a top-heavy and awkward tool to use, but no available substitute exists except the blowpipe, and this needs much practice to use efficiently, and for most of the household repairs is not available at all. The usual form of soldering-iron is that illustrated at Fig. 1, and it may be had small and neat for very light jobs, or larger and heavier for general work. The smaller one may be had, with a box of resin and a strip of solder, at 1s., on a card with directions for use. This is useful enough for very light work, but the iron is too small to retain the heat long, though very convenient where gas is available for heating it.

For general work the larger tool becomes a necessity, but the form shown in Fig. 2—which is a "hatchet-shaped" soldering-bit—is, I think, easier to manipulate than the straight one. In all cases the bit is a lump of copper held in an iron socket, except that used by plumbers, which is merely a bulb of iron extending into a handle and untinned, because it needs a red heat, or nearly so, when in use.

The copper should be filed up to a blunt point in Fig. 1, but of triangular section, or to a blunt edge in Fig. 2; or No. 1 may be four-sided and one side bevelled off towards the point, but neither point nor edge need be at all sharp, but only approximating to the figures named.

The tinning may be done in two or three ways. The iron is heated to faint red, screwed in a vice, filed rapidly to clean the scale and brighten it, and it may then be rubbed on a lump of sal-ammoniac, and applied to a bit of solder on a sheet of tin or iron or on a slab of wood, and rubbed about until it takes up a coating of the solder; or take one of the common bricks which has a recess made in it to hold the mortar, and put into it a little resin and a lump of solder, and rub the iron in the hollow. I prefer this to all other methods, as the rough brick keeps cleaning the surface of the iron, which rapidly picks up the tin; and if from any cause the operation is difficult, a few drops of Baker's soldering fluid will almost instantly set matters right. The brick, with the solder that remains, is always ready for use, and, indeed, in actual work I very generally use it to contain the solder that is being used. Speaking here of Baker's soldering fluid, which is widely known and used, it has the fault common to all such solutions of chilling the iron, and if resin or sal-ammoniac is found to answer, either is, for this reason, preferable; but there are many cases in which the fluid preparations are essential to success.

Before we can be in a position to commence repairing metal work—which in general will be sheet metal (tin, brass, copper, and zinc)—a few very inexpensive tools are needed. I do not suggest an outfit of tinman's tools, but appliances that will answer for the repairs commonly needed. First, a boxwood mallet, with one end rounded and the other flat, about 3 in. in diameter—a tool easily procurable or easily made by any turner; secondly, a block of hard wood (boxwood for preference), hollowed out on one side with a hemispherical cavity also about 3 in. in diameter, or larger if the wood will allow it. It will be convenient to have one still larger, for which beech will serve very well. Neither recess need be deep; an inch in perpendicular measure will generally suffice, as the purpose of these blocks is to round up such tin-plate articles as saucepan or kettle lids, of which the curvature is generally slight. The bottom of these blocks may either be level, to stand on the bench—kept steady by a couple of nails driven into the bench, or better, by a carver's screw passing through the bench—or the bottom part may be sawn so as to produce a tenon, to be secured in the leg-vice.

In case the reader may be unacquainted with the carver's screw, it is presented in most catalogues. The tapered end is screwed into the block below, and the tail part passes through a suitable hole in the bench, and is secured by the washer and bow-nut. There is no simple tool of more use in an amateur's workshop.

A blacksmith must be called in to make a hatchet-stake and a beak-iron—the first to enable the workman to turn down the edge of a piece of tin in forming a seam, the other for folding taper tubes such as that of a coffee-pot spout or saucepan handle, or the spout of a lamp-feeder or oil-can. The hatchet-stake, curved horizontally (Fig. 6), will also be required for putting new bottoms to saucepans, water-cans, and such like articles.

I premise the possession of vice, pliers, hammers, and a bench, but there will be needed a few assorted copper rivets, and a punch or two—flat at the end to punch the piece out—for making rivet holes. A pair of tinman's snips, or small shears, will also be needed; and with these alone most of the suggested repairs can be done.

The illustrations are: Figs. 1 and 2, soldering-irons (straight and hatchet); Fig. 3, snips; Fig. 4, a different form, intended for vice-work, and called shears (the snips will suffice for most jobs of mending); Fig. 5, a hatchet-stake; Fig. 6, curved ditto; Fig. 7, mallet; Fig. 8, beak-iron; Figs. 9 and 10, blocks (the second sawn to a tenon to be held in the vice). It will be plain that substitutes may be used for one or two of these (a lathe-rest with long T has been once or twice degraded to become a hatchet- or folding-stake, and I could tell a worse tale even than that); but so inexpensive are the proper tools, and so easily procurable, that it is much wiser to obtain them, and they are much easier to work with. Any good tool-shop (Melhuish, of Fetter Lane, for instance) will supply all the above as cheaply as a village blacksmith could make them.

Let us, however, get to work. The lid of the kitchen kettle has, as usual, come to grief, and Fig. 11 shows all that is left of it—viz., an elliptical bit of iron with a biggish hole in the middle, and slightly cupped. Now, the first consideration is, Can it be mended at all, and is it worth mending? Answer: No. The rim, you observe, has been eaten off by rust, and also a great part

of what was once the folded edge, and the hole for the handle is terribly enlarged from similar causes. But it is possible to make it serviceable for kitchen use (until a new one is made, at any rate), and the mode of doing so is simple. Lay the cover down on a piece of board half an inch thick or more, and draw a blacklead pencil-line round it. Cut out this with a keyhole or frame saw; or, if you have not such a tool at hand, saw round about it, cutting off the angles till the line is reached. Make another line ⅛ in. inside the first, and trim to this with chisel, rasp, knife, or any available tool; and then see if it will go into the mouth of the kettle. It should enter easily, as it will swell with the steam by-and-bye. Now it remains to attach this under the metal top, to take the place of the rim of tin that used to be there. Probably you will find that you cannot fasten it by nails near the edge, as it would split the wood, so we will use a single screw passed through the hole in the cover; but, as this is much too large, a washer must be cut to overlap the hole, and if the screw is passed through this, and screwed well home, it will at once secure the whole affair. But there is no handle, and the screw—a round-headed brass one by preference—is in the way as regards solder. Bend a strip of tin almost to a circle (Fig. 12), loosen the screw till the ends can be fixed under the washer, and screw down tightly. You have at once a serviceable kettle lid handle, and all complete without a drop of solder, and after a quarter of an hour's work. A touch of Aspinall or black varnish will give the whole a more decent appearance. This, remember, is a mere substitute for a better, or at any rate a more orthodox one, which may now have attention.

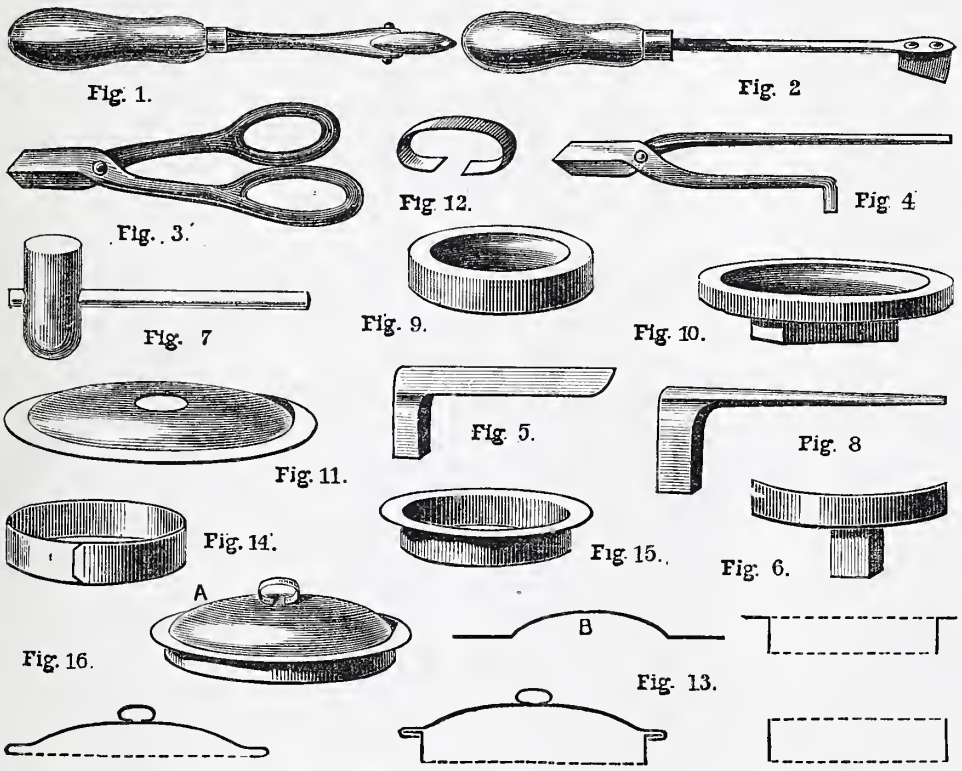
Take a sheet of stoutish tin plate and mark out an ellipse of the required size, using the old cover as a guide if it exists; but if not, a pattern can be easily cut out of cardboard, and transferred to the tin plate by scribing round it. Let it be a little larger than the original, which it will be seen has a folded edge, which will be required also on the new one. It will, moreover, contract it somewhat to make it of a hollow character if this is considered necessary—which, however, as a fact it is not. As a first attempt, the outer edge should certainly be left an inch wide all round, and the cover only hammered up to a small extent about the centre. It will then have the form of Fig. 16, A, seen in section at B. The cover thus partially shaped should be only large enough to overlap the orifice or mouth of the kettle ¼ in., of which overlap ⅛ in. is now to be turned over on the curved hatchet-stake, using the flat side of the mallet or pane of a hammer; but, though bent over, it is not to be beaten down close. This turned seam is, in fact, to hold the rim in place, as well as to give a neater appearance to the cover.

The rounding up or cupping of the central part is not difficult. It is only necessary to lay it on the hollow block and hammer it with the rounded end of the mallet, occasionally giving a few blows also to the edge laid upon a flat surface. It will soon be perceived at what part the blows are necessary to keep the work even, and the process should not be hurried, but carried on gently, so as to avoid risk of puckers along what is to be the flat border. A strip of tin is now to be cut for the rim which enters the kettle, about ⅝ in. in width and just long enough to lap a little when bent to shape. It should be bent round and tried on the kettle itself, and the lap fastened with a touch of solder. The edge has now to be bent all round at right angles to such a width as will allow it to enter the turned-in edge of the cover, which is then to be flattened close down upon it so as to hold it securely.

Fig. 14 is the strip bent and soldered; Fig. 15 the same with its edge turned out square; Fig. 16 the cover put in place, with the rim attached. To make it clearer, outlines or sections of these parts are added. It is not even essential to solder any part of a cover made in this way, as the rim, when once secured in the fold of the top part, cannot possibly get away from it by use, but a little solder is generally run round the fold, to add to the security of the parts. In soldering this or any tin work, let the iron be quite hot, but always below a red heat, which would at once destroy the tinning. Sprinkle a *little* powdered resin along the seam; pick up, by touching it with the heated iron, a bit of solder, which will hang as a drop upon the tinned surface, and transfer it to the seam. Hold the latter so that the tendency of the melted solder will be to run downwards, and it will follow the iron and be led along by it until exhausted, leaving a neat and thin layer and firmly uniting the parts together. A badly tinned soldering-iron will not pick up or lead the metal; and if insufficiently heated it will leave it in lumps, and no real union of the parts will be made. The metal on which the solder is to be spread needs to be itself heated to the temperature of the solder, so as not immediately to chill it; hence the difficulty of soldering thick pieces unless they are first heated over a fire or gas flame so as to melt solder when applied to them.

When mending is needed upon work that has become rusty or dirty, it must be well cleaned and then re-tinned by rubbing the iron upon it with solder and resin, or sal-ammoniac or Baker's fluid, until the surface is fairly coated again; but it is often very difficult to persuade the solder to deposit on such surfaces, and it may be more economical to throw the rusted articles away and replace them altogether by new ones. Baker's fluid will, however, conquer most of such difficulties, or the home-made solution of zinc in hydrochloric acid, which is nearly the same thing.

There has been of late years such an increase in tin goods, where wooden or cardboard boxes used to be the rule, that there is seldom need to buy new sheets for patching and small repairs. If biscuit tins, sardine boxes, and such like are preserved and cut open, the tin can be laid aside in the form of small sheets, circular pieces—which often fall into use just as they are—and clippings of various shapes and sizes, and very soon an ample stock will be secured. It is, however, as well to keep in stock a sheet or two of thicker metal, as some tins are very thin (especially some of the cylindrical ones), and these, although serving for small patches, are of no use for re-bottoming water-cans, saucepans, and articles in constant use. Many suggestions have already been given in WORK for the utilising of old tin—one of the latest being that canisters and milk tins should be cut into scoops, etc., for ladling out small quantities such as sugar, starch, pepper, etc. But beyond doubt the best use of all is that of turning it to account in the repair of metal jobs at home such as those I have indicated. Sheet metal work should interest the hobbyist as well as, say, carpentry; and the true worker must not always expect to find "kid glove" work.



Repairing Sheet Metal Articles. Figs. 1 and 2.—Soldering-Irons. Fig. 3.—Snips. Fig. 4.—Shears. Fig. 5.—Hatchet-Stake. Fig. 6.—Bottom Stake. Fig. 7.—Mallet. Fig. 8.—Beak-Iron. Figs. 9 and 10.—Hollowing-Blocks. Figs. 11 to 16.—Mending and making Covers of Kettle or Saucepan.

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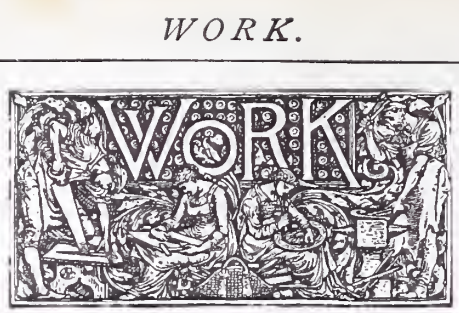

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ARE STRIKES ADVANTAGEOUS?—Whatever else the present times may be noted for, there is no denying that the fashion for strikes has grown to unprecedented dimensions. They are necessarily fearful things for the men who engage in them, and still more fearful for the women and children depending on these men. Yet we are sometimes told that these strikes are but the rumblings of approaching struggles of far greater magnitude and involving deeper issues than the question of a few halfpence more or less per hour for labour. The pretext for striking is generally against a reduction or for an increase of wages. Sometimes the men avert the reduction or secure the rise—for a time at least; sometimes, however, they fail, and they get dispersed in their search for employment elsewhere, or else go back to their former employer, with bitterness in their hearts and depressed spirits. The experience is not unknown, we fear, of homes being denuded of whatever articles could be turned into money during the struggle. Beneath all this are many untold tales of tragic intensity. Even the dockers and the 'busmen, though they nominally won, are yet, taken all round, no better off. Has, then, no benefit accrued from these bitter feuds between labour and capital? We believe that no direct benefit, to be at all compared with the suffering entailed, has accrued. Indirectly, however, these strikes have awakened the community to a sense of the hard lot of the workers, and the public mind is resolved that that lot shall be ameliorated. It is no longer possible now for the claims of labour to be neglected, and it is impossible to deny to strikes the credit for bringing things to this pass. This, of course, is a great achievement, but at what cost has it been brought about? Though we are far from the solution of our labour troubles, and though the methods of solution most loudly advocated contain many fallacies in them, nothing can now set back the labour movement. This being so, would it not be well to call a halt, to cease from striking, and to begin discussing? Strikes can do no more than they have done. What is wanted now is a practical scheme for a fair adjustment in our industrial relations, and schemes cannot be evolved while those who should be engaged upon them are fighting. The most important of all questions before the people of this country is that of restoring, preserving, and extending the trade of the country, and of finding a fair and equitable wage for the labour of the people. No legislative process is more pressing than this, and the first care of the new Parliament, or, indeed, of any subsequent Parliament, ought to be this labour and wages question. Upon its trade the prosperity of Britain depends; and where would trade be but for the workers?

FILTRATION OF WATER.—Experiments extending over a number of years, on the Zürich water supply, show that sand filtration affords no absolute protection against pathogenic organisms, for although this statement has been disputed, as also that the rate of filtration affects the bacterial inhabitants of the water, it is now proved beyond doubt that in some cases the water may take up organisms even from fresh sand. The refinements of laboratory research, useful as they are, are scarcely a practical guide in such cases as the filtration of water through sand. Had we microscopes of sufficient power, we should doubtless find animalculæ in the air we breathe and in that we expire. The filter beds used by our large water companies are satisfactory in their action, otherwise the death-rate of London would not maintain its low average. As a rule, fancy filtration is a failure; carbon is the favourite purifier, on account of its capacity for absorbing gases, and, by bringing them into close approximation with oxygen, rendering them innocuous; but on a large scale this cannot be applied economically. In point of fact, those who are rendered nervous by the accounts they read of the universally bacterial state of our surroundings, should boil their water and let it cool in an air-tight vessel before drinking it, unless they will take the trouble to read up a little physiology, and so learn that we have natural defences against these invaders of our health. Ciliary appendages prevent the access of dust to our lungs, and living organisms are destroyed by the digestive action of the salivary glands, liver, and other organs acting in connection with the stomach.

DECAY OF STONE.—Stones of homogeneous texture usually decay by surface erosion, but in some cases the surface becomes indurated, while the interior portions remain soft. In such cases, the exterior shell, so to speak, scales off, leaving the soft core beneath to undergo the same changes. Such stone is quite inapplicable for moulded work—such as banisters and friezes. Climate has also much to do with the decay of stone, and in England it has been noticed that the southern and western parts of our cathedrals yield, while the northern and eastern resist. There is one point that should be universally attended to; it is this—let every stone be laid in the building in a position parallel to its natural bed in the quarry, as nearly as is practicable; we may say, let the run of its strata in the quarry be horizontal in the building.

DESIGN AND DECORATION OF ALL AGES.

BY M. H. C. L.

Roman.

The decorative art of Rome is one of the least interesting that can be distinctly classed as a school, for it contains little of originality, and bears the marks of decadence in artistic taste.

The beginnings of Italian art were in Etruria, a large district in the centre of Italy, which flourished when Rome was founded, and perished, as a nation, when the people, who, 385 years before, had separated from the rest, and built a little town on the Palatine Hill, grew strong and conquered the Etruscans B.C. 330. It was the custom of the Romans to spoil the countries which they vanquished of all their art treasures, but in later days their own art seems to have been little affected by these importations. Before they had an art of their own, however, they were susceptible to outside influences, and from the Etruscans and Greeks, to whom as artists the former were closely allied, the Romans drew all their inspiration.

It is considered probable that Etruria was first peopled by the Phœnicians, who are known to have been, in very early days, in the neighbouring island of Elba. Be this as it may, the Etruscans were skilled craftsmen, and have left us many specimens of their art. A large number of bronzes

Roman Ornament. Fig. 1.—Pair of Dolphins (Mosaic). Fig. 2.—Design of Mosaic Floor. Fig. 3.—Border on Silver Sibula. Fig. 4.—Ornament based on Honeysuckle Design. Fig. 5.—Mosaic Work Border. Fig. 6.—Border. Fig. 7.—Marble Column. Fig. 8.—Mouth of Etruscan Vase. Fig. 9.—Figure in Scene on Etruscan Tomb. Fig. 10.—Sea-Horse (Etruscan). Fig. 11.—Scene on Etruscan Vase. Fig. 12.—Pompeian Wall Decoration. Figs. 13, 14, 15, 16, 17.—Roman Ornaments: from Pillar of Hadrian and from Chariot.

and vases have been discovered in their tombs, but it is now believed that most of these vases were either brought directly from Greece or copied from Greek models. There are, however, distinct elements in the Etruscan and the Greek genius: the latter tended to ideal representation, and worked onwards till it produced the human figure in perfect and passionless symmetry. A slight observation of the Etruscan figures, however, as we see them, carved in full relief upon their tombs—a branch of art which must almost certainly have been of native production—shows that their aspiration was different. There is character and human interest in the men and women, all very wide awake, even when in a recumbent position, who have come down to us thus from the dimness of unstoried antiquity. Take, for instance, one of the sepulchral monuments preserved in the British Museum. The man and wife are here shown in the most animated attitudes, with a peculiarly piquant expression and smiles of *espièglerie* on their faces, evidently engaged in lively conversation. There is in the Etruscans that spirit which, as Pater remarks, distinguished mediæval and modern from classic art, the representation of character and the result of human experience upon the face—the picturesque element, in fact—as opposed to the severely beautiful which expresses itself in ideal types. This same tone of the picturesque shows itself in the element of quaintness that characterises their serious objects. Fig. 8 is the top of a vase, on the body of which Fig. 11 is represented.

There is a humorous element in the little deity, Fig. 9, from the tomb mentioned before, which forms part of a group evidently representing some animated scene, as a man who is talking points to the departing goddess. The sea-horse in Fig. 10 is another favourite Etruscan form. Among the archaic bronzes is one which ought to be reproduced by Pears as a companion to his "Dirty Boy"; a woman, much prettier, however, than the old capped nurse, is holding an unwilling boy and rubbing him with a towel. The Assyrian influence is very strongly marked in Etruscan art in its early period. With higher civilisation, it conformed more to the classic Greek type, but it never lost its quaintness, and had thus a special charm and value of its own, so that Etruscan bowls, goblets, and beaten work were sought for throughout the civilised world, even in Athens itself.

It was Etruscan art that gave birth to the art of Rome, but the Romans were a serious people, and though what was the picturesque element in the more artistic Etruscans came out in the Grotesque style, of which the Romans were the inventors, the humorous element is singularly lacking in the women's heads growing out of flowers, and the animals ending in foliated tails, which are known as Grotesque. The origin of the word is curious. A workman, in comparatively modern days, happened in digging to come upon what he took for a grotto, though it proved, on excavation, to be the Baths of Titus: this grotto was decorated with the mixture of animal and vegetable forms (favourite with the Romans), and decoration of this kind was henceforth called Grotesque. When Pompeii was discovered, the walls were found to be decorated with forms like these, and a curious fancy for them seized on modern art. Why, it is hard to guess, unless the charm was that of the strange interest attaching to the place where they were discovered, for they are comic without being amusing, unnatural without being quaint. The loggia of the Vatican is decorated in the Grotesque style. The discovery of Pompeii has had, it is certain, a very marked effect on modern decoration. From the sleep of centuries beneath the lava of Vesuvius was awoke, if we may use the term, a bit of ancient Rome, whose life had been arrested in its full swing. There were the houses just as the people lived in them, the temples, the market places, the very people themselves, they who are beyond awakening, as we see them now in the ghastly little museum inside Pompeii. Most of the treasures found there have been removed to the Museum at Naples, as the wall paintings would soon have perished exposed to the sky, but some of the less perishable decorations have been left in their place; and it is curious—as one wanders through that dreary, dead city, marking the dry ruts where the chariots went in the streets, and trying to repeople the walled spaces where once the complete houses stood—to come across a portion or a bit of wall, brilliant in blue and white mosaic, or many-coloured painting, just as bright and as fresh as when the owners first proudly looked on the new piece of art.

In Pompeii and Herculaneum we have specimens of Roman domestic decoration, and we see that the walls were painted with representations of things as we see them—that is, in perspective of an empiric kind, for the scientific study of perspective did not begin till about the sixteenth century. Besides the decorations, which were, to a great extent, of the Grotesque style, there were actual pictures painted on the walls, little scenes sometimes intended to represent what might be seen on looking through a window. Fig. 12 is a decoration in the Pompeian style. The breaking up of a stalk by stiff horizontal ornaments without any meaning was one of the unlovely inventions of the Romans, with which the Renaissance has made us all familiar. Sometimes birds and animals ran through the foliage; sometimes, as we have seen, the two forms of animal and vegetable life were fused. The colours employed were brilliant rather than harmonious, and the whole system of ornament fantastic, and at best meriting no higher epithet than pleasing.

In the public buildings of the Romans the Greek ideas were followed and improved upon. The Corinthian and Ionic orders were mixed to form a composite order entirely lacking the severe grace of either style.

The one aim of the Romans in their decoration was to produce a rich effect. To richness everything was sacrificed, as is the case in much of the Oriental work, and, sad to say, in a great deal of the work of our own country and our time. Take, for instance, the example in Fig. 7, a marble column of ancient Rome. Here we find the scale pattern in three varieties—the palm-leaf border, a space of fluting, branches of ivy, naturalistically treated, acanthus and broad leaves mixed, and odd little eaves dividing the different varieties of decoration.

The chariot (*biga*) in the Græco-Roman Museum of the Vatican is another instance of mixed decoration. The horses' yoke ends in heads of birds, the bosses of the wheels in lions' heads, and the pole in the head of a ram; the spokes are decorated with acanthus, the traces with a floral border containing a variety of blossoms. The body of the chariot itself is covered with an elaborate design, highly raised and beautifully modelled, of varied scroll foliage, where from the same branch grow oak leaves and corn, ivy leaves and berries, poppy leaves and seed vessels, and the blossoms of cruciform flowers. Figs. 4, 6, 13, 14, 15, 16, and 17 are ornaments from a biga or chariot, and from the Pillar of Hadrian.

An antique candelabrum, now in the Louvre at Paris, has a similar mixture of ornament, acanthus and oak sprays, broad leaves and oak leaf bordering, all being used to decorate the stem, while this stands on a base consisting of three branches terminating in hoops. In the spaces between the hoops are bas-reliefs of skulls of oxen with ornamented horns. Subjects representing sacrifice are the only instances of art found in the work of the practical and unpoetic Romans. The skulls occur on the Temple at Tivoli. On a tripod from the Villa of Hadrian, also at Tivoli, are three heads of oxen united by the garlands of fruit which hang from their horns, since the victims were crowned for sacrifice. Ribbons flow over the stone surface and confine the garlands, which are in the style copied by Grinling Gibbons in his carvings. The ribbons—a favourite device in Roman ornament—are also, no doubt, a sacrificial symbol. The Romans had no objection to the decorative use of manufactured objects, which we have been taught to think a debased form of art. The base of the Column of Trajan is covered with bas-reliefs of armour; and masks, such as were worn by the tragic and comic actors, were a very favourite device for the mosaic floors.

These floors were not unusual in private houses, but the largest of them were in the public baths, and those which are left remain as perfect as when laid down. On these mosaics we find scenes from mythology and from ordinary life, birds and dolphins, geometrical designs, frets and guilloches, scroll patterns sometimes simple, sometimes highly elaborate (see Figs. 1, 2, and 5).

The technique of the Romans was excellent, and some of their embossed work is most delicate and beautiful. Fig. 3 is a border from a silver sibula. This kind of border, called by Mr. Leland the wire pattern, now more popular than any other, was evolved by the Romans, who perhaps took the idea from Oriental art. In one respect, as Mr. Stannus points out, the Romans actually improved upon Greek art, and that is in the treatment of the acanthus. The Greek Corinthian column is covered with a number of equal leaves, which, though graceful, give no broad general effect of light and shade. The Romans massed the foliage, and made deep depressions, with corresponding elevations, on a larger plan, and the effect, as seen from below, was bolder and more harmonious. There are two varieties of their acanthus, the olive leaf and the parsley, in which the serrations are rather differently arranged. In fact, the Romans were happy throughout in their treatment of foliage, except when they departed from nature in the meaningless Grotesque style. Their sprays of olive and ivy and laurel are among the pleasantest things on which the eye can rest in Roman ornament.

MODEL BOAT-MAKING FOR BOYS.

BY A CRAFTSMAN.

MAINSTAYS—DEADEYES—SAILS—ENSIGNS—CONCLUSION.

THE mainstays are usually three or four in number. They are fastened to the top of the mast, close to the crosstrees, and on to

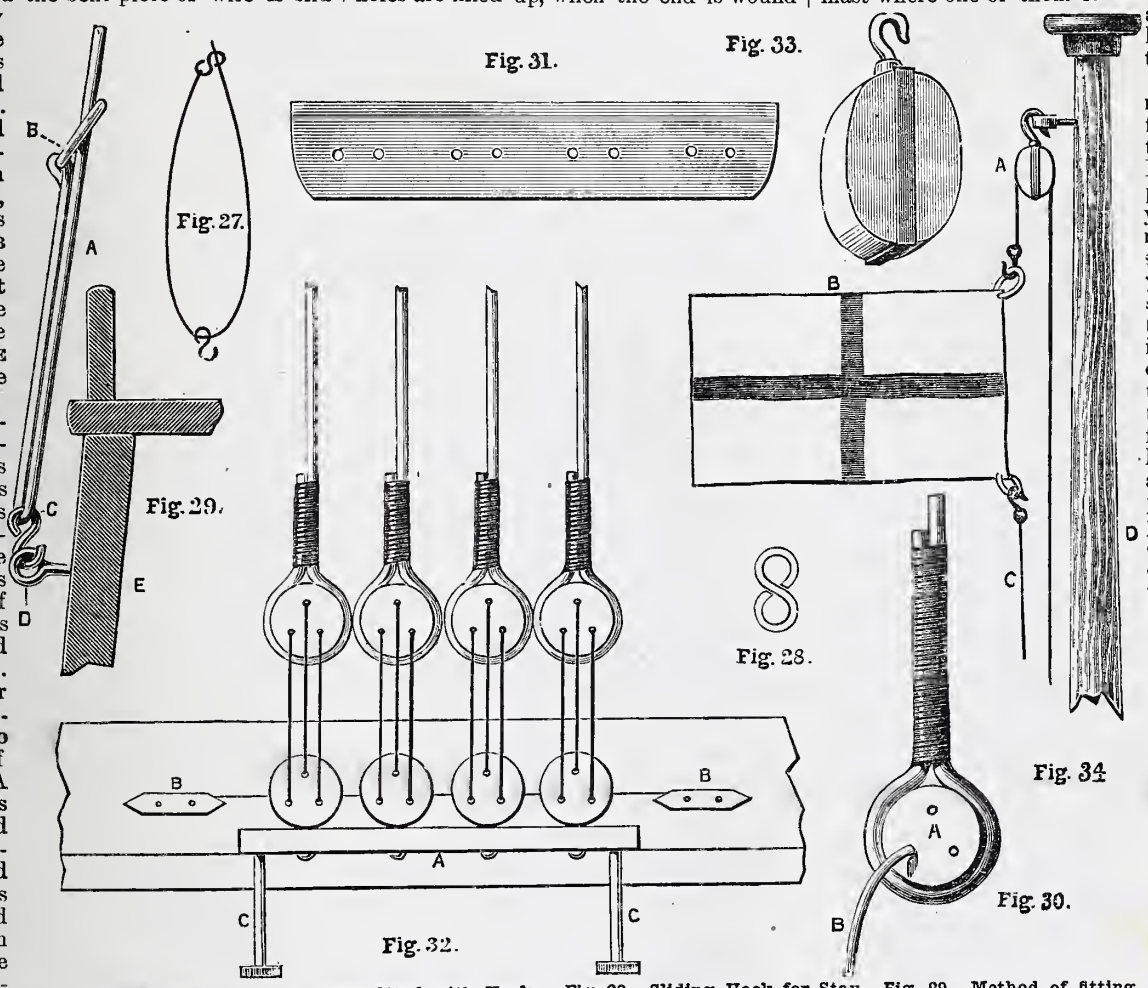
the outside of the hull, a little above the bulwarks. They are made of whipcord, and their lower ends are secured by a sliding arrangement (shown in Fig. 27), or by means of deadeyes. In the sliding arrangement, a piece of wire, of the shape shown in Fig. 28, is tied on to the end of the stay, a hook is threaded on to it, and then the other end is passed through the other hole in the bent piece of wire, and fixed in its place on the mast. When this is done, the arrangement will be in the position shown in Fig. 27. The hook is fixed on to the brass eye fastened outside the hull, and the bent piece of wire is slid up the stay until the whole is stretched quite tight. A stay fixed in this manner is shown in Fig. 29, where A is the stay, B is the piece of bent brass, C the hook, D the eye, and E part of the hull.

The method of fixing the stays by means of deadeyes is more complex. The deadeyes consist of round pieces of wood about ½ in. in diameter or less, according to the size of the boat. A groove is cut round the circumference, and three holes are bored through each. The stay is attached to the deadeye by being passed round it and bound up with fishing string in the manner shown in Fig. 30. A piece of string, B (Fig. 30), about 16 in. long, and having a knot tied at one end, is drawn through a hole in each deadeye until the knot prevents it from going any further. These pieces of string are for attaching the stays to other deadeyes which are fitted on to the outside of the hull. When all the mainstays have been treated in this manner, they are tied up in a bunch, and fixed on to the mainmast in such a position that the deadeyes are about ½ in. above the bulwarks. Their number varies according to the wishes of the constructor, but four are, as a rule, employed. The lower deadeyes must now be fitted on to the hull. A strip of boxwood, of the shape shown in Fig. 31, and having eight holes bored through it in the position shown by the dots, is fixed on to the outside of the hull just above the projecting ledge of the deck. It may be further strengthened, if necessary, by fastening a piece of brass wire from each end of it to a brass eye screwed on to the hull a little lower down. A piece of brass wire is wound round each deadeye, and its two ends are passed through a pair of holes in the strip of wood, and securely fastened underneath it. A cleat is fastened on to the hull at each end of each strip of wood. The strings in the upper deadeyes are then threaded alternately through the holes in the lower and upper deadeyes until all the holes are filled up, when the end is wound round a cleat. When each stay has been secured in this manner, the lower ends of the stays which secure the mast on one side of the hull will have the appearance presented by Fig. 32, where A is the strip of wood (Fig. 31), B, B are the cleats, and C, C are the wires which are attached to strengthen A. The backstays and stays attached to the bowsprit are fastened to the hull in the same manner.

The sails must now be made. The best manner of making them of the right size is to cut paper patterns, carefully measuring the various dimensions, and then to cut them out from the patterns. They must be made of the finest calico, and hemmed all round. Before fitting them in their places, some blocks must be procured, and fixed on to the masts for the halyards to pass over. One of these must be fastened on to each gaff, in the position shown in Fig. 21, and on to the topmast. Two more must be fastened on to the foremast, near the crosstrees, for the halyards belonging to jib and foresail to pass over. An extra block may be fixed on to the end of the gaff for raising or lowering a flag. These blocks can be procured ready made with or without sheaves, or you can make them yourself. One of them is shown in Fig. 33. It consists simply of a piece of wood with a hole bored through it, and surrounded by a piece of wire, one end of which is bent into the form of a hook. A brass eye is screwed into the mast where one of them is to be fastened, and it is hooked on to it.

The sails may now be fixed in their places. For this purpose, you will require several yards of the string used for fishing. Pieces of string are tied on to the gaffs to form the halyards, and are passed over pulleys down to the deck, where they are secured after the gaffs have been hauled up into their right positions. The booms are fitted with sheets, which are tied on to rings which slide along bent wires (M, Fig. 9). The mainsails are tied on to the gaffs and booms, and on to rings which slide up and down the masts. The topsails are hooked on to the end of the gaff and on to the mast at the crosstrees with small hooks made of copper wire. A piece of whipcord is fastened on to the front of the foremast at the crosstrees, and to the deck at the bow, and the foresail is fastened along it by means of rings, so that it will slide up and down. Both the foresail and the jib are hauled up and down by halyards in the same manner that the mainsails are, and are fastened to the deck and bowsprit by short pieces of string tied to brass eyes.

Sometimes halyards are attached to the topmast for the purpose of raising or lowering flags. These latter can be procured at the Model Dockyard. They are fitted on to the halyards in the manner shown in Fig. 34.



Model Boat-Making. Fig. 27.—Stay fitted with Hooks. Fig. 28.—Sliding Hook for Stay. Fig. 29.—Method of fitting Stay on to Hull. Fig. 30.—Deadeye fitted on to Stay—A, Deadeye; B, Piece of String. Fig. 31.—Piece of Wood to which Lower Set of Deadeyes is fixed. Fig. 32.—Set of Stays fitted with Deadeyes—A, Piece of Boxwood (Fig. 31); B, B, Cleats; C, C, Wires with which A is secured. Fig. 33.—View of a Block or Pulley. Fig. 34.—Mode of hoisting Flag up and down from Topmast—A, Pulley; B, Flag; C, Halyard; D, Topmast.

TRADE: PRESENT AND FUTURE.

*** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

CUTLERY TRADE.—The cutlery trade shows no improvement, kindred trades suffering in consequence. The strike at Messrs. Rodgers' continues, without prospect of an immediate settlement.

TIMBER TRADE.—There has been another large sale of wood at the North Docks, Liverpool, including 1,458 logs of mahogany, 223 logs of cedar, 547 logs satinwood, 1,249 logs sequoia, 51 tons rosewood, 80 logs oak, 25 logs ash, 454 planks and boards ash, 95 logs whitewood, 3,210 planks and hoards whitewood and other.

GLASS BOTTLE TRADE.—The glass bottle industry at Mexborough, which has been steadily increasing during the past few years, is actively employed, the demand being for pickle jars, white wine and aerated water bottles. A new glass works, employing three hundred hands, has just got into working order.

BUILDING TRADE.—Trade in Manchester and Salford is favourable, almost every firm reporting a good supply of work in hand. The lock-out at Bolton continues. Our Liverpool correspondent writes:—Paperhangers are doing a good trade. The wages are 8d. per hour. Plasterers have also a good deal of work on hand; the wages are also 8d. Altogether, this year has been a good one for all workmen connected with the building trades here.

CYCLE TRADE.—Agents and dealers throughout Scotland are as busy as can be expected at this advanced period of the season—more so, indeed, than in any previous year. The Beeston Humber Company are doing a very good business. They have a large market in the United States, notwithstanding a 45 per cent. tariff paid on each machine, so that a rider of a Beeston Humber in the States has to pay about £50 for his mount.

IRON AND STEEL TRADES.—The Sheffield district forges and tilts are not quite so well employed. Orders for railway material have been placed fairly well, but not to the same extent as in some previous years. Prices of Bessemer finished material are unaltered. Now and again there is a little sign of movement in the hematite market, caused by the fact that the stocks are low. Hematites are quoted delivered in Sheffield at from 58s. to 60s. per ton.

COAL AND COKE TRADES.—The coal trade is fairly active. The stability of the coal market means a great deal to Sheffield, as any sign of weakness prevents quotations for steel or iron being made in advance. Best foundry cokes are now quoted at from 17s. to 18s. per ton at the pits. Steam coal sells well at 9s. to 9s. 6d.; Barnsley house coal, 9s. 6d. to 11s. 6d.; silkstones at from 11s. to 12s.: all per ton.

COTTON TRADE.—The Lancashire cotton trade is still depressed, the chief cause being an overwhelming stock of yarn. Our Rochdale correspondent writes:—The cotton, flannel, and engineering trades have not improved in the least, and short time will soon be the rule.

SILVER AND ELECTRO TRADES.—The silver and electro-plated trades have slightly improved, and there is an increased demand for Britannia metal goods for both the home and foreign markets. The sterling silver trade is almost at a standstill.

BOOT AND SHOE TRADE.—In London and all the manufacturing centres trade is quiet. Our Liverpool correspondent writes:—A fair amount of trade is being done in the retail business in the shops in the city, but on the outskirts business is not brisk.

JEWELLERY TRADE.—This is very dull, owing to the elections. The Goldsmiths' Hall has again sent out notices to manufacturers, warning them that no change has been made in the law with reference to hall-marking goods, except that the duty is taken off. The regulations as to "additions" are still in force.

SHIPBUILDING TRADE.—In the shipbuilding trade orders are very few just now, and several of the yards on the Tyne are lessening the number of men they employ. On the Wear there is a fair amount of work, and so far the Marine Engine Works are well off for work; an occasional order for a steamer is obtained.

CHEMICAL TRADE.—Chemicals are steady, and stocks are kept low.

ENGINEERING TRADE.—Business in most departments in the Manchester district continues to grow gradually less, and unless some material alteration for the better soon occurs, matters will reach a serious crisis. Naturally, the question of reducing wages is now receiving due consideration at the hands of the employers. Shipbuilding, except in the Barrow district, continues in a highly unsatisfactory state. In the Barrow shipyards business continues to be brisk. The iron trade of this district is distinctly improving. In South Lancashire, however, the trade remains in an exceedingly depressed condition, and, although in pig iron prices are firmer, buying is confined to present needs. For steel boiler plates prices have fallen, and £7 10s. per ton has lately been frequently quoted for delivery in the neighbourhood of Manchester. The metal market business is slow, and the tendency is, if anything, downward.

SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

I.—LETTERS FROM CORRESPONDENTS.

Eggs Encased in Tree Trunk.—A. J. H. (*Brixton*) writes:—"Some sawyers at Whitstable-on-Sea, in the employ of the Whitstable Shipping Company, while cutting up an elm-tree, discovered two swallows' eggs in a hole. It is supposed that a swallow made her nest in the hollow, where they were left, and the tree, in growing, closed up the aperture."

Easily-Made Bracket.—L. G. (*West Dowling*) writes:—"I enclose a rough sketch of an easily-made bracket, which, no doubt, will be appreciated by some of the readers of WORK. The frames can be made of beaded oak picture-frame moulding

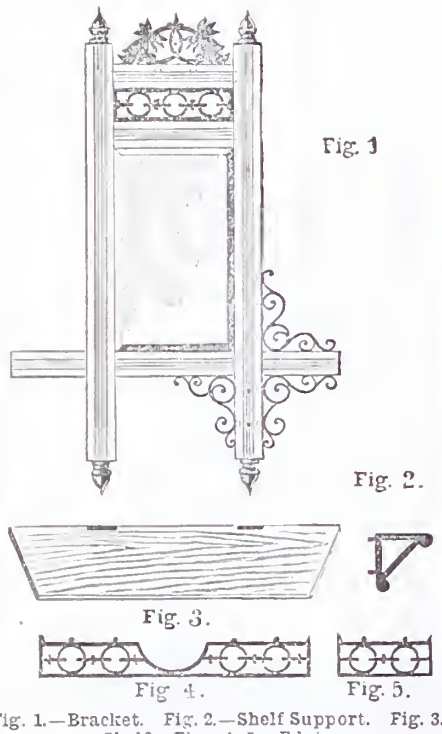


Fig. 1.—Bracket. Fig. 2.—Shelf Support. Fig. 3.—Shelf. Figs. 4, 5.—Edging.

(Fig. 1), and panel, corner pieces, shelf, and shelf edging of ¼ in. oak fret-wood, and top ornament and shelf brackets of ½ in. oak (former carved in relief); and same fitted with bevelled edge mirror, stained walnut colour, and varnished, makes a pretty bracket."

Timber Sizes.—A. J. H. (*Brixton, S.W.*) writes:—"I am glad to see you have noticed the inconvenience that builders and merchants are frequently put to through architects specifying sizes not stocked by any timber merchants (see No. 165). I drew attention to this in my article on 'The Purchasing of Timber' some time ago (see No. 33); and I think you would be doing your working readers a good turn by urging writers to specify only such sizes as can be obtained readily at any timber-yard. For the benefit of these and others I give the stock sizes in deals, planks, and battens as follows: 4 × 11, 4 × 9, 3 × 11, 3 × 9, 3 × 8, 3 × 7, 2½ × 7, 2½ × 6½, 2 × 9, 2 × 8, 2 × 7, 2 × 6, 2 × 5, 2 × 4, in yellow deal: and 3 × 9, 3 × 11, and up in pine."—[Not only builders and merchants are inconvenienced respecting timber, but, judging from the letters constantly coming to hand, amateur and professional hobbyists are in a fix as to woods and prices for sizes for construction purposes. It is a pity merchants do not keep their names and addresses before our readers, with prices for stock sizes of various kinds. Unless we are much mistaken there is business to be done.—ED.]

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

WORK Back Numbers.—W. P. (*Bermondsey*).—You will be pretty sure to find a customer if you advertise in the "Sale and Exchange" column of WORK.—ED.

WORK, Vol. I.—H. H. (*Folkestone*).—WORK, Vol. I., is out of print. You would probably obtain one by advertising in the "Sale and Exchange" column of WORK.

French Polishing.—J. W. (*Darlington*).—The subject of French Polishing has been fully treated in Vol. III. of WORK, in articles and "Shop," far better, in fact, than in any book as yet known to us. There is a book published by Messrs. Wyman, Great Queen Street, London, in their Technical Series, "French Polishing," price 2s. 6d., but this can only be recommended to those who have already some knowledge of polishing—in short, it is a professional's rather than an amateur's work. But, as one who earns his living at polishing, I have pleasure in directing your attention to the articles referred to in WORK by Mr. Denning, and would gladly, did space permit, treat of your difficulty more fully. Briefly, I may say, be sparing in the use of oil: its object is to ease the polish rubber and allow the gums to work easily. The object of "spiriting off" is to remove this oil and increase the lustre. If the polish rubber has been used right and done its duty, this should be a comparatively easy task, but requires care and practice. The chief cause of failure lies in getting the spirit rubber too wet, so softening and tearing up the gums. I have known many meet with success by dispensing with its use, using instead a swab of clean soft rag, fairly damp (not wet) with methylated spirits. For the present, make your polish by dissolving about 6 oz. of best orange shellac in one pint of methylated spirits. As you get more proficient, and wish to get over your work quicker, you may substitute rectified naphtha in lieu of spirits. It is impossible for us to give replies in our next issue.—LIFEBOAT.

Cement Casting.—A. B. (*Thurso*).—For slabs, chimney-pieces, and similar work, the moulds are of wood, made very smooth inside and varnished, while for enrichments, trusses, etc., wax or gelatine moulds are used. The proportion of sand will depend upon the quality of the cement and the nature of the work; but, generally speaking, for fine work one-fourth of sand will be sufficient, while for slabs one-half or more may be used; a little experimenting will soon give you the proper proportions. There is nothing used to make the cement set more quickly, as, if good, it will soon set. In casting large articles, they are generally faced with fine cement and the inside filled with a coarser kind, in which more sand is mixed.—M.

Motor.—GUNMAN.—If you use the dry cells described in Vol. IV., No. 163, p. 99, for driving the little model motor (Vol. III., No. 151), you will not meet with much success. If you notice in the article on the motor, it says that it can be driven by two or three double carbon bichromate cells—three are quite enough; the little dry cell was only given as a rider upon making simple cells. It is the bichromate one that you had better use for the motor; not that you could *not* drive it with the dry cells (of which you would want at least three in series), but it is not suited for that purpose; the motor would go for, say, about five or ten minutes, and then stop, owing to the current dying away; the battery would then want a rest, after such work as that, of some hours before it had recouped itself. Such a cell as described is only suitable when short, sharp currents are wanted, such as ringing bells, etc. Now, the size of a cell is of no moment at all as regards the power—or, to speak strictly, the electro-motive force—that it will produce. Any double carbon bichromate cell with a little less than ½ in. between the zinc and carbons will produce an E.M.F. of a little over 2 volts, whether it is made up in a very small jar or a very large one; it is the amount of electricity that is governed by the size, not the E.M.F. A large cell will perform a certain task longer than a small one: this is why the sizes of the cells were left to your own resources and discretion. Make your cells for the motor to hold about half a pint of solution each; you will find that they will drive the little motor as long as you will require it. Very large cells become expensive, even if you make them yourself. The sketch you show in your letter is after the carbon holders as sold in the shops to illustrate the arc light; but I am afraid you could do nothing in that way from the few remarks I could make here. If you do want to try your hand at model electric lighting, look up Mr. Bonney's series of papers in the back numbers of WORK, where you will find the subject simply and ably handled.—J. B.

Directions for Modelling in Clay, Casting in Plaster, etc.—MODELLER.—I know of no cheap handbook which I can recommend, but the subjects in which you desire instruction have been exhaustively treated in WORK, Vol. II. You will find the papers, illustrated by numerous diagrams, in Nos. 53, 56, 60, 64, 68, 71, 74, 77, 83, 88, 93. These will cost you 11d., and form a cheap enough handbook in all conscience, without mentioning the other useful matter contained in the numbers.—M. M.

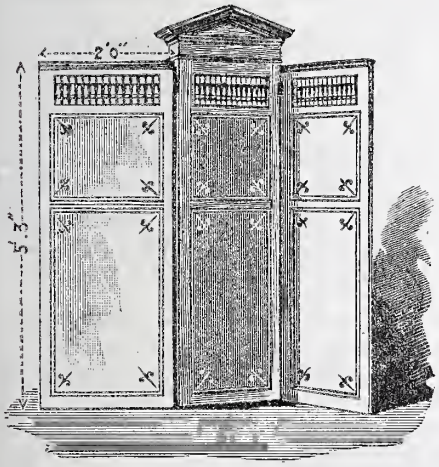
Newtonian Telescope.—H. W. (*Byfield*) asks for information on the construction of a Newtonian telescope: also, "Where can I get the speculum and flat?" An endeavour to answer the last question is the sole reason for my not replying earlier. I am afraid that H. W. has grown disheartened at the

long delay; and I regret that still no answer is forthcoming. I have written to several well-known opticians for prices, some of whom are known to me through business relations. One replied, "We are too busy to make speculum"; another said, "Don't sell to amateurs"; another, who advertises the very articles, though I have repeatedly written, has not even vouchsafed a reply. I make these remarks with the hope they may catch the eye of some reader who may be able to supply the required information. But *Nil Desperandum;* why not make one? I can positively state that it is well within the power of a clever mechanic. Amongst the best speculum grinders, living and dead, are to be found men who took the matter up first as amateurs. One of the finest telescopes I ever had the pleasure of using was a splendid 12 in. Newtonian ground by a minister who devoted his leisure to that work. The literature on the subject is exceedingly full, and I shall be glad to give useful

Newtonian Telescope—*a*, **Speculum**; *b*, **Flat**; *c*, **Rod carrying the Flat; Dotted Lines path of the Light.**

hints if H. W. wishes to go into the matter. H. W. proposes to use a speculum 3 in. diameter and 36 in. focus. Supposing H. W. thinks of grinding for himself, I should advise him to make, say, a 4 in. or 5 in., or even 6 in., as no doubt he is aware the difficulty does not increase with the size at the same rapid ratio it does with the increase of an O.G. I would just remind H. W. that the light-grasping power depends on the diameter, and the magnifying power on the length of focus. With reference to his first question, "How to make a Newtonian," I can only give a short reply in "Shop." The tube may be made of any material desirable, such as metal or wood. Within the focus—that is to say, at a distance from the speculum shorter than the focus—the flat must be placed at an angle of 45° opposite the tube carrying the eye-piece. The sum of the distance between the speculum and flat and flat and eye-piece must equal the focal length of the speculum. Great care must be taken that the axis of the speculum must be coincident with axis of the tube, so that the light may fall upon the flat. With reference to grinding and mounting the speculum, also mounting the telescope on stand, if H. W. desires information, I shall be happy to render it.—O. B.

Screen.—Amateur Screen.—I hope this design will suit you; 1½ in. by 1 in. deal will do for the framing. The canvas or cloth should be stretched and folded at the edges and tacked down, and a small mould or bead run round to hide the tacks. The corners of the panels should have a stencil ornament on them. The top panels are filled in with 1 in. turned spindles. The mould above should not project beyond the 1 in., or you will not be able to close the screen tight. The framing is mortised



Folding Screen.

together, and the whole of it would not cost above three or four shillings. The pediment in the centre leaf is formed of 1 in. stuff with all the mouldings stuck on; it could be omitted altogether, if desired. The kind of hinges you require would be "folding screen hinges," and can be procured at any ironmonger's at about 1s. 3d. or 1s. 6d. per pair. When painted, or the mouldings picked out in various colours, this screen would have a very pretty effect.—F. J.

Fret Machine.—Donovan.—You might be able to rig up a scroll-saw to work in your lathe, so as to cut brackets, etc., out of deal or any kind of soft wood, though it will always be slow work; and as to the barrow fronts of 1 in. elm, that is out of the question for a scroll-saw, and the Rogers fret machine cannot be expected to do them, as it is not strong enough. What I should recommend you to do is to rig up a small band-saw to work in lathe. This would work quicker and better than a scroll-saw; and as you only mention 1 in. in thickness, it would not be so very hard work if you have a good fly-wheel on lathe. If you will write again, and state particulars of lathes, how deep the bed is, and the size of slot in bed, and also if wood or iron, I will send sketches of a band-saw attachment which you will be able to make yourself; and if you prefer it, I will also send sketches of a scroll-saw attachment, though the former will be most suitable for your work.—Chopstick.

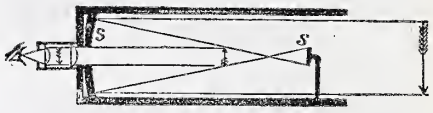
Glaze and Ebony Stain.—J. P. H. (*No Address*).—Glaze as used by French polishers can be bought ready-made at most drysaltery stores as "patent glaze" at from 8s. to 16s. per gallon, according to quality and age; it improves with age. To make the genuine article, dissolve 6 or 8 oz. of best gum benzoin (costing 2s. 6d. per lb.) in 1 pint of methylated spirits. An article on Glazing appeared in No. 126 of Work, August 15, 1891, Vol. III., which you will do well to read. "Ebony Stain, how to Make, and where to Buy," has been frequently given in "Shop," and has appeared in No. 167, since your letter was written. Pressure on space will not allow me to repeat it here.—Lifeboat.

Bronzing Chandelier.—Barnet.—You do not state what colour you wish to bronze your chandelier, so I will give you instructions for green bronzing it. Take it down from its place, and plug the nosepiece of the gas supply. Next, take it to pieces as much as you can, taking care of all small pieces, rings, chains, screws, etc. The two side arms may be soldered or brazed in, but it is very seldom done so. You will soon see: the centre tube will unscrew, but you will not be able to take the pulley wheels off the inner tube; this, however, does not matter much. The lacquer must next be got off by boiling the parts in a strong solution of soda or potash; scrub well with a small brush. The long tubes, of course, you will not be able to get in any vessel; you must hold them upright in the vessel, and use the brush. Next dissolve 1 oz. of bichloride of mercury in a quart of vinegar; this will take some time to dissolve, and will want frequent shaking, so it will be best to prepare this first. The greatest care must be taken to keep this solution from children, etc., as it is a virulent poison. The parts must be well brushed over with this solution, using a soft brush. Whilst wet the parts are next blackleaded and well polished: they should have a beautiful gloss all over; should any parts not take the blacklead, they must be treated with the bichloride solution again. The parts are now ready to be lacquered. The lacquer to use is green lacquer—apply with a soft camel-hair brush. The parts must be made warm, but not so hot as to scorch the lacquer. After you have done all the parts over with the green, it is ready for "relieving," without which it would be a dull-looking affair; some taste and judgment are needful in this. It is done by scraping certain parts of the green lacquer off, leaving the bright metal, which is then burnished with small and suitable-shaped burnishers, and lacquered with pale lacquer. Try and get a look at a new green-bronzed pendant or chandelier in an ironmonger's or gasfitter's shop. It will give you a better idea than I can give here in a few words. This concludes the operation. Put together, and re-fix.—R. A.

Lacquer for Brass.—J. K. (*Bradford*).—It does not pay to make lacquers for own use unless large quantities are required. However, I give you two recipes, which you can try if you can get the material: (1) Take 2½ oz. of gum shellac and dissolve in 1 pint of methylated spirit; colour with annatto dragon's blood or turmeric to the shade required. (2) 1 quart of methylated spirit, 1½ oz. of shellac, ¼ oz. of gum elemi, 1 oz. of gum sandarach. See also back Nos. of Work, in which much information is given, especially No. 57, page 82.—R. A.

Gum Lac.—Anxious.—Gum lac is generally supposed to be either seed lac, shellac, or stick lac; technically speaking, it is the material in its crude state, *i.e.*, before refining, hence your difficulty of obtaining it in this country. You are, no doubt, aware that lac manufacturing is not a home industry. It abounds in Bengal and Assam: the chief centre of the industry is Calcutta, whence it is exported to all parts of the world. What kind of lac the German authority had in view when writing his recipe I cannot say, probably the crude, as shellac will not dissolve in water without some solvent, such as caustic soda, borax, or ammonia. In the process of manufacture seed lac is the second stage, and as this, previous to washing, contains a small proportion of dye or colouring matter, it may be this that gives the tone of wood referred to; at any rate you might try it. There should be no difficulty in obtaining this: it is sold by most drysalters, including S. Thornley, Snow Hill; and Canning Bros., Great Hampton Street, both of Birmingham.—Lifeboat.

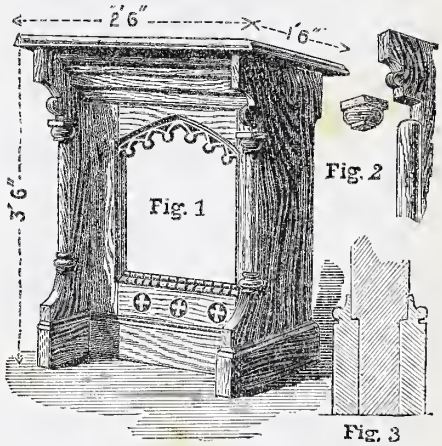
Reflecting Telescope.—A Reader writes to say that he has purchased parts of a reflecting telescope second-hand, the small mirror and focussing arrangements being missing, and asks the following questions:—(1) Must the second mirror which has to be replaced be concave or convex? (2) What diameter and length of focus, and probable cost? (3) Could I make it myself? He further states that the speculum in his possession is 3 in. diameter and 16 in. focus, with a central hole $\frac{13}{16}$ in. in diameter; and lastly, he has some speculum metal in his possession sufficient to make the small mirror. To make my answer as intelligible as possible, I send a sketch of a Gregorian telescope, but I fear that an answer to be of much practical help to a reader would be deemed too long for "Shop." (1) Must the second mirror be concave or convex? The Gregorian telescope has a concave mirror, and is placed at a distance from the speculum greater than its focal length, as in sketch. The Cassegrainian telescope has a convex mirror, and it is placed at a distance from the speculum less than its focal length. A Reader must determine which he will adopt; but if he intends to make his own, I certainly think the concave will be the easier. (2) Diameter and length of focus? It is evident that the mirror must not be larger than the hole in the large mirror—smaller, if anything, as its shadow falling on the speculum reduces by so much its light-grasping power. In the Gregorian telescope the small concave mirror is placed beyond



Gregorian Telescope.

the principal focus, as shown in the sketch, and reflects the image on to the eye-piece, so that I should say it should at least be 20 in. focus. Theory will give data, but, after all, in practical working we shall find sometimes we have to modify these. As to probable cost, I am sorry I can give no information. I have written several firms with reference to mirrors, but one and all have declined to answer my questions. (3) Could I make it myself? Now, if I know what tools A Reader has, and what ability he has to use them, I might venture an opinion; but it would be a rash man, I think, under the circumstances, who would give an opinion definitely. I must therefore decline the responsibility of answering. My advice is: procure a small plano-concave lens of the required curve—say, 20 in. radius; this could be got in Sheffield or Birmingham for a few pence, I think—and silver it by any of the well-known processes which have been explained in Work. This must be placed in a cell, and held in its position in the tube of the telescope by a pillar, as shown in the sketch. The pillar must be as thin as possible, so as to cause but little loss of light; the requisite strength can be secured by making it wider than it is thick. In adjusting it, care must be taken that it stands parallel to the speculum, and that its centre is coincident with it. Provision must also be made for adjusting its relative position to the large mirror; possibly, there is a slot in the tube longitudinally for this purpose. With reference to the eye-piece, I must refer A Reader to recent articles of mine that have appeared in Work, where he will find all requisite information for mounting the lenses.—O. B.

Prayer Desk.—F. J. (*West Bromwich*).—This design, if executed in oak, would cost about £6. The end standards, of 2 in. or 2½ in. stuff, have the columns worked on them, leaving room for the cap and base to be inserted after (see Fig. 2). The



Prayer Desk. Fig. 1.—Perspective Sketch. Fig. 2.—Showing Cap and Side Standards. Fig. 3.—Fixing of Plinth.

bottom rail is pierced three or four times with Gothic ornaments, and has an embattled top. In order to receive the plinth, the standards, etc., are checked out a little, as in Fig. 3. In making such an article, avoid meaningless ornament and stop-chamfers. Leave square edges, and the oak will look all the better for it. Run a mould, however, on the edge of the desk, and fix a mould on both sides over the arch.—F. J.

Endless Screw.—Horological.—If Horological has a lathe and slide-rest, he might be able to manage it by pulling round the mandrel by hand, and working the slide-rest at same time. But the

result may not be a true spiral, and the correct way, I should say, would be a screw-cutting lathe, as it is really a screw that is wanted. I have before now utilised an ordinary wood screw, filing it to size and finishing by hand, for sundry jobs.—A. B. C.

Weldless Steel Tubes.—L. E. (*London, W.*).—The proper way to bend steel tubes is to put them through rolls as in a rolling-mill, the rolls having semicircular grooves in each to coincide with and of the size to admit the tube. As your correspondent may not have a rolling-mill handy, he may get through the operation as they do in small cycle-repairing shops—namely: if the tube is to have but a slight bend, it is done by heating to red all the part equally to be bent, and gripping the cold end gently in the vice; if the tube is long, it will serve as its own lever; if short, a bar is thrust into the end and used as a lever, when the requisite amount of bend may be given. If the bend is a quick one, especially with tubes of one inch and upwards, the part to be bent is filled with dry sand, rammed hard, and plugged at each end with paper to keep the sand in place; heat and bend as before. It is to be remembered that the part that is hottest will bend first; therefore, the whole of the part to be bent must be heated *equally*.—A. S. P.

Shop.—Anxious.—Yours is rather a difficult problem. You say there is a 9 in. brick partition between the two houses, and no communication whatever, but your next-door neighbour complains of you knocking. You might try fixing two or three thicknesses of carpet felt (not paper) over the whole of the wall. This, of course, could be covered with match-boarding, or battened and papered if found effective, but by itself I am afraid it would not be so. Where the trouble is is where you knock. In your business, as far as I have been able to notice, the knocking takes place in one spot—say, a yard square. Now, what I should advise you to do is to thoroughly isolate that spot from the rest of the building. This is not a very great undertaking, especially as I understand from your letter you are the owner of the property. First cut a hole in the floor as large as the surface you require to knock on, take up the floor boards, cut up the parts of the joists exposed, properly supporting the ends of the joists cut and left in. Then dig out the ground (I assume your shop is on the ground floor) to the depth of 1 ft. 6 in. below the floor line. Now construct a rough wooden box 2 in. smaller than your hole all round; thoroughly ram the bottom of the hole and put in the box, wedging it temporarily away from the existing joists all round; the box should only have sides, no bottom. Next fill in the box with Portland cement concrete, made with two parts of clean-washed ballast to one of cement. Now bed in some pieces of 4½ in. × 3 in. joists, cut so that the bottom part is larger than the top, to prevent it drawing out of the concrete, keeping the outside joists at least six inches from the outside of your concrete bed, and bring the whole up to the same level as the existing floor joists. You now have a solid block quite independent from the surrounding floor, and when the cement is thoroughly set—which will not be for about six days, no matter how hard it may appear on the top surface—cover the space with two thicknesses of carpet felt, and re-nail your floor boards down, cutting them so that they do not touch the old floor by about ⅜ of an inch all round. The space left all round the "knocking-block" should be covered with a piece of soft leather nailed all round on the old floor, and just butting up to the edge of the boards of the block, which will, if done as directed above, stand above the old floor level by about ¼ of an inch.—E. D.

Nickel Plating.—New Reader.—Articles appeared in Work, Nos. 15 and 48.

Author's Correcting Signs.—Hither Green.—Messrs. Pears gave a sheet away some years ago as advertisement. Get it, or apply to Messrs. Pitman, Paternoster Row. The matter is treated in one of their shorthand works.

Old Violin.—C. W. (*Lumbutts*).—From your description of your violin, I cannot gather anything which would lead me to give an idea of the maker's name. Many of the *early English* fiddles have a very thick neck, and frequently require to be "grafted"—that is, to have a new handle spliced in—before they are fit for use. If you wish to know more about your fiddle, you had better consult someone competent to give an opinion.—B.

III.—Questions Submitted to Readers.

**** The attention and co-operation of readers of* Work *are invited for this section of "Shop."*

G. D. C. Monogram.—G. D. C. (*Brixton*) writes:—"Will some reader kindly give me, through your valuable paper, a design for the monogram G. D. C., of a similar design to the one given to H. E. B. in No. 165?"

Racing Cutter.—J. B. (*Glasgow*) writes:—"Would any reader oblige me with instructions how to make a racing cutter yacht, to be 3 ft. 6 in. long?"

Asphalte Paths.—W. R. (*St. Albans*) writes:—"Will any reader of Work kindly inform me if garden paths can be made of ashes, pitch, and tar; and, if so, what is the best method of doing it, or any other cheap method of making asphalte paths?"

Quarter Horse-Power Engine—Heliostat.—G. W. S. (*Church, near Hyde*) would be glad to make the acquaintance of A. P. S. (*Hyde*), whose letter to the Editor respecting the ¼ h.-p. engine was answered in No. 149, p. 706. Having completed the ¼ h.-p. engine, G. W. S. would be much obliged to F. A. M. for some information about a suitable boiler as to size, where obtainable, etc. G. W. S. would also be glad if some reader would explain how a heliostat is to be constructed.

Mail-Cart Design.—Poor Father writes:—"Will some kind reader of Work give me a design for an easily constructed mail-cart?"

Hanging Lamp.—W. E. W. (*Wimbledon*) writes:—"I have a duplex hanging lamp, purporting to be of wrought iron and copper. I find the latter is not of that metal, but of brass plated (?) with copper, which has in places (especially on the reservoir) been entirely removed by the action of the paraffin. I shall be glad to know: (1) Is this the usual mode of construction, or is it adopted as a way to make a cheap article in imitation of the better sort? (2) Is it within the scope of an amateur to re-copper the parts; and if so, what is the process? (3) Would it be better to burnish and lacquer the brass; and if so, what would be the best way to remove the copper deposit? (4) Where could I get the articles re-coppered in London?"

IV.—Questions Answered by Correspondents.

R. F. for Fretwork.—C. K. (*Stratford*) writes:—"In Work, No. 159, page 46, Tinsmith asks for a monogram. I trust this one may suit him."

R. F. Fret Monogram.

Copal Varnish.—P. E. B. (*Birkenhead*) writes to J. R. E. (*Balolo Mission, Upper Congo*) (see No. 168, page 188):—"I make a very good varnish from gum-copal in the most easy manner possible—viz., by putting the copal into a bottle and adding methylated spirits. In a few days it will have dissolved; strain through muslin, and it is ready for use. There is always a sediment left which never dissolves, to be thrown away."

Small Power Engine Castings.—M. (*Bishop Auckland*) writes to Halifax (see No. 166, page 158):—"The Dronfield Casting Company, Sheffield, supply malleable iron castings. You might procure what you require from them."

Fretwork.—M. (*Bishop Auckland*) writes to J. McC. (*North Brixton*) (see No. 168, page 190):—"The following may suit you: 'Fret-sawing and Marquetry-cutting' (Ward, Lock, Bowden & Co.)."

Tin—Geometry.—M. (*Bishop Auckland*) writes to Young Reader (see No. 168, page 190):—"If you can burn off all the tin and solder, you might sell them for scrap iron, but it may cost as much as you will get for them. The following book may suit you: 'Descriptive Geometry,' by J. F. Heather (Crosby Lockwood & Son)."

Monogram F. T. for Painting.—C. K. (*Stratford*) writes:—"In Work, No. 161, p. 78, E. A. T. (*Burnham*) asks for a monogram. I trust this one may suit him."

F. T. Monogram for Painting.

Slide Rule.—M. (*Bishop Auckland*) writes to W. W. (*Carbrook*) (see No. 166, page 158):—"If the book is out of print you might obtain a copy from Mr. Batsford, 52, High Holborn. Would one of the following be suitable? 'The Slide Rule,' by Lieut.-Col. J. R. Campbell, price 1s. (Spon, Strand); or 'The Slide Rule,' by Charles Hoare, 2s. 6d. (Crosby Lockwood & Son)."

Division Plate.—M. (*Bishop Auckland*) writes to Drill (see No. 170, page 222):—"You will find a description of the division plate on page 153, Vol. I. of Work. If you have not this, one of the following books will perhaps suit you: 'Geometric Turning Simplified,' by J. Lukin; or 'Ornamental Turning,' by J. H. Evans (Spon, 125, Strand)."

Picture Restoring.—M. (*Bishop Auckland*) writes to J. H. (*Edinburgh*) (see No. 170, page 222):—"If your picture is a good one, you had better get it cleaned by a professional cleaner, as in trying to remove the varnish you might spoil the picture."

Red and Green Fire.—W. B. (*Golcar*) writes, in reply to A. J. W. (*Battersea*) (see No. 160, page 62):—"I beg to give recipes for green fire of any calibre. Use 16 oz. meal powder and 3½ oz. of fine copper filings. Red fire is made from 40 parts of dry nitrate of strontium, 13 parts of finely-powdered sulphur, 5 parts of chlorate of potash, and 4 parts of sulphate of antimony. The ingredients may be pounded together in a mortar, except the chlorate of potash, which must be ground separately. All must be thoroughly mixed; and if the fire should burn dim, a small quantity of charcoal must be added."

Stained Glass Designs.—H. K. (*Hulme*) writes, in answer to J. B. (*Moss Side*) (see No. 172, page 254):—"He can be supplied with designs for the above by writing to 81, Raly Street, Moss Side, Manchester. The price will be according to designs."

V.—Letters Received.

Questions have been received from the following correspondents, and answers only await space in Shop, upon which there is great pressure:—Midland; T. W. W. (*Leeds*); H. T. (*West Bromwich*); A Fitter; T. H. H. (*Birkenhead*); J. A. (*Pendleton*); F. T. G. (*Keighley*); T. W. (*Manchester*); F. H. M. M. (*Alexandria*); Ironwork; J. W. (*Dundee*); F. T. (*Bristol*); Lover of the Sea; Gael; J. A. (*Smallheath*); E. C. W. (*Clapham*); Anxious; W. A. L. (*Birmingham*); Overseer; W. R. (*Liverpool*); Constant Reader; J. R. (*Greenock*); C. J. P. (*South Norwood*).

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All manuscripts intended for the "Useful Household Article" Competition must be addressed to the Editor of Work, c/o Cassell & Co., Ld., Ludgate Hill, London, E.C. They must reach him on or before Saturday, July 30, endorsed, "Useful Household Article" Competition.

NOTICE TO READERS.

Among next week's contents of Work (No. 177) will be the following important papers:—

How to Make a Wardian Case;
Screw-Cutting in the Lathe;
Photo-Printing Frames for the Million;
Art of Staircasing;
Leather Work and Modelling Designs;
How to Make and Work the Spectroscope;
"Cycle" First Prize Essay; also
Third Prize Competition Announcement.

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Picture Moulds.—15 to 25 per cent. saved. Send for wholesale list, one stamp.—Dent's, Importers, Tamworth. [12 R

Water Motors, from 5s. each; ½ h.-p., price 20s.; list, stamp.—Walton, 9, Queen Anne St., Stoke-on-Trent.

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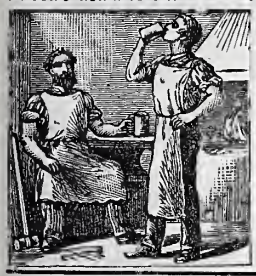

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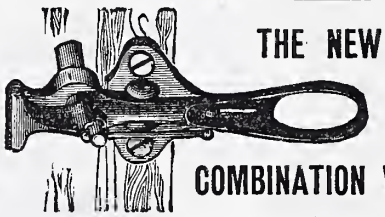

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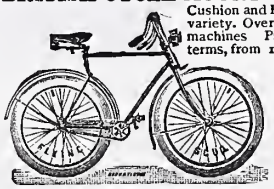

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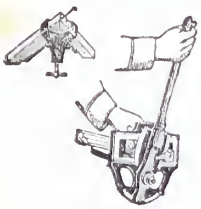

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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Vol. IV.—No. 177.] SATURDAY, AUGUST 6, 1892. [Price One Penny.

WORK WORLD.

By years of exposure to atmospheric temperature, hardened steel loses hardness.

* *

The Southport Corporation has adopted the high tension system for its electric supply.

* *

Steel not only loses its magnetism, but becomes non-magnetic when heated to an orange colour.

* *

At the World's Fair will be an exhibit of bells displayed in a reproduction of the Tzar Kolokol (king of bells); the famous broken bell of Moscow, which is 22 ft. in diameter and 21 ft. 3 in. high, weighs 443,772 lb. This bell is now used as a chapel.

* *

The positive plates of a storage battery when fully charged should look like wet slate, nearly black; when partly charged they are dark red, chocolate, or plum colour. The negative plates are always much lighter than the positives, and have a pale slate colour.

* *

Inspection and tests with the St. Pancras electric installation elicited some of the applications of electricity for trade purposes. A ventilating fan was set in motion, a tailor's flat-iron and a hatter's iron were quickly heated; so also were a pair of lady's curling tongs. Cooking, we know, can be done by the heat generated. Gas should now go.

* *

An 8-ft. water tunnel, extending four miles out under Lake Michigan at a depth of 80 ft., has been completed. It was begun over four years ago, and has cost over $1,100,000. When connected with the waterworks pumps it will supply 130,000,000 gallons of water per day to the city, bringing the total available supply up to 300,000,000 gallons daily.

* *

Bridgnorth now owns the steepest inclined railway in England. It connects the high and low towns which have hitherto been joined by means of 200 steps and long sloping paths. The entire length is 201 ft., with a vertical rise of 111 ft.—passing through a cutting in solid rock 50 ft. deep—thus giving what is generally termed a gradient of 1 in 1½ ft. The motive power is water, furnished by means of two gas engines.

* *

Tanning is now being done largely in America by electricity. The following table gives a summary, from the standpoint of duration, of the advantages that tanning by electricity possesses over the old chemical tanning:—

Nature of the hides.	Duration of tanning. By the new process.	Duration of tanning. By the old process.
Light calf ...	24 to 32 hours.	3 months.
Heavy calf ...	48 ,, 60 ,,	4 ,, 6 ,,
Light cow and horse	72 ,,	8 ,, 10 ,,
Heavy cow and med. ox ...	84 ,, 96 ,,	10 ,, 12 ,,
Heavy ox ...	96 ,, 108 ,,	12 ,, 15 ,,

* *

The trade in macadamised stone between Cherbourg and this country has recently grown with extraordinary rapidity. In 1890 the export from that port increased tenfold over that of 1889, and from 1890 to 1891 it has trebled, amounting in the latter year to nearly 30,000 tons. Railways and tramways are shortly to be made to facilitate the conveyance of this material from the quarries in the Montagne du Roule to the shipping quays, to avoid the expense and delays of cartage, and more powerful machinery is to be erected at the quarries.

* *

On the day of opening the Vyrnwy water supply to Liverpool, 14½ million gallons ran into the reservoir. The surface area of the lake is 1,121 acres, its length being 4¾ miles, with a width of ¼ to ⅝ths of a mile. The dam is constructed of masonry, the weight of which is 510,000 tons, with a length of 1,172 ft., and 161 ft. in height from foundation to parapet. The greatest thickness of the dam at base is 120 ft.; while the length of the aqueduct is 77 miles, divided by balancing reservoirs into six sections. The aqueduct crosses twelve railways, five canals, and about two rivers, including the Mersey, which has proved very formidable to tunnel.

Edison has been awarded the Albert Medal for 1892. This medal was instituted by the Society of Arts in 1862 in memory of Prince Consort, for eighteen years President of this society, and is awarded annually for merit in promoting the arts, manufactures, or commerce. It was first presented, in 1864, to Sir Rowland Hill, and among others the following have been its recipients:—Faraday, Whitworth, Liebig, Lesseps, Bessemer, Siemens, Armstrong, Thompson, Joule, Hofmann, and Helmholtz. Captain Eads, another American, received it in recognition of his engineering feats at the mouth of the Mississippi in 1884.

* *

Tempered steel may be straightened during the process of hardening. Files taken from a bath of melted lead are chilled while red-hot in a stream of running water; the immersion for an instant hardens only the surfaces, while the interior is pliant with heat. At this time the file may be straightened by bending over and under bars. It is stated that a crook has been taken out of a tempered rymer when heated at the bend by a spirit lamp; the heat was sufficient to allow the steel to give, but not enough to start the temper. Steel tempered blue may be straightened by blows with a pened hammer on a smooth anvil, the face of which should be warmed to remove the chill.

* *

The adhesiveness of properly prepared glue will resist a force of 715 lb. per square inch. In an experiment recently performed, a force of 1,260 lb. applied gradually was found necessary to separate two cylinders of dry ashwood, the ends of which presented a surface of 1·76 square inch, and which were glued together, end to end, and allowed twenty-four hours to set. When the joint gave way, after two or three minutes, it was found that the intervening layer of glue was very thin, and did not entirely cover the surfaces joined. The wood used showed a lateral cohesive strength of only 562 lb. per square inch, so had the joint been lateral the wood would have split before the glue yielded. In view of the common idea that a glue joint of timber ends is not strong, this is instructive.

A WARDIAN CASE.

BY C. MAYNARD WALKER.

THE illustration prefacing this article will at once explain the use to which a Wardian case is put; but perhaps I may be permitted to explain the use of the name itself. The term "Wardian" is applied properly to a kind of glass case in which plants are grown, and thus worthily perpetuates the name of Mr. Ward, the originator of indoor fern or plant cases, an invention which a recent writer on a branch of horticulture describes "as one of the most useful inventions of the age." Certain it is that if the value or usefulness of an invention were measured by the pleasure it affords, then a Wardian case would stand very high upon the list; and although its value may be unappreciated by those who possess gardens and plant houses, yet such cases of living interest are admirably suited to the wants of thousands of persons not so blessed, but who live comparatively cooped up in towns and cities. Even in the most unfavourable localities for outdoor vegetation, such indoor gardens (really miniature conservatories) may be replete with beauty alike secure from the changes of our fitful climate or from the more deadly impurities of town air, or the poisonously polluted atmosphere of gas or artificially lighted rooms, and continue to thrive, and even luxuriantly flourish, where nothing else exposed would grow. That this is really the case with properly constructed fern-cases, I am able from a long experience to unhesitatingly affirm. I think the most striking instance of the efficacy of the principle of a Wardian case was one which I met with in a showroom of a London house of business situated in a narrow and dingy lane in the City, the showroom itself being directly over a storehouse for paraffin-oil, which, as everyone knows, is more or less volatile, so much so that, in the room referred to, if water was left in a basin, the surface became filmed over with a kind of scum. In this atmosphere a hart's-tongue fern was bravely flourishing under a round glass fern shade; but so soon as the glass was removed, the fern leaves would in a very few minutes droop and hang down, recovering when the shade had been restored a few hours later. If ferns could be cultivated under such conditions, I think a Wardian case may be trusted to behave efficiently anywhere. The term Wardian does not, of course, apply to any particular design, nor the value depend upon the form—the simpler forms of cases, costing but a few pence only in their construction, being as good in their way as more elaborate erections costing as many pounds, providing they are properly managed. The design under present consideration is submitted to the reader as being one which may be easily constructed by any worker of average ability, and one which will cost comparatively little, and be a really serviceable article. It is intended to be made of zinc and glass, except where further enrichment may be desired; the external pillars and cross-bars may be of polished brass, adding very materially to the value of the work.

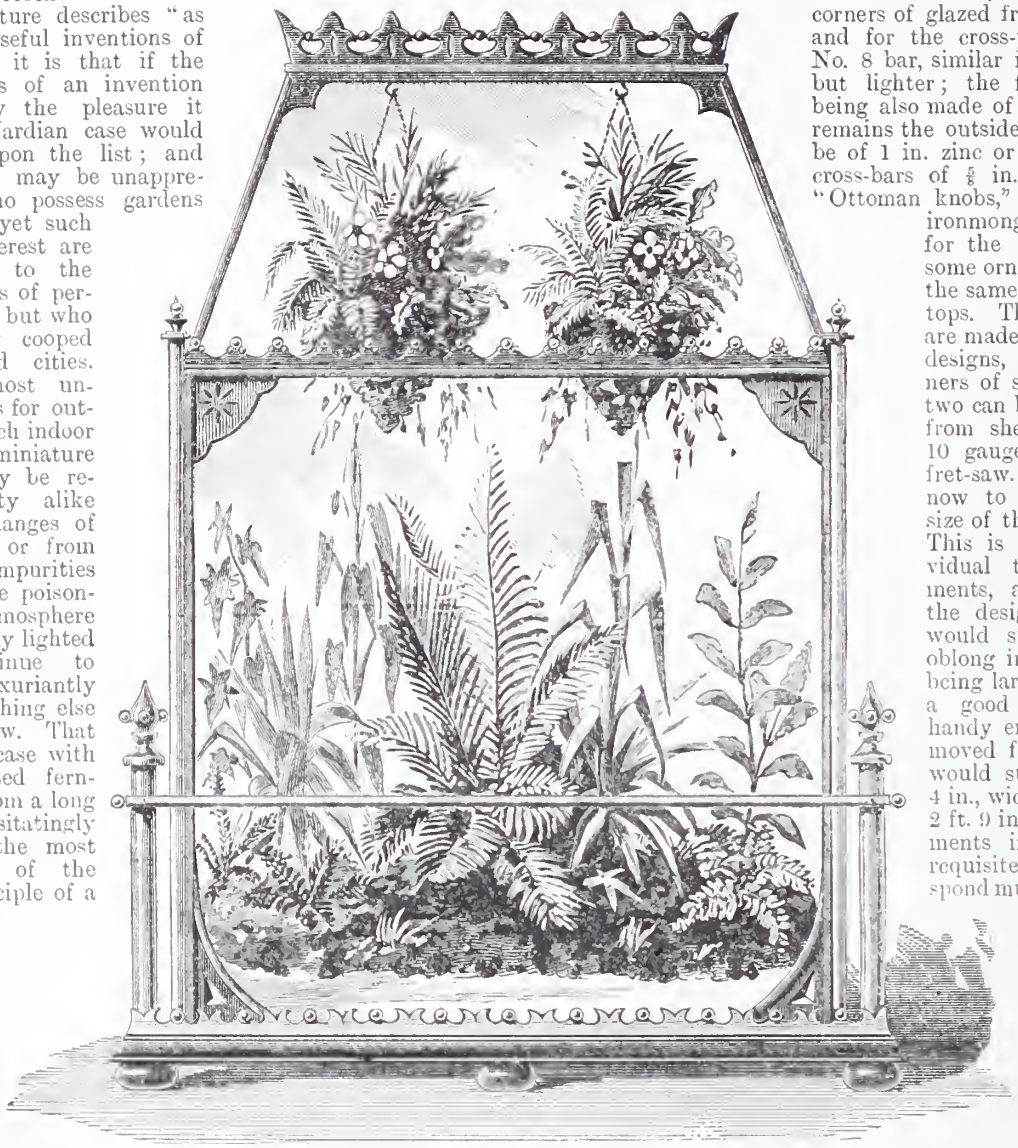
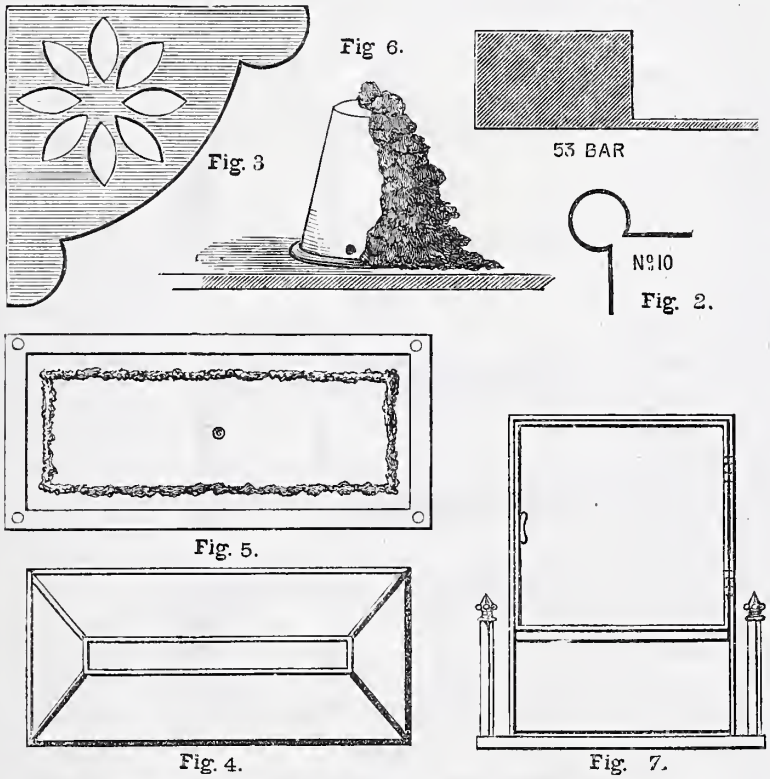


Fig. 1.—Wardian Case Complete.

And here, having in my mind's eye some reader mistrustful of his ability, and looking with wistful eyes upon a design which appears too elaborate to undertake for anyone who is not an experienced workman, permit me to say that there is no real difficulty in the work, and I will promise complete success to anyone who, being able to solder neatly and *see straight and true*, will follow the directions herewith. The ornamental borders at the base, the shoulder, and top of the case are zinc stampings, and may be purchased in large or small quantities through ordinary zinc dealers, or of Messrs. Still & Co., metal spinners, and are designated in that firm's catalogue as follows:—The top border is No. 373, and costs about 8d. per 3 ft. length; the fret on shoulder of case is No. 231, sold in 8 ft. lengths at about 1½d. per foot run; the stamped border at base of case is No. 384, and costs about 1s. per 3 ft. length. So that in ordering these all that is necessary is to quote the numbers given and to forward the cash. The frame of the case is intended to be made of zinc bar, and this can be obtained through any zinc worker, or direct from Messrs. Treggon & Co., the well-known firm, numbered as follows:—For the base frame, inside the ornamental border, is a rebated bar, No. 53, of which Fig. 2 shows a section; the uprights for the corners of glazed frame of No. 10 bar, and for the cross-pieces at shoulder No. 8 bar, similar in shape to No. 10, but lighter; the frame of the roof being also made of No. 8 bar. There remains the outside pillars, which may be of 1 in. zinc or brass tubing, with cross-bars of ⅝ in. ditto.; six white "Ottoman knobs," obtainable at any ironmonger's, will be wanted for the six feet; as also some ornamental knobs from the same source for the pillar tops. The corner ornaments are made by cutting out the designs, Fig. 3, for the corners of shoulder—the other two can be cut by the eye—from sheet-zinc (about No. 10 gauge) with an ordinary fret-saw. The first thing now to be decided is the size of the case to be made. This is a matter of individual taste and requirements, and will not affect the design in any way. I would suggest that it be oblong in shape; and while being large enough to make a good show, should be handy enough to be easily moved from its position. I would suggest length 2 ft. 4 in., width 1 ft. 2 in., height 2 ft. 9 in.—over all measurements in each case. The requisite materials to correspond must now be obtained, and, having these, we can set to work. First the base frame of No. 53 bar; this, as also the other bar, can be readily cut with an ordinary back-saw to form the necessary mitre, just as though you were making a picture-frame. Care must be taken that these are cut and soldered up true. To this end, constantly apply the square to try the work. The object of this particular form of bar is, first, to provide a base for the outside pillars, and then a flat edge to which can be fastened the ornamental border, and leave a neat flat surface between it and the glass frame. Next cut a piece of No. 10 sheet-zinc about ¼ in. smaller each way than the frame, and solder the same to the under side of the frame. Make a centre mark in this bottom, and drill a ¾ in. hole, into which solder a zinc tube about 2½ in. high, leaving about ¼ in. projecting underneath. This tube is an air-vent to the interior of case. Next cut up some No. 10 bar for the corners, the rebates of which must be cut away a

distance of 2 in. from the top, so that the end of bar above the frame gives the effect of a free pillar. Where the rebate is cut off must be made good with solder, and filed up neatly. These uprights are to be soldered into the rebate of the base, leaving a space so that each corner outside pillar has room to stand clear as shown (Fig. 1). Again, great care must be taken that these are soldered perfectly upright, and square to each other; the same remark applies to fixing the cross-bars of the shoulder. The roof is now to be made, and is very much more convenient if made to take off and on as a separate affair. This is made of No. 8 bar, carefully mitred and fitted, so that the glass is put in from the outside. The construction is shown by the plan, Fig. 4, the middle portion forming a ventilator when in use with slips of glass. For smaller cases no end doors are necessary, but in one of these or larger dimensions a door must be fitted at each end. These consist of a pair of frames of No. 8 zinc bar, hung on hinges, and high enough to clear the cross-bars, so that the ends are divided into two by an additional length of bar. Across the ventilator at top are fixed two bars upon which to hang the fern baskets—a short length of bar, with a hole drilled and fitted with an S-hook, answering the purpose. Having the borders and fret pieces ready, and fastened by solder into their respective positions, the frame should now be glazed. Leaving the outside pillars for the present, the two large squares of glass should be of 26 oz. sheet, as also the lower part at the ends, while the roof and the doors may be of ordinary window glass. The reason for adopting so thick a glass is that, if it be desired to use the case as a combination of aquarium and fern case—*i.e.*, the lower portion on a level with the cross-bars being used as an aquarium, and an ornamental rockwork rising from the bottom to a little above this level, upon which to grow ferns and sub-aqueous plants—all we have to do is to stop up, or do away with, the air-tube at the bottom, make it waterproof, and our glass is strong enough for the purpose; but our present aim is a plant ease only. Having glazed the case neatly with ordinary putty, we shall add considerably to the rigidity by mixing up a batter of Portland or Roman cement, and pouring the same into the case to nearly the height of the air-tube, the work standing on a perfectly level place during the operation. This will set into a hard and self-fitting bottom. Previous to doing this, however, the knobs should be put on by passing ordinary screws through them and the bottom of the case, the cement setting them in firmly. All the work should now be cleaned up neatly; and, lastly, fix the pillars and fender bars and their ornaments, and the case is ready for painting. Any of the following will look well—chocolate, black, French grey, or celadon, each picked out with gold. We now come to the important question of planting the ferns. It will be seen from the illustration that the plan of arranging these differs from that generally in vogue; every reader may not endorse my opinion, but I think where the lower part of the case for some 6 in. or so deep, and close up to the exterior lines, is used as a box to contain the fern mould, a needlessly clumsy and heavy effect is produced. This is avoided, and a much larger show of foliage is visible, by adopting the plan of building up a rockwork enclosure formed of cemented pieces of coke, about 2 in. from the glass sides, of a rustic and irregular form, rising higher towards the centre (see Fig. 5), the margin of 2 in. being covered with shingle or crushed shells. A thick layer of broken crocks are laid in the bottom of rockwork first to provide drainage; a root or two of ivy is under-planted, of a *non-clinging* variety, and the ferns planted over all to taste. The spacious roof of the case is intended to be occupied as shown with hanging baskets. These are easily made by taking two flower-pots, and boring three equidistant holes under the rims, which, after being roughly covered with Roman cement and coloured to taste, are suspended with chain or wire (see Fig. 6). There is very little difficulty in growing ferns. Get the mould from a good nurseryman, and you will have little to do but keep the roots always moist. With regard to the position in which the case should stand, my own experience favours a window looking west; if this is not obtainable, and you are obliged to put up with a window exposed to strong sunshine, care must be taken to shade it during the sunny hours.

Little more remains to be said, as the figures in the illustration explain themselves; but should any difficulty arise, "Shop" is at the service of all readers.



Wardian Case. Fig. 2.—Section of Bars. Fig. 3.—Fret for Corners. Fig. 4.—Plan. Fig. 5.—Plan of Base of Case, showing Position of Rockwork. Fig. 6.—Method of making Baskets. Fig. 7.—End of Case, showing Position of Doors.

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BY CHARLES A. PARKER.

Preparation of the Observing Telescope—Tubing—Object-Cell—Eyepiece—Draw-Tube—Cell for Eye-Lens—Cell for Field-Lens—Mode of mounting Lens—Stop Collar—Mode of mounting Lenses without Cells—Eyepiece Collar—Bayonet-Joint for Collar—Mounting Lenses in Wooden Cells—Selection of suitable Lenses.

We must now turn our attention to the preparation of the observing telescope, the body tube of which is precisely similar to the body tube of the collimator described in the previous paper, as will be understood by the following condensed description:—Take a $10\frac{3}{4}$ in. length of stout-drawn brass tubing, of $1\frac{1}{2}$ in. diameter, to match the collimator tube, and having trued up both ends, provide it with a $\frac{3}{4}$ in. brass stop, which is soldered in the middle of the tube the same as before. When this has been done, prepare a brass cell to contain the object lens, which should be an ordinary $1\frac{1}{4}$ in. plano-convex lens of 12 in. focus, similar to the collimating lens. As two methods of preparing these cells were described in the previous article, it will be unnecessary to repeat the mode of procedure, which is in every way identical with that already given.

The object-cell being completed, we must next provide the telescope with an eyepiece, which is shown in section in Figs. 21, 22, and 23, with the lenses mounted in three different ways, in order to suit the taste or ability of the maker. The lenses required for the eyepiece will be an $\frac{1}{2}$ in. eye-lens of 1 in. focus, and a $\frac{3}{4}$ in. field-lens of 2 in. focus, both being of the ordinary plano-convex type. First true up both ends of a 3 in. length of drawn brass tubing, 1 in. in diameter, and then proceed to fit it with a couple of brass cells to contain the above lenses. These cells should be cast from suitable patterns, prepared according to the section of the eyepiece shown in Fig. 21, after which they may be turned in a lathe to fit the eyepiece tube, the cell to contain the eye-lens being threaded to screw into a corresponding thread inside one end of the above-mentioned tube. In turning the seat for the lens the edge should be left as thin as possible, and only $\frac{1}{32}$ in. above the lens, being turned very thin, so that a slight pressure with a burnisher will be sufficient to turn the edge down over the lens, and thus secure it in position.

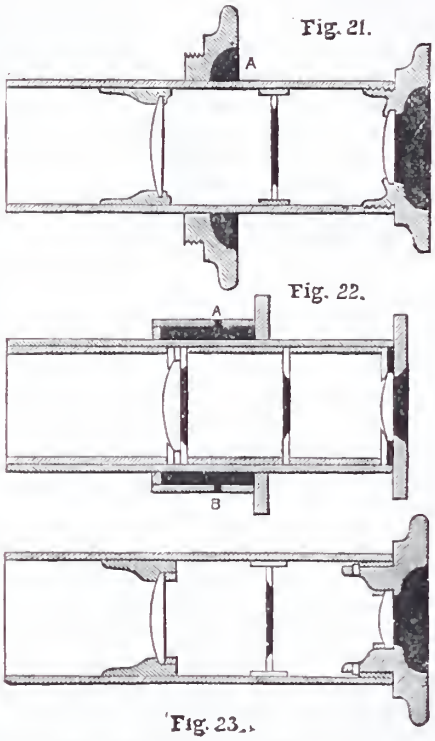
The cell for the field-lens is made in precisely the same manner, with the exception that it will not require to be threaded, as it is simply intended to slide somewhat stiffly into the eyepiece tube until about $1\frac{3}{4}$ in. from the eye-lens. The best way to secure the lenses in position is to first mount the cell in a recess bored in a soft wood chuck, and then bend the edge of the brass over the lens just sufficient to hold it in position,

after which the cell is mounted in a lathe for the edge to be burnished over the lens while it is being spun round. A small disc of brass, pierced with a ½ in. aperture, is now soldered into the eyepiece tube at 1 in. from the outer end, in order to form a stop, after which the eyepiece is fitted into the body tube of the telescope by means of a suitable collar, through which it is made to slide. Having cast the collar from a pattern made to the form of A, Fig. 21, fit the same into a wood chuck, and then mount it in a lathe and bore out the interior, so that the tube of the eyepiece will just slide easily within it, the fitting being finished by rubbing the tube lengthwise with emery cloth applied on hollow rubber to suit the tube, after which the collar is threaded, and then made to screw into a corresponding thread at the end of the telescope tube, or, if preferred, it may be fitted to the latter by means of a bayonet-joint, to be shortly described.

The following plan of mounting the lenses, which is much more simple than the foregoing, does away with the necessity for making castings of the cells, and for this reason it will doubtless be employed by some of our readers. First obtain a 3 in. length of tolerably thin drawn brass tubing, exactly 1 in. in diameter, together with another length of similar tubing, which will just slide in telescope fashion inside the first. Next proceed to true up both ends of the first piece in a lathe, so that the tube, when placed on a perfectly level surface, will stand exactly vertical. This done, prepare a stout circular disc of brass, to measure 1⅜ in., and then cut or drill a ⅜ in. countersunk circular opening in the centre, after which the disc should be soft soldered to one end of the larger tube just prepared. Assuming that the eyepiece and the field-lens measure exactly ½ in. and ¾ in. in diameter respectively, prepare five discs of brass of the following dimensions, which will just slip into the larger tube of the eyepiece:—The first disc should be furnished with a ½ in. hole, which must be cut or drilled straight through the metal, and not countersunk; but the second disc may have a ⅜ in. slightly countersunk aperture, and the third a similar ½ in. opening; the fourth disc, which is ⅝ in. in diameter, also being countersunk; the fifth is, however, a ¾ in. circle cut straight through; but the sixth disc has another ⅝ in. countersunk hole. Now hold the eyepiece tube cup downwards, and drop the eye-lens in first, plain side downwards, and after this the first and second of the discs—the last named having the chamfered side next to the lens—following this up with a ¾ in. ring of the smaller tubing, and then the third disc, which forms the stop of the eyepiece, with another ¾ in. ring of tubing above this. The fourth disc is now slipped into the tube with the countersunk side towards the eyepiece; then the field-lens is dropped on to this, plain side downwards, after which the fifth disc is put on to this, thus centreing the lens in respect to the tube; and, lastly, the sixth disc, with the chamfered side next to the lens, the remaining length of tubing being afterwards pushed into the tube, in order to retain the whole in position.

The eyepiece will now be ready to be fitted into the adjusting collar. To make this, true up both ends of a ¾ in. ring of 1¼ in. brass tube, and then fit a disc of brass tightly into one end of this collar, flushing a small quantity of soft solder round the edge of the disc as an additional security. This done, turn in a lathe another disc, stouter than the first, to measure 1¾ in. in diameter, and then cut a 1 in. hole in the middle of this, into which the eyepiece tube should be made to tightly fit, afterwards soft soldering this disc on to the open end of the collar just prepared. It will now be requisite to mount the collar in a lathe, and turn a corresponding hole, 1 in. in diameter, at the other end of it, which will thus enable the eyepiece tube to slide smoothly through the collar. It is important to see that these holes are cut perfectly parallel and true to each other; for if this is not so the eyepiece, when fitted to the telescope, instead of looking at the centre of the object-lens, will point round the corner, like the Irishman's gun.

The collar thus prepared may now be fitted to the end of the telescope tube by means of a bayonet-joint, prepared in the following manner:—Take a tolerably stout



The Spectroscope. Fig. 21.—Section of Eyepiece Tube. Fig. 22.—Simple Form of Eyepiece. Fig. 23.—Section of Eyepiece with Wooden Cell.

strip of brass, about ¼ in. wide, and bend it into the form of a ring, which will just spring tightly into the end of the telescope tube, flush with the outer surface, in which position it is fixed by means of some soft solder run round the ring between the two surfaces, any extraneous solder being afterwards removed by the aid of an old file. A couple of holes are now drilled and tapped on opposite sides of the collar, in the position indicated at A and B in Fig. 22, to receive a couple of small screws which form the bayonet-catch, and are tightly screwed into the tube, after which a couple of slots are filed in a corresponding position in the ring of the telescope tube, through which the screw-heads pass until they are just clear of the ring, when a slight turn in either direction serves to secure the collar in position. The screws must, of course, be planted in a suitable manner, so that the collar fits securely into the telescope tube without unnecessary freedom. It is better to file the collar to fit the tube than to have it too easy.

In Fig. 23 is shown yet another plan, the lenses being mounted in wooden cells, a mode of procedure which will doubtless be adopted by those of our readers who are not adepts at brass finishing. To make these cells, mount a piece of well-seasoned Spanish mahogany in a chuck, endways of the grain, and then proceed to turn it to fit the tube, afterwards truing up the end carefully. Now proceed to turn the seat for the lens, after which the hollow should be worked out from behind and the wood finished off as clean as possible. As soon as the lenses have been fitted in the cells thus prepared, turn a couple of brass rings to fit into each one, for the purpose of securing the lenses in position, after which these rings should be blacked in the usual manner. The wooden cells may be painted with the dead black at the same time that the body, tubes, etc., are varnished. It may also be stated that the eyepiece is attached to the telescope tube by means of a collar, constructed according to one or other of the plans before described. In the event of wooden cells being employed for the lenses, it will be necessary to mount the eyepiece by means of a bayonet-catch, made in the manner above described, which is clearly illustrated in section in Fig. 23.

Before passing on further, it may be advisable to give a few details with reference to the lenses. As previously stated, we shall require an object-lens for each tube, 1¼ in. in diameter and 12 in. focus, together with an eye-lens, ½ in. in diameter and 1 in. focus, and a field-lens, ¾ in. in diameter and 2 in. focus, all these lenses being of the ordinary plano-convex type. A telescope constructed in the manner described will give an inverted image, but this is of no consequence in a spectroscope.

It must be understood there are two distinct classes of lenses—the chromatic and the achromatic; the first named giving a coloured fringe to all objects viewed through it, which in a spectroscope is not of very great importance. In the achromatic lenses this fault is corrected by the use of a second lens, which is cemented to the first by means of Canadian balsam. Although achromatic lenses may be employed with advantage, the results obtained are not of sufficient importance to warrant their use, unless the reader is so disposed.

When purchasing the lenses it will be well to see that they are correctly edged—that is to say, see that the edges have been ground away in a lathe at an angle to the plain side of the lens. Lenses, as above named, can be obtained from any manufacturing optician, at prices varying from about 6d. each to 1s. or more, according to the firm supplying them. In the trade they only cost a few pence each. The focus of a lens can be readily ascertained by holding it between the sun and a piece of card or a whitened wall, the distance which gives the most distinct image furnishing the focus of the lens.

It will be necessary to keep the hands quite clean and free from brass turnings when handling the lenses, otherwise the surface will soon be spoilt with ugly scratches. For this reason it is advisable to spread a newspaper over the bench when they are being tried in the seating of the cells; or, better still, this job may be done clean away from the litter of the work bench.

In my next paper I shall hope to speak about the Stand, Table, Supporting Collar, and other parts of the Spectroscope. Meanwhile, master what has already appeared.

SCREW-CUTTING IN THE LATHE.

BY J. H.

Leading Principles and Simple Trains.

Mode of Treatment proposed—The Lathe—The Leading or Guide Screw—Graphic Examples of Relative Rates of Revolution—The Case of Fractional Pitches—Meaning of "Driver" and "Driven" Wheels—Meaning of a "Simple Train."

Mode of Treatment proposed.—Many of the lads in our turneries experience so much difficulty in learning the mystery—for so it appears to them—of cutting screw threads, that it seems desirable to treat the subject in a way rather different from the mere descriptive method usually adopted. I propose, therefore, to explain it by means of graphic outlines; and if to some lathe men my descriptions may seem rather elementary and somewhat prolix, my apology is the difficulty which many apprentices and, for the matter of that, metal turners experience in mastering the principles of screw-cutting.

The Lathe.—I think I may safely assume that every reader of Work who feels any interest in lathe matters understands the essential mechanism of the screw-cutting lathe. At any rate, I shall make that assumption, and not occupy a page of our valuable space with illustrated details of headstock gear and slide-rest mechanism. Should, however, the ideas of any of our younger readers on this subject be rather hazy, they can find the mechanism of the screw-cutting lathe described clearly and fully in "Cutting Tools worked by Hand and Machine" (Cassell & Co.), Chapter VI., and in "Metal Turning" (Whittaker & Co.), Chapter I. I will therefore plunge at once into my subject.

The Leading or Guide Screw.—In Fig. 1 let A represent the leading screw of a self-acting lathe, and B a rod upon which screws

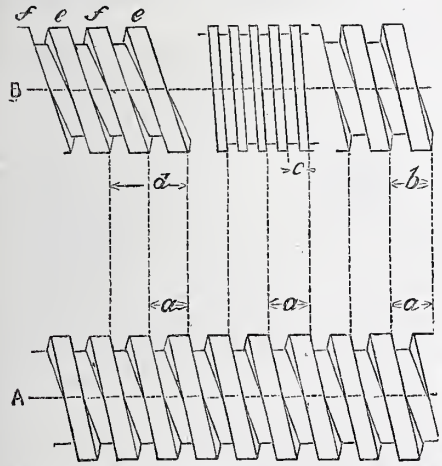
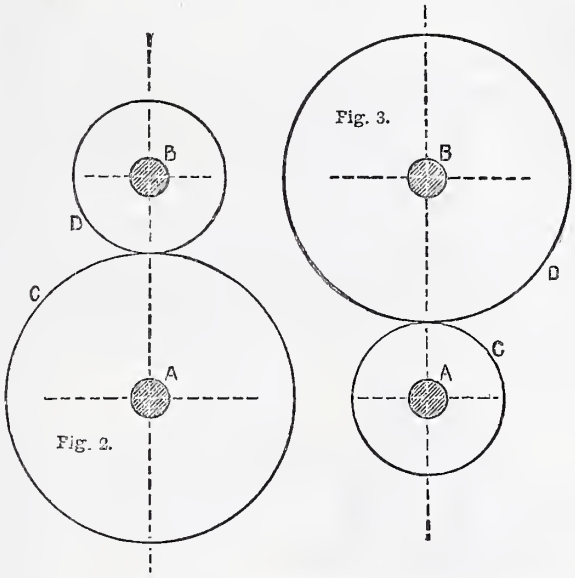


Fig. 1.—Graphic Diagram to illustrate Pitches Equal, Finer, and Coarser than that of the Guide Screw.

have to be cut. Now the problem is simply this: How to utilise the leading screw, A, whose "pitch," or rate of thread, is constant and invariable, for the cutting of threads of diversified pitches upon rods, B, running between lathe centres. This evidently resolves itself into a question of the relative rates of revolution of A and B. The headstock mandrel, to which the work, B, is centred, drives the leading screw through the medium of change-wheels. The problem, therefore, is to impart the required ratio of speed from the mandrel, through the change-wheels, to the guide screw.

Graphic Examples of Relative Rates of Revolution.—In Fig. 1, *a*, *a*, *a* is the pitch of the guide screw, which screw is encircled by the clasp-nut. The pitch, I may remark, is equal to a thread and a space; or the distance from centre to centre of adjacent threads; or from centre to centre of the spaces; or, in the most accurate language,



Figs. 2, 3.—Diagrams to illustrate the relations of Change-Wheels.

the longitudinal or axial distance covered by a thread in a single revolution round its cylinder. Say this screw is of $\frac{1}{4}$ in. pitch. If we want to cut a screw of $\frac{1}{4}$ in. pitch—*b* on B—then the clasp-nut and tool point must be made to traverse the distance *a* and *b* in equal times. In other words, A and B must each make a complete revolution simultaneously. Clearly also, if we desire to cut a thread on B of $\frac{1}{8}$ in. pitch, *c*—viz., of one-half the pitch of A—the rod B must make two revolutions while A is making one. But, on the other hand, if we want to cut a thread on B of $\frac{1}{2}$ in. pitch, *d*—viz., of twice the pitch of A—then B must make but one revolution while A makes two. (Note, by the way, that this screw is double threaded—that is, *e* is one thread and *f* another.) The problem, therefore, is resolved into one of relative rates of revolution and of relative traverse of the cutting tool in equal times. *And the rates of revolution of* A *and* B *are clearly in inverse proportion to the pitch of* A *and* B. That is to say, to cut a screw upon B of half the pitch of A, then B must revolve at twice the speed of A; and to cut a screw on B of twice the pitch of A, then B must revolve at half the speed of A. Hence the change-wheels used must be selected so that the numbers of their teeth shall bear the same proportions as the screw rates of the guide screw and of the screw to be cut; and they must be so fixed that the inverse relations required shall be obtained. So that, if the rates are equal, wheels of equal size will be used on the spindles both of the guide screw and screw to be cut. But to cut a screw, *c*, of $\frac{1}{8}$ in. pitch on B—viz., of half the pitch of A—a wheel must be put on mandrel B half the size of that one put on A (as in Fig. 2). Then wheel C, Fig. 2, will only make half a revolution to a complete revolution of wheel D, and the leading screw, A, will be retarded in relation to the rod, B, by just one-half, and a thread of $\frac{1}{4}$ in. $\div 2 = \frac{1}{8}$ in., will be cut on B. Conversely, to cut a thread of $\frac{1}{2}$ in. pitch, *d*, on B—that is, twice the pitch of A—a wheel, D, will be put on B, Fig. 3, having twice the number of teeth of the wheel C on A, and the rate of traverse of the leading screw, A, will be double that of the rod, B.

These are the fundamental facts, which, better than any set rules, should be well assimilated in the mind of the screw-cutter. There need be little floundering among the rules which appear in so many and various forms in treatises on screw-cutting, and which are often a source of mental confusion.

The Case of Fractional Pitches.—Going a step further, precisely the same inverse relation must exist when cutting fractional threads. At A in Fig. 4 we have the same leading screw of $\frac{1}{4}$ in. pitch. At *b* one and a half threads are cut in the length of the pitch of the guide screw. At *c* one thread is cut in the space occupied by one and a half threads of the guide screw. To cut *b* a wheel must go on the guide screw, A, having one and a half times the number of teeth of that on the lathe mandrel, B. To cut *c* a wheel must go on the lathe mandrel, B, having one and a half times the number of teeth of that on the guide screw.

Meaning of "Driver" and "Driven" Wheels.—The wheel that is put on the lathe mandrel, B in the figures, is called the driving or "driver" wheel; the one that goes on the guide screw, A, is termed the "driven" wheel. We say, therefore, that the same ratio must subsist between the number of teeth (or diameters) of the driving and the driven wheels as exists between the pitch of the guide screw and the pitch of the screw to be cut. The same thing is said in another way, convenient to remember, thus: When cutting threads of finer pitch than that on the leading screw, the smaller wheel must drive and the larger be driven. When

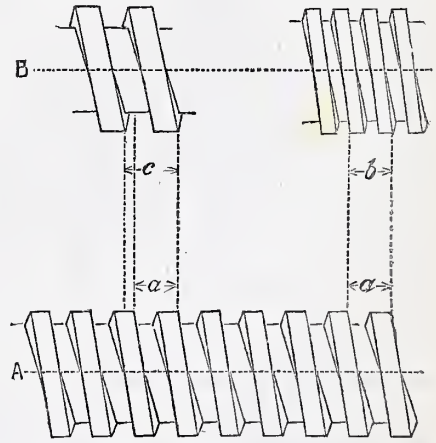


Fig. 4.—Graphic Diagram to illustrate Fractional Pitches.

cutting threads coarser than that on the leading screw, the larger wheel will drive and the smaller be driven. These are axioms to be committed to memory.

Meaning of a "Simple Train."—When there is only one driving wheel and one driven, we have what is termed a simple train of wheels. But it often happens that several wheels are required to cut a screw of very fine or very coarse pitch, and these

compound trains, as they are called, sometimes occasion difficulty as to the correct relative locations of the several wheels. The necessity for the employment of a compound train arises when the numbers representing the ratio of the leading screw and of the screw to be cut extend beyond the limits of an ordinary series of change-wheels. Those limits are commonly wheels of twenty and one hundred and twenty teeth. The ratio of these is $\frac{120}{20} = 6$, and when limited by these wheels, the ratio between the pitch of a guide screw and that of a screw to be cut on any lathe cannot exceed six, unless a compound train is employed. In a lathe having a guide screw of $\frac{1}{4}$ in. pitch—*i.e.*, of four threads to the inch — twenty-four threads to the inch mark the limit that can be cut with a simple train, thus: $\frac{24}{4} = 6$. In a lathe having a guide screw of $\frac{1}{2}$ in. pitch—*i.e.*, of two threads per inch —the limit is reached at twelve threads per inch, thus: $\frac{12}{2} = 6$. I will not now commence this rather wide subject of compound trains, but will leave my readers to digest the fundamental principles laid down in the present article, leaving compound trains to be treated in the second paper.

PHOTOGRAPHIC PRINTING FRAMES FOR THE MILLION.

BY CHARLES R. KING.

What is more annoying than to find, with the ordinary small printing frame, that the movement of opening the back has caused the print to shift?

Here is a printing frame that is proof against such a failure. The writer has used it for two years wherever he wanted a close contact all over the paper on the negative, and to be certain of its not moving. For this reason he values these frames at double that of the shop-made articles.

How to make it. A steel glass-cutter to cut up your waste negatives, and several dozen of the paper-clips known as "bull-dogs"; or you can use ordinary wood-clips, as does a well-known Parisian photographer, who employs this device almost exclusively; but the iron clip is far better, because—please note—you can print up to the very margin of landscape views, without being obliged to use a face-glass, as he does. This face-glass takes the place of the plate-glass in large printing frames. Here, with these clips, it is unnecessary. You will have made a dozen printing frames with their pads of blotting-paper in the same time this has taken to write. The "frame," minus one-half, is shown in Fig. 1.

For printing plates up to 15 in. by 12 in., the only additional work necessary to make a first-rate printing frame is strips of wood just the length of the backing-glasses, which may be two, three, or four in number. The ends need to be bevelled. The clip is clasped over them in the manner shown (Fig. 2). If the strips are so thin as to slightly spring off the middle of the backing-plate, a little tuft of paper may be inserted without fear of breaking the negative, so long as it is done with reasonable care.

By using a face-glass of large size, this frame enables one to print small negatives on any size piece of paper where broad margins are required, as in contact bromide printing and platinotype.

Try it; you will never use a wooden printing frame again. It is no expense. There are always old negatives about, and the clips are always useful in the office. If you are a traveller, you will never add to your baggage a clumsy printing frame. You will take some clips, and your failures will supply the glass you may require.

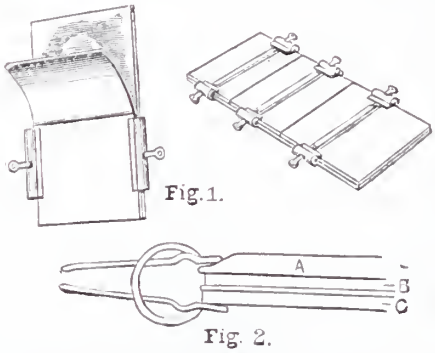
THE ART OF STAIRCASING.

BY GEORGE F. CHILD.

Close String Stairs with Winders.

Introduction—Working Drawings, Plan, and Elevation—Setting out Wall-Strings—Setting out Outside String—Gluing up Wall-Strings—Cross-Tongues for Joints—Gluing up Staircase—Halving Newels—Form of Bull-Nose Step—Housing Newels—Easements.

Introduction.—In the plan of the staircase before us it will be seen that we have a somewhat awkward arrangement to deal with, the "going" being so little that winders at both top and bottom are imperative. It will also be remarked that a door,



Photograph Printing Frame with cut Wood. Fig. 1.—Frame. Fig. 2.—Clip—A, Wood; B, Negative; C, Glass Back.

D, opens directly upon the stairs at the top, thus making a special arrangement at this point necessary.

Working Drawings, Plan, and Elevation.—Having drawn the enclosing walls of plan and elevation and marked in the height for landing, L, we find that we cannot manage with less than thirteen risers, which, as we know, gives twelve treads, or steps. Now, on referring to the plan, we plainly see that to arrange for a straight flight it will be necessary to introduce a landing at the top and a space equal to a landing at the bottom. This, of course, cannot be done, as we could not obtain space for our twelve steps. We now try if it can be managed with winders at the bottom, and again fail to get the necessary going. By this it will be seen there is no alternative but winders at top and bottom also. Having decided upon our course of action, we proceed to set out the winders at the bottom. By introducing a step in front of the newel we materially assist our going, as it gives us an extra tread; therefore draw the step No. 1. Now draw the three winders as previously described. Next set off the width between wall and newel at the top, making it equal to the bottom. We now notice that the door on the landing, L, comes rather close to the top step, thus making it dangerous for a person passing through in the dark. To obviate this, the top winder (or, more correctly speaking, the landing) should be brought forward as from *a* to *b*, which is, of course, an improvement. Next set off the three winders, dividing them out equally as before.

We now find that by this performance we reduce the number of our treads by seven—being four at the bottom and three at the top. This gives us five to deal with; therefore, divide the space remaining between the winders into five equal portions, thus completing our plan.

To finish the sectional elevation, project the treads from the plan to intersect with the lines drawn for the risers as before, and drawing the easements on string. The dotted lines at the bottom represent the two first steps and newel, and at the top the landing, newel, balusters, and handrail respectively.

Setting out the Wall-Strings.—We now, by taking the most careful measurement, obtain the length necessary for the string, which would be the distance between *a* on Fig. 5 to *b* on Fig. 6. (These two figures really should be one, as plainly shown; the reason for being drawn thus is obvious.) Now roughly draw the three steps from 5 to 9, and produce the lines 4 and 10 for the winders, and the lines 3 and 11 also. The spaces between the dotted lines represent the necessary stuff to be glued on for the winders. It has been assumed that the winders have been set out full size on a board, as before described, as to repeat the full directions with each plate is altogether unnecessary. There being something different in each plate renders a careful study of the whole desirable.

Setting out the Outside String.—To set out this string, all that is necessary is to mark the shoulders, s, s, Fig. 12, and draw the steps from the pitch-board. The tenons are cut as shown, and draw-bored into the newels.

Gluing up the Wall-Strings.—The wall-strings must be glued up with a tongue, as before described. The elevation in Fig. 3 is obtained by projecting the winder and marking the height of each riser to meet it. Fig. 4 is drawn in exactly the same manner, F L being the floor line and S the skirting. The method of applying the bevel for these two strings has been described in a previous article.

Cross-Tongues for Joints.—To ensure a good job, a tongue should be used for all joints known as a cross-tongue. This is so called on account of its being cut across the grain of the wood, which, of course, makes it much stronger. This form of tongue is illustrated at Fig. 11. A piece of board is obtained of the requisite thickness, and a portion cut off at an angle, as from *a* to *b*; the tongues are then sawn off from this point until a sufficient number are obtained.

Gluing up Staircase.—To glue up this staircase, it is well to fix the flyers first, as previously described. The newels may then be joined, and the winders, with the short strings, glued and wedged into their proper positions.

Halving Newels.—As these newels might be of an inconvenient length, and perhaps prevent the staircase being carried into the building, it is a good plan to halve them together above the winders, and fix them with screws when required.

Form of Bull-nose Step.—The step seen at Fig. 7 is a common form of bull-nose, often used where brought forward beyond the staircase, it being less likely to be in the way than a square one.

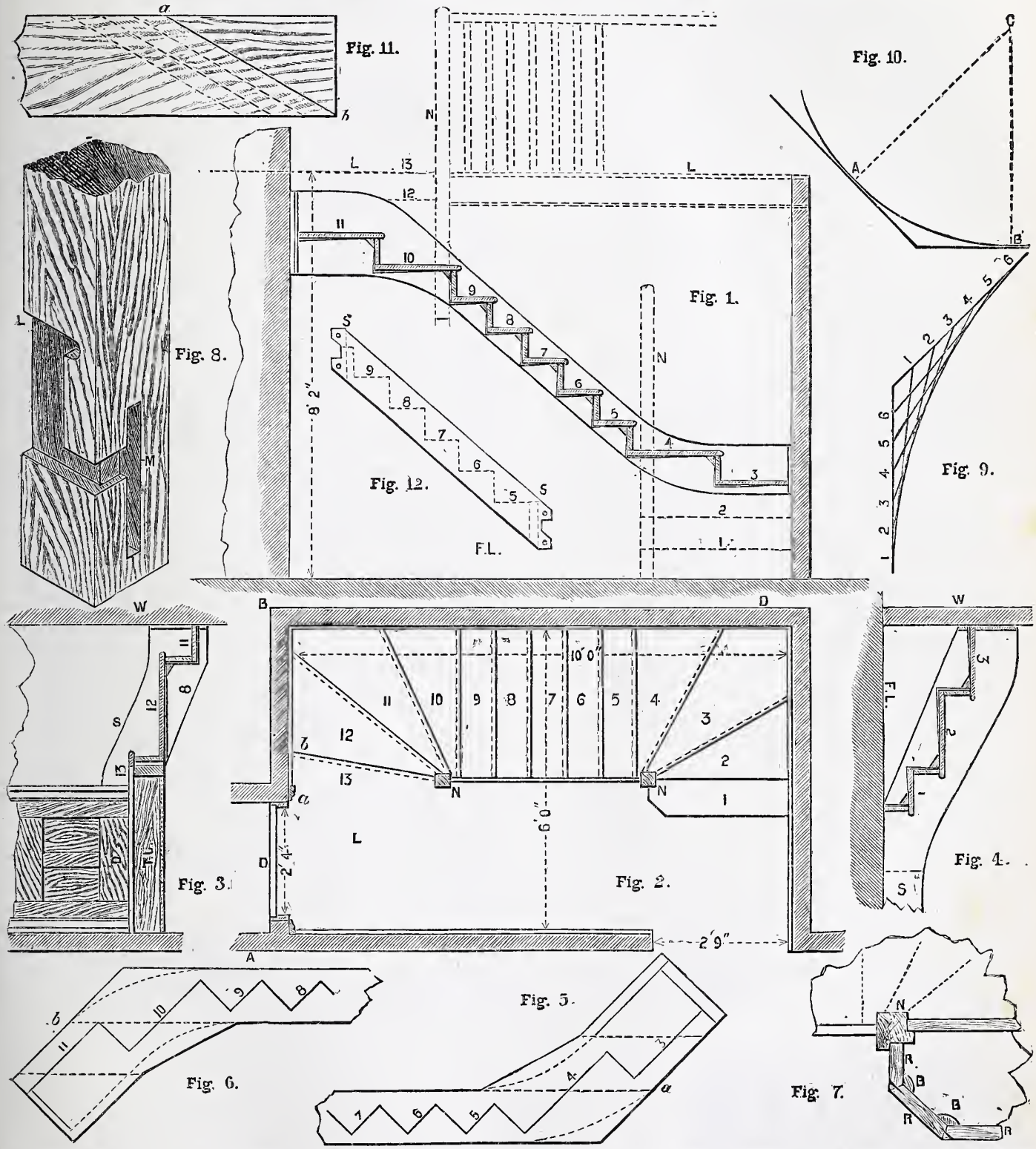
In this example the riser is simply cut to a mitre and nailed, blocks being glued in the angles at the back. The tread is nailed on the top, showing the same margin (about

1 in.) at the front and end. A solid block of deal is often used in place of this arrangement of riser, but this is entirely a matter of fancy, either plan answering equally well.

Housing Newels.—Fig. 8 will give a very good idea of the manner in which the winders are housed into the newels. M represents the mortise into which the tenons on the strings enter. The top step passes round the newel and under the last riser on landing, which is plainly seen. More will be said in the following chapter on the subject of housing the newels, as it is very important that this point should be perfectly understood, so much depending upon it.

Easements.—Two methods are here shown of obtaining a perfect easement in a practical manner. This is often done by simply bending a thin strip of wood and marking round the curve with a pencil. Fig. 9 is very little trouble, and gives a perfect easement. To construct this, draw any number of equal divisions from the angle, and draw lines from corresponding numbers on both sides, when the points thus obtained give the required curve.

Fig. 10 is another method. This is drawn by taking any equal distances, as A and B, and erecting perpendiculars to them, when the point where the lines meet gives the centre from which to strike the arc.



Staircasing. Fig. 1.—Sectional Elevation—F L, Floor Line; L L, Landing; N, N, Newels. Fig. 2.—Plan—L, Landing; N, N, Newels; D, Door; *a b*, Space from the Door to top Step. Fig. 3.—Elevation on A B—W, Wall; T J, Trimmer Joist; D, Door; S, String. Fig. 4.—Elevation on C D—F L, Floor Line; S, Skirting; W, Wall. Figs. 5 and 6.—Enlargement of Wall-String—*a* to *b*, Length of String. Fig. 7.—Bull-Nose Step—N, Newel; R R R, Riser; B, Blocks. Fig. 8.—Enlargement of Newel—M, Mortise; L, Landing. Figs. 9 and 10.—Two Methods of obtaining Easements. Fig. 11.—Method employed to cut out Cross-Tongues. Fig. 12.—Outside String, S S being the Shoulder Line.

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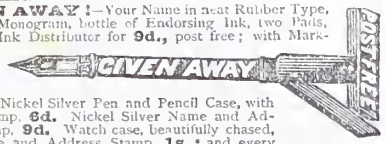

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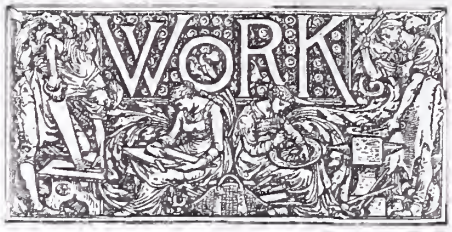

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*** All letters suggesting Articles, Designs, and MS. communications for insertion in this Journal will be welcomed, and should be addressed to the Editor of WORK, CASSELL and COMPANY, Limited, London, E.C.

WHEEL KEYS.—Workmen who have to fit keys into wheels, shaft couplings, and the like, will find it a good practical way to first make a wooden key and fit this neatly into the key seat and wheel or coupling keyway when on the shaft. The wood key should be a good tight fit. Then he would give the wooden key to the blacksmith to make a key a little larger all ways—say to the thickness of a piece of newspaper. This will be sufficient to file off, and by this method he will be able to make a better and also a quicker job. Giving the blacksmith the sizes in figures would most likely lead to his key being made perhaps $\frac{1}{32}$ of an inch all ways too large. Those who use the file every day know that to reduce such work down to the proper size means hard labour. It does not always follow in the mechanical trades that by doing a deal of hard work the most is accomplished. Far from it. Very often the thinking workman who goes about his work putting into operation the "tips" he has from time to time picked up, turns out more real work than a more active and willing comrade exerting even more manual energy.

WORLD'S FAIR EXHIBITS.—The Chicago Exhibition officials or authorities seem bent on making their offers of space, and invitation to show our products, as objectionable as they can. Now the English trade-price must not be put on goods for disposal. This is contrary to all rule that has hitherto guided exhibitions; any price the exhibitor chose to put on was the rule. But the motive is obvious—the prices of many things in England ticketed in Chicago would tell the sightseers how much cheaper the English market was than the American. Our cousins must forget the dollar for a time if they want our goods to adorn their show.

CARRIAGE-BUILDERS' TRANSFER PATTERNS.—These beautifully executed paintings are now to be obtained at a reasonable price. Artists who have graduated in the carriage-painter's shop are highly qualified in many cases to produce to order heraldic devices, landscapes, hunting scenes, and home-life views and fancies. But anyone with artistic taste, a facile touch of brush, and knowledge of colour-mixing, and their harmony when applied in juxtaposition, can execute these transfers, or "decalcomanie." Obtain a smooth sheet of gummed paper, similar to that used for postage-stamps. Upon the gummed surface paint in prepared oil colours, or colours made up as in the proper colours of body-painting work, if made by the painter, but preferably the capsuled colours from the artists' colourman, as they are superfine. When dry, get a similar sheet of plain gummed paper, slightly damp it evenly all over, lie it down on a hard, flat, smooth surface of table, and lay the painted sheet on it, with the design on the damp gum; press it between the leaves of a book, or felted boards of large size, till dry. Remove the upper pressing book-leaves or board. Then turn and damp all over the upper side of the sheet painted on, and when soft enough, remove it; it comes off easily. This leaves the painted design face downward on the gummed paper, ready for transfer to the varnished panel. This is done as follows:—Varnish the panel, and when tacky to the touch, press evenly on the transfer to the panel, so as to be sure the transfer is impressed in the varnish. When set, soak the paper with water all over, and peel off the paper, and your transfer is as firm on the panel as if painted there. The whole may then be varnished.

DANGER!—Artificial imitations of ivory and bone have yet another danger. We pointed out a short time ago that wearers of this composition in the form of buttons, etc., carry about with them, more or less, an explosive—in fact, an equivalent to nitro-glycerine, owing to its inflammable nature; and an instance has been known of a gentleman's collar of this substance catching fire whilst being worn, owing to the careless handling of a lighted taper. There has come under our notice a pianoforte with the keyboard destroyed, which was caused by a light falling upon it. As this composition is used largely for covering the keys of medium-priced pianos, organs, etc., we call attention to its danger, and warn our readers against laying lighted cigars, matches, or naked lights of any description in close proximity to anything made of this composition. It is easily distinguishable from ivory or bone by scraping with a sharp knife, or wiping over with a piece of rag damp with methylated spirits, when it will, if not genuine, emit a strong smell of camphor.

SOLDIER CYCLISTS.—We cordially agree with Major Holmes in his views on military cycling, and hope that some of the suggestions set out in his article upon the subject in the *United Service Magazine* will find favour in the proper quarter. When initiating our recent Prize Essay Competition upon "The Cycle: Its Worth to the Nation," we had in mind the possible future before it both for volunteer and army service purposes; we are, therefore, glad to see ourselves supported by a practical soldier. Major Holmes submits that the cycle will convey infantry with greater rapidity and under better conditions than any other available means, for which reason he suggests that a cycling regiment should be established in every county.

DESIGNS FOR WOOD, MODELLING, OR LEATHER-WORK PANELS.

BY J. EADIE-REID.

IN introducing to the notice of our readers the accompanying page of designs for adaptation in wood-carving, a little talk on the principles of such designs would not be amiss. It must first be remembered that the designs have not been created so much for themselves as for their value as decorative features of the cabinet or sideboard, and then merely as enrichments, not as independent features. Having before us a given space, upon which we consider ornament would be valuable, we must next think what arrangement of lines will fit best, and at the same time quietly.

It is for the purpose of helping our readers out of this difficulty that the designs have been prepared for their use. The lines, forming the basis of the forms, are of the serpentine character, and more or less complete in themselves. In drawing the leaf forms, see that the serrations are carefully and clearly drawn—not simply an angular zigzag, but each serration must be drawn with its own curve and back. If this is slurred over, the design will immediately lose its character. (See Fig. 4.) This illustrative note is a characteristic leaf of the Byzantine period, and will help you in realising the conventional treatment.

There is no better training in leaf drawing than that which is to be gained from a day's study under the hedges.

It will repay the student of ornament far better, instead of the stereotyped water-colour sketch brought back in triumph from the country, if a neat little book, filled with careful pencillings of wayside sprays and ground plants, were in its place—perhaps not so interesting and pretty in the eyes of his admiring relatives, but infinitely more valuable to himself in his practical work. We cannot conventionalise if we have not the knowledge of plant form. Conventional treatment is not an improvement upon nature, but rather an application of the material nature has so lavishly

Fig. 1.—Vine Panel (Conventional) for Sideboard or Cabinet. Fig. 2.—Alternative Designs reduced. Fig. 3.—Byzantine Detail for Rosette.

spread before us—if we will but use our eyes.

The complaint is often heard from workmen that it is of no good their trying to draw with a fine point, for they can never do it.

In answer to this, may I remind the carver, for instance, that it is no discredit to him if he may not be able to produce a fine pencil line or a steady brush mark. If he is able to draw firmly and cleanly with his chisel is not that sufficient?

His drawings might be produced with the burnt end of a stick, but they are for his own purposes, and perfectly intelligible. They are, in short, working drawings, done in the method which comes easiest to the workman's hand. It may be pencil, brush, or charcoal. They are never intended for exhibition! He must, therefore, not be discouraged, when he begins sketching from natural forms, to feel that his first attempts are crude.

The power required for the chisel is somewhat different from the delicate touch necessary for a brush or pen. Practice and patience are all that is necessary, and no man who loves his art is ever without opportunities; no difficulties are so great that they cannot be surmounted.

HOUSE SAFEGUARDS.

Considering the number of inventions in the nineteenth century, it seems strange that the idea of house safeguards does not tempt some of our inventors to devise some plan or means of defence better than that already resorted to. The window fasteners now used so extensively, and "cracked up" for sale as the height of perfection, may be justly termed the "burglar's friend," as by the means of tools such as burglars carry nothing is more simple to unfasten. In many houses the ordinary pocket-knife blade will unfasten catches—more especially if the frames are loose in their sockets—so as to enable the windows to open easily, making access to the interior easy to accomplish. The best and simplest method at present is, undoubtedly, the plan resorted to in some houses in the western counties, which is to procure a small-sized gimlet, and with that bore a hole through the top and bottom frames, passing into the sashes or supports until a depth of about 2in. or 2½in. is attained. Then procure an ordinary wire nail, and pass through the incision made—viz., through both window-frame and sash. By colouring the nail-head to match frame the trick passes unnoticed. It is surprising to find what additional strength this one nail proves, a simple experiment of which will justify the fact. As the job does not injure the frames or sashes to any great extent, more than one of these "safeties" may be put in to give extra strength, but seldom is more than one necessary. One thing, however, must be borne in mind—namely, that in removing care must be taken either to draw out the nail or nails and putty up the holes, or to tell the incoming tenant the "wrinkle." So much for the safety of the windows. We will now proceed to the back doors. We mention the back more particularly because, it must be remembered, burglaries are generally first attempted there. The method employed for this is a simple contrivance, which is in the power of any amateur to make. Procure a piece of brass, copper, or other metal, and shape as in the illustration. Fig. 1 shows the contrivance: A, place for screw; B, top part, to be bent so as to allow easy handling. By this means the cleverest burglar will be baffled in opening a latch-door. It only remains to be noticed that the article works on the head part of the screw, it being fastened so as to allow easy working.

THE CYCLE: ITS WORTH TO THE NATION.

(*Being the First Prize Essay, by* "Philolaus"—Rev. F. A. Wodehouse, *Gotham Rectory, Kegworth, Derby.*)

The cycle, like everything else, has its friends and foes, enthusiastic admirers of its merits and hearty depreciators of its worth; so much is there in the "point of view." For ourselves, however, we are inclined to say there is less room for disagreement here than in the case of many less controverted themes. We regard the various drawbacks which have caused many to look askance at the cycle, or perhaps at cycling, as unfortunate accidentals rather than inherent defects. Experience having given a bias to our judgment favourable to the subject under discussion, it is with sympathetic assurance that we endeavour to answer, "What is the cycle worth to the nation?"

Fig. 4.—Leaf showing Serrations.

As a Trade.—In looking at the cycle from this point of view, it is less to our purpose to enter into actual figures than to mark a few points characteristic of this branch of industry. We claim for this trade that it is one diffused throughout the length and breadth of the land. True, to one town must be given a pre-eminence; Coventry, no doubt, can lay claim to being a kind of cycle metropolis, but priority in time, and a certain numerical pre-eminence in cycle factories, in no way means monopoly. Through the introduction of the cycle there has been created an industry which is everywhere. Whilst so many other manufactures we are able to locate, and to assign to different neighbourhoods almost an exclusive appropriation of production, as regards the one under discussion we ask, What town is there of any size without its makers and repairers, its cycle factories and cycle depôts? From Glasgow to Brighton, from Bristol to Norwich, the rule would be true, perhaps, with no exception. A large factory will, for several months in the year, turn out from 250 to 300 machines per week, and find employment for over 400 men and boys. The total number of machines sold last year was 600,000; this year the number will probably be more, but these will be made not in one or two places, but by many makers in all parts of our land.

The cycle trade employs essentially skilled labour. Of no trade can this be said more truly than of that now under discussion. We deprecate, indeed, any hasty stigmatising of any work as not skilled. The husbandman who drives the plough, delighting the eye with the straightness of his furrows, is a skilled labourer. He who steers the ponderous 'bus through the mazy labyrinths of metropolitan traffic is a skilled labourer. Nevertheless, there is such a consciousness in the mind of the mechanic of latent possibilities of further improvement, such an ever progressive elaboration of details, such a semi-conscious sympathy in the maker for the machine, that cycle makers may fairly claim a leading place amongst our artisans. The maker of a locomotive will probably never drive one: the needle of the sewing machine will never ply its busy work under the guidance of him who made it, but the constructor of the cycle is usually a rider. He knows the ins and outs of the machine. His very recreation inspires him with affectionate accuracy in his work; the hand, the head, and the heart unite in wholesome and conscientious harmony.

More important still, the cycle trade is an increasing one. We stand almost at the beginning of its possibilities of development. A writer, evidently acquainted with the subject, expresses his conviction that the 600,000 machines of 1891 will, in a few years, be more than doubled. The very development of type from the Bone-shaker to the Geared Ordinary demands an ever renewed supply. Other trades are pressed into the service. What if every vehicle, thanks to the exertions of cyclists, should be required to carry a lamp! or how much of our road improvement is due to the same cause? We chronicle great things of the trade; we prophesy greater. The cycle trade has taken its stand among the great trades of the land. What is a great trade worth? Who shall estimate? Not the adept at figures and statistics so much as he who can gauge the difference between the miserable concomitants of enforced idleness, and the happy home, contented mind, and sturdy children of the well-employed artisan.

As a Means of Locomotion.—The introduction of progression by steam marked a new era in the history of our land. We are not claiming for the cycle a like importance; from the nature of the case its use is limited to a certain portion only of our population; nevertheless we wish to point out how valuable are some of the characteristics of this new way of getting about for those by whom "it may be had."

It is Speedy.—The rider moves by "pneumatic despatch." "These cyclers fly along," is the cry of friend and foe alike. The rapidity with which he moves is indeed one of the chief causes of complaint against the rider. No reader will accuse us of exaggeration if we say that an ordinary rider on average roads will, compared with the traveller on foot, save forty minutes out of every sixty. The proverbial "four miles an hour" of the pedestrian becomes the twelve miles an hour of the cyclist. Three times the distance is accomplished with less effort; whilst the burden of enforced travel is transformed into a pleasure. This twelve miles an hour we may regard as a normal speed; but let it be an occasion of life and death, let the very existence of some loved one hang in the balance, we may well marvel at the speed that may be attained. Twenty-two miles in the hour sustained! What ideal powers of unimagined progression!

It is Cheap.—That this should be advanced as an argument that can be sustained may at first seem somewhat surprising, yet in estimating the cost of cycles there is need of care. Price lists and advertised prices are deceptive. The cycle trade has ranged itself among those which give large discount for cash. The £20 or £18 advertised may be found to be not more than £15 or £12 "cash down," whilst makers who have a name to lose advertise on these terms very serviceable machines for £10. But the cycle trade, from its peculiar position, is one with a large second-hand "connection." Auctions are, during the summer months, held in every large town. Advertisements in marts and emporiums (wisely selected, of course) are reliable. Agents who will sell at a small profit for quick returns are not few and far between.

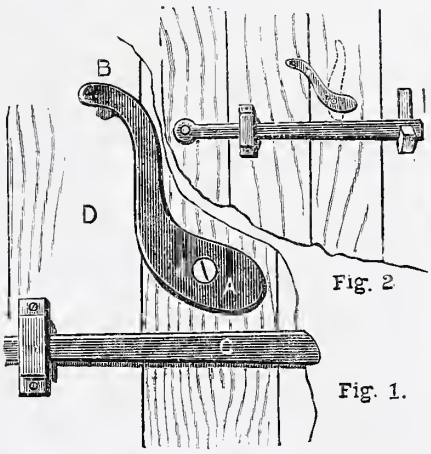
The cycle world is largely composed of riders who are constantly selling good machines on low terms in order to provide themselves with better. The very inventions that run up the prices of the best, unduly lower the market value of less advanced types. Where the man of means will discard the solid and cushion tire, contented with nothing but a pneumatic; where the cross frame is contemned, and nothing will do but the latest base-extended diamond; where the chain has come to be regarded as obsolete, and ambition (or the love of cleanliness) demands a Geared Ordinary, a

"Loco," etc., a "poorer brother" can secure, at greatly reduced rates, a machine that will prove a boon companion for many a long day. Thus provided, what are his subsequent costs of maintenance? A horse is the only rival as to speed. Contrast the expense of shoeing, grooming, feeding, with the few pence required for oil. No doubt an opponent will ask, What is to be said about spokes breaking, wheels buckling, cranks loosening, above all, tires bursting? We answer, "Hundreds of machines can be bought superior to such fatalities." Pneumatics are luxuries, whilst their bursting propensities under newer auspices are somewhat exaggerated. Our rider, then, for £12 is furnished with a machine which, with care, will last him for at least five years, riding for eight months in the year, and an average of one hundred miles a week, and thus costing him about 1d. for every five miles; at the end of the time he sells his machine for £6, thus really halving his expenditure; and whilst merely expending his bodily energy, which is increased by the exertion, he conveys himself on a most reasonable estimate at a charge of one-halfpenny for every five miles!

It is a means of locomotion which can be employed where *such powers are most wanted.* This is a merit, the worth of which it is most difficult to appraise at its true value. To those who can deliberate as to their mode of transit, whether they will travel by cab or 'bus, tram or rail, the value of this idiosyncrasy in the cycle will probably be greatly underrated. For them it means little that the cycle can be kept at the "odd place" and the lonely cottage. The city world knows not how the country world lives. It is the lonely cultivator of fields, not the denizen of the well-vehicled mart, who can best appreciate a machine which asks alone for a narrow track at the side of a road, and then under his easy pedalling bears him quietly and unostentatiously to hives of human industry, and central homes of company and civilisation. If these are its characteristics as a means of locomotion, who shall rightly gauge its worth to the nation?

To say that only a limited number can avail themselves of it is but to say that its value is not simply measureless. After all, it reaches men, and men of all ranks and ages. The nation is made up of individuals; to how many among such is it a boon? The soldier finds a vast convenience for "orderly" work, its limited requirement of forage being no small recommendation in the eyes of the War Office; the doctor, a horse which will "patiently abide" while the complaints of the most exacting hypochondriac are explored; the clergyman finds the scattered parish robbed of its drawbacks, the commercial man, the working man, the political agent, not to say their sisters, cousins, etc.; but we forbear. Improved means of locomotion—how much it implies! How beneficial the tendency of such a new introduction into our ways and means of communication! Isolation is minimised; space is annihilated; Home Rule becomes a bugbear; the world lives together; brotherly love continues; man is one.

As a Pastime and Recreation.—Under this head the thoughts of many will turn to racing. We leave such to plead their own cause. As horse racing is supposed to lead to improvement in the breeding of horses, so we may conjecture that cycle racing tends to sharpen the wits of factors as to lightening and improving machines. For ourselves, however, we have in mind touring, and the half-holiday or evening ride. We can here only ask our readers to think for themselves what this must be. It is essentially recreation. The escape into the fresh air, the exercise given to muscles otherwise almost unused, this sense of expansion after confinement; of movement, after a state of almost enforced dormancy, how precious! The feelings of the cyclist are those of the bird let out of its cage, or the horse turned into the wide-spreading meadow. Every faculty finds vent and exercise. "Our sight," says Rogers, "is the noblest of all our senses. It fills the mind with most ideas, converses with its objects at the greatest distance, and continues longest in action without being tired." To sight, what endless dioramas are offered by cycling. "I had rather be blind than deaf," says another. Cycling bears the rider whose ears have been partially stunned all day by the roar of the 'bus, the tram, and the rail, to the home of the nightingale and the twitter of the sparrow. Is there any greater pleasure than rest after toil? Who knows more of this than the cyclist stretched on the mossy slope or reclining on the banks of some pellucid stream; whilst, acme of delight! we have heard of those who, in some unsophisticated dwelling, have found a Maud Müller destined to be, not a beacon of "what might have been," but a "safety match" for the remainder of their pilgrimage. Nor must we forget that many of those who have studied the mechanism of the human frame claim for cycling far more than the mere benefits, great as they are, of recreation. They find in the varied motion of up hill and down, of rise and dip, something far more than in the ordinary walk; in the expanded lungs inhaling the bracing air at the top of some eminence, and almost immediately after in the relaxing vale, a benefit far surpassing the proverbial "change of air"; whilst, though we venture the idea with diffidence, the abstainer from intoxicating drinks may recognise in the cycle one of the truest allies he has ever been fortunate enough to meet with in his philanthropic endeavours to stem the tide of our national curse. No cyclist, while such, can be a drunkard. We speak with caution. Our acquaintance with cyclists is limited. Cycling, we know, is a thirst-producer, somewhat remarkably so, but, on the other hand, the merest tyro knows as well as the most advanced rider, *strong drink taken in excess and cycling are utterly incompatible.* A drunkard, or a man the worse for drink on a cycle, must be a short-lived anomaly; and whilst the nation knows to its cost that the passion for drink is a master passion, we believe that it will in due time discover that for many there is a still greater counter attraction, and will behold the drunken slave of the *cup* transformed into the sober votary of the *wheel.* If so, we triumphantly canvass the sentiment—"The Cycle: its Worth to the Nation."



Safeguard. Fig. 1.—Contrivance—A, Place for Screw; B, Top Part; C, Latch; D, Door. Fig. 2.—Article in use.

We note that our instructions advise us that suggested improvements will be taken into account in judging what the advocates of cycling have to say for their favourite pursuit. With all due deference to the thought, we hesitate to take up the pages of WORK with pictorial expressions of scarcely matured imaginations. The idea is excellent, but the fact is, that whilst in one sense the bicycle trade is in its infancy, and there is not the slightest reason to think that perfection of construction has been reached, on the other hand improvements in design have already been wonderfully developed. Anyone who has followed the history of the manufacture knows that the name of suggested improvements is legion, but that of the vast number those that can be adopted as genuine and practical are few. Everyone loves his own child, but we seem already to feel the chilling glance of the Editor cast on designs which we freely acknowledge will not be put upon the markets, at any rate, this season. We therefore elect to keep them to ourselves, and our suggested sliding saddle, our pedal crank, so arranged that the foot can be applied for almost the whole of the rotation, our brake applied by simply leaning back in the saddle, and our singularly happy improvement on the Zimer Gear, are only mentioned to whet the appetites of those who can appreciate the happiness of the idea underlying them.

But apart from this, we trust we have said enough to raise the cycle in the estimation of our readers. *Honi soit qui mal y pense.* One word to fellow cyclists. The cycle is an admirable piece of workmanship, yet what is the cycle compared to the rider? Shall the manufactured article be worth so much, its rider nothing? No! Cyclists! let us stand together! rally under our flag of industry, progress, and health; our ambition to demonstrate OUR WORTH TO THE NATION.

NEW BREAD KNIFE.

THE advantages claimed for the Christy bread knife, which is the invention of a young American — Russ Jackson Christy — are its cheapness, lightness, great cutting efficiency, and that it slices bread without making crumbs. It is made entirely by machinery, the blades being sheared out of steel sheets 15 ft. long and 8 in. wide, and the handles being of soft steel wire. The blades are dovetailed—each one at the two places of attachment with the handle—and run into the grooved wire. The wire is then struck, the two sides of the grooves meeting in the dovetails. As will be seen from the illustration, the knife may be conveniently hung up by the handle instead of being placed in a drawer and having its edge spoilt by contact with other knives and forks. The reason it makes no crumbs is because the side next the loaf in cutting is flat, not an inclined plane, as in the ordinary wedge-shaped knife, the Christy being ground on one side only. The ordinary knife makes crumbs because, being wedge-shaped, the top of the wedge disturbs the bread particles in the loaf. This is avoided by the Christy blade, its perfectly level inner face exerting no lateral pressure on the loaf. Again, through the scalloped edge a greater extent of cutting surface is applied simultaneously. It will thus cut bread that is quite new and hot into thin slices. For left-handed people the blades are ground on the other side. The manufacturers also produce a cake knife and carver on the same principle, and a paring knife with a straight edge, but ground on one side only, the perfectly flat side being next the apple or potato or whatever it may be, and so preventing the knife from running into the article and cutting off more than is intended.

Crumbless Bread and Cake Knife.

As a proof of the conductivity of silver, a correspondent and eye-witness vouches for the following: At an hotel at Bordeaux the maid waiting at the dinner table—during a severe thunderstorm—had in her hair a large silver ornament in the shape of a dagger. Immediately preceding a terrific thunderclap came a flash of lightning, which struck the silver ornament in question, and burnt the whole of the back hair, without otherwise harming the girl.

TRADE: PRESENT AND FUTURE.

*** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

TIMBER TRADE.—The following are some of the latest prices realised: 1 in. by 12 in. 1st dry pine, £17 15s. std.; 3 in. by 9 in. 1st Petersburg yellow, £12 5s. std.; 3 in. by 9 in. 1st and 2nd Novrkoping, yellow, £13 std.; 3 in. by 9 in. 3rd Novrkoping yellow, £10 5s. std.; 2 in. by 4 in. yellow, from £6 5s. to £7 std.; 1 in. by 6½ in. yellow flooring, 9s. per square; ⅝ in. by 6½ in. yellow flooring, 6s. 6d. per square; and pitch pine timber, 53s. to 55s. per load.

COTTON TRADE.—Another serious crisis threatens the cotton industry of Lancashire. A general reduction of wages is expected to be announced, when a complete stoppage of the mills will follow, as the operatives will resent the least interference with their wages. As to the critical condition of the industry there can be no doubt; indeed, it is estimated that more money has been lost in Lancashire during the last twelve months than in any year since the trade was established. In Oldham alone the losses on one quarter's working have amounted to £100,000.

ENGINEERING TRADE.—There is a better tone prevailing in most branches. The large stationary engine builders are busier than they have been for several weeks past, while boiler makers generally are again moderately well off for work. The large firms who make a speciality of textile machinery are fairly employed. The machine tool makers have experienced a slight revival in trade, but locomotive builders report comparatively little new work coming forward, and some of the principal works are but indifferently employed. The reports for the past month of trade union organisations connected with the engineering industries reveal an unsatisfactory state of affairs, both as regards the general reports of the condition of trade and the number of unemployed members. In the Amalgamated Society of Engineers there are now about 5½ per cent. of the total membership in receipt of support, while in the Steam Engine Makers' Society the returns show about 2½ per cent. of the members on donation benefit; each of these returns is an increase on that of the previous month. The reports as to the state of trade show a tendency towards slackening activity in the principal industrial centres, and it is only in exceptional cases that trade is reported as good.

CYCLE TRADE.—This trade is fairly busy. The Whitworth Cycle Company are building large additions to their factory, by which their output will be doubled. The New Howe machines have done surprisingly well on the racing path this season. A good deal of discussion is going on as to whether the safety or the new geared ordinary will prove the machine of next season. As an indication of recent trading, it may be noted that the value of cycles and cycle materials exported from Coventry and Birmingham to the United States in the three months ending June 30th amounted to £333,741.

SILVER TRADE.—Many firms in Sheffield are on short time, save with a few manufacturers who have obtained important orders of a special nature.

SHIPBUILDING TRADE.—In the manufacturing branch there is no improvement owing to the small orders in the shipbuilding line.

HARDWARE TRADES.—Our Liverpool Correspondent writes:—Representatives of the Amalgamated Society of Engineers, Boilermakers, Iron Shipbuilders, Plumbers, and Labourers met their employers to consider notices of a 10 per cent. reduction of wages on men earning 30s. a week, 7½ per cent. on 20s. to 30s., and 5 per cent. under 20s. The men offered to accept a reduction of 2½ per cent. if an eight-hour day was agreed to, but this was refused, as also a proposal of 5 per cent. The men are resolved to have an eight-hours day as part of the settlement.

SHIPPING TRADE.—Our Liverpool Correspondent writes:—In the shipping line there is no change in freights. Shipments via Welsh lines are full and regular, but in other quarters the trade is very dull. At present one firm trading with India have five or six vessels lying up. Trade with the Mediterranean is bad, and until the new crop of currants and other fruit is ready very little will be doing.

BUILDING TRADE.—The trade in Manchester and district is still very good. The strike of plumbers at Bolton respecting the allowance for country work and lodging, which has lasted twelve weeks, has been settled by arbitration. The umpire awarded the men the same terms as the plumbers of Manchester and other large towns. Our Rochdale Correspondent writes:—The building trades continue fairly busy.

COAL TRADE.—In Sheffield trade is fairly good. London and gas coals are very slow of sale.

STEEL AND IRON TRADES.—There is a slight improvement in the local steel trade. Two or three good inquiries are in the town which, if they result in business, will give the crucible steel trade full employment. The makers of wheels, tires, springs, and axles are busily employed. There is not much activity in the rolling mills and tilt forges, and the older Sheffield trades show a corresponding depression.

SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

I.—LETTER FROM A CORRESPONDENT.

Hobbyists' Emporium.—THOMASO writes:—"As I understand this suggestion (see WORK, No. 169, page 204), it is proposed to provide an outlet for budding mechanical genius by establishing a sort of permanent exhibition where his (the b. m. g.'s) latest atrocities may be displayed to the wondering gaze of the uninitiated, and, it is hoped, sold to the foolish. Objections to such a course occur to me in such number that I hardly know where to begin. It is proverbially safe, however, to begin at the beginning, and so here goes. The concern cannot be conducted on any system of mutuality similar to that suggested by E. D. in page 204, for the reasons presently stated. His suggestion is absurd. Who is to take the profits resulting from the commission on sale and subscriptions? The concern clearly cannot be carried on, as E. D. apparently thinks, so that the profits shall always exactly balance the expenditure; and if the profits are to be divided among the members (the only possible way out of the difficulty), what is the difference between the proposed concern and an unlimited company, between the 'committee' and 'directors,' and 'members' and 'shareholders'? There is no difference between a number of people making articles independently of each other and then selling them at their mutual expense, each taking a profit, and a lot of people subscribing to buy articles ready-made, and selling them again at their mutual expense and dividing the profit, as in the case of public companies generally. Start the concern as proposed, and then see the legal disabilities it would be under. But it never could start business, for the simple reason that there being no one personally responsible for the rent, no landlord would let his premises; and if any debt was incurred, and there was not enough cash to pay it with, the committee and secretary would say, 'We are only acting for the members. We are not responsible'; and the members would say, 'We have paid our subscriptions, and acknowledge no further liability.' The result would, of course, be legal proceedings, when I have no doubt it would be decided that the concern was a company, and all the members personally liable for the debts; and the men of substance would have to pay for the men of straw. If, on the other hand, it is intended that the secretary and committee shall 'boss' some individual who starts and owns the concern and bears all the responsibility, all I can say is that that individual (when found) will turn out to have escaped from a lunatic asylum. E. D. also proposes that a subscription (annual) shall be payable as well as a commission. No matter whom it is paid to, it is bad. What right is the payment of the subscription going to confer on the subscriber? Obviously it confers the right to send in articles and have them exposed for sale. Is it intended that the proprietor, or whoever receives the goods, shall have the right of rejecting articles he may deem unsaleable or otherwise unsuitable, or is he to be obliged to take any rubbish offered him? If the former, what becomes of the subscriber's right to have his goods offered for sale, and (*inter alia*) what becomes of his subscription? If the latter, Providence protect us from the waggon-loads of rubbish! The annual subscription is rough on those who want to sell perhaps only one article in the course of the year. It is intended that the articles shall be made for sale, and shall not be 'second-hand'; this looks as if there was a sneaking sort of feeling that the affair would degenerate into its prototype—a marine store. Personally, I do not see how it can become anything else. Suppose a rule provides that only 'new' articles are to be eligible, will someone supply me with a definition of 'new' that shall enable 'new' articles made by an amateur to be distinguished from old? How long is the maker of an article to be allowed to keep it and still call it 'new'? If by 'new' is meant 'unused,' then I ask, is an article of ornament, for instance, to be deemed 'used,' because it has been looked at for a time? Verily the second-hand articles are hard to define and keep out! It is further proposed—I presume in order to confine the work to amateurs—that the worker shall make a general declaration that he will make all articles himself. Now, it is well known among amateurs even that parts of many articles have to be bought ready-made. Marvellous is to be the power of E. D.'s declaration, therefore! It is actually going to decide how much of an article a man may buy ready-made, and yet say of the complete article 'I made it!' How and where is the line to be drawn to satisfy the very natural scruples of conscientious workers? and if the worker is not conscientious, what is the good of the declaration? If it is intended to exclude professionals, this declaration obviously will not do it; neither will it do if worded to exclude 'work by which the worker gets his living.' For he has only to vary the work slightly, and make the declaration with a clear conscience—clear to himself, that is. Verily fraud is hard to define and keep out! I do not think it necessary to show that if a subscription and commission is decided on, they must be small to pay the worker, and large to enable the concern to pay its way. For does not E. D. say that the exhibition should be in a central position, and in such positions are not rents high and rates tremendous? To add to the expense, it is proposed that stalls should be taken at London exhibitions to advertise the concern and sell the work. What midsummer madness! Set the mediocre productions of amateurs in competition with picked professional work! Who pays the cost of these stalls? Does it come out of the common fund? If so, the whole emporium will have to be exhibited, or I fail to see what sort of soft solder is going to be applied to those workers whose work is not exhibited. I think, after such an exhibition, there would be a goodly withdrawal of offended members. I have dealt with difficulties that occur to me with respect to the starting of such a concern. If anyone proposes a scheme which avoids them, it will be time enough for me to show why it cannot succeed. Whatever is decided on, the concern must belong to an autocratic *individual*. If we are going to have any more schemes suggested, pray let them be put forward by people with some knowledge of trading and business generally. The amateur promoter is not a being calculated to inspire either confidence or respect. I do not suggest a scheme myself, because I am satisfied that no scheme will be practicable. Others may 'rush in,' but I say, with Disraeli, that I am on the side of the angels, and (to complete the proverb) 'fear to tread.'"—[It would not be a bad plan if you furnished us with your real name and address.—ED.]

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Development of Inventions.—H. H. (*Finsbury*).—The title of the Association referred to is "The London Commercial Association"; its offices are at 47, Holborn Viaduct, London, E.C.—F. C.

Quarter-Plate Camera.—A SUBSCRIBER.—If you will refer to WORK, Vol. I., No. 83, you will there find full directions for making a whole-plate camera, with explanatory diagrams. As a half- or quarter-plate is made on the same lines, it is quite easy to reduce the measurements from the diagrams given. They may be deviated from so far as the *strengthening* part of the construction goes; the wood may be lighter, and the base clamped instead of panelled. The back of the camera and focusing screen portion should be made first, to the size suitable for quarter-plate, and the rest built up to it.—D.

WORK, Vol. I.—H. S. (*London, N.W.*).—The best way would be to advertise Vol. I., with price. W. H. (*Huyton*) could then consider it.

Diaphragm.—F. S. L. (*Liverpool*).—It is a difficult matter to give the name of a *suitable* material for the diaphragm of a phonograph, there have been so many different substances used, sometimes with good results and oftentimes with the opposite. Parchment, mica, ferrotype, glass, etc., have all been tried. I would advise you to experiment for yourself. The papers on the phonograph will soon be given.—W. D.

Mirrors.—P. S. (*Wigan*).—The composition on the backs of mirrors consists either of an amalgam of tinfoil and mercury, or nitrate of silver deposited by means of other chemicals; either process is a difficult one for an amateur, but of the two the latter is the easiest. Should you wish to have a try, the following are formulæ:—(1) A, nitrate of silver, 175 grains; distilled (or boiled) water, 10 oz. B, Nitrate of ammonia, 262 grains; water (distilled), 10 oz. C, pure caustic potash, 1 oz. (avoirdupois); water (distilled), 10 oz. D, pure sugar candy, ½ oz. (avoirdupois); water (distilled), 5 oz.; dissolve and add tartaric acid, 50 grains. Boil in a flask for ten minutes, and, when cool, add sufficient distilled water to make up to 10 oz. For use, take equal parts of A and B. Mix also in another measure equal parts of C and D. Then mix both these mixtures together in the silvering vessel, and suspend the mirror face downwards in the solution. (2) A, pure nitrate of silver, 10 grains; water, 1 oz. Add carefully, drop by drop, strong ammonia until the brown precipitate is re-dissolved, stirring meanwhile with a glass rod. B, pure crystallised Rochelle salt, 10 grains; water, 1 oz. When ready, pour on sufficient to cover the glass, using two parts of A to one part of B. Let it stand in the warm sunshine for half an hour or an hour. Pour off the rest of the solutions, and wash gently with soft water and cotton-wool. With either recipe, the glass must be perfectly clean.—W. E. D., JR.

Paper-Cutting Machine.—A. S. (*Hockley*).—There are hundreds of such machines in the market as you ask a description of. Mr. W. C. Herne's "Advance" cutter would, I think, answer your purpose.—G. C.

Motor.—AMATEUR.—As regards the model motor (see WORK, No. 154, page 785), the coils will not be

close together on the outside of the bend. Keep them close on the inside, however, and make the coils radiate nicely for the sake of appearance; winding round the bend in this way will not interfere with the working. For your second question, you can use your No. 24 copper wire on the magnet, but make your winding fully ⅝ in. in diameter; don't use any much thicker wire than I have shown for the armature, although one size larger will not make much difference perhaps, as you see the space for winding is so very limited, and you want to get as great a length on as you can in this case.—J. B.

Spectacles.—T. W. M. (*Stepney*).—Whoever told you that you could repolish the lenses with sweet-oil must have been laughing at you. You may possibly brighten them with putty powder (oxide of tin, to be bought at the chemist's). This should be moistened, and may be applied with a small piece of very fine cork.—E. A. F.

Cottage Designs.—S. B. (*New Stockport*).—In answer to your letter respecting the cottages, published in No. 150, p. 723, the sizes of the various rooms are as follows: Parlour, 12 ft. by 10 ft.; kitchen, 14 ft. by 10 ft.; scullery, 10 ft. by 8 ft. All these rooms are 9 ft. 6 in. high. The sizes of the bedrooms are exactly the same dimensions as the rooms under them; but as regards their height, they are 6 ft. up to wall-plate, and 10 ft. to the collar, as per sketch.—W. B.

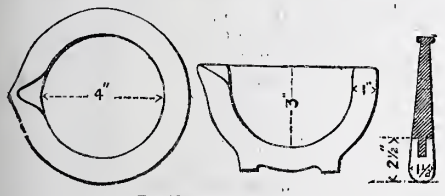
Cottage Plan.

Phonograph.—DELTA.—You will have seen that a further article appeared in WORK, No. 174.

Acid for cleaning Brass Rings.—J. C. G. (*Vauxhall*).—Boil the rings in a strong solution of washing soda, rinse them in hot water, string them on brass wire, and immerse them for half an hour in a pickling acid composed of a wine-glassful of oil of vitriol in one quart of water. The rings will then have a nice golden yellow tint without polish. To make them look like silver, take them fresh from the acid, rinse again in fresh water, and immerse them in a silver-plating solution or in a solution of silver made of 1 dram of nitrate of silver in half a wine-glassful of water, added to 1 oz. of cyanide of potassium in ½ pint of water. This is one of the simple silvering liquids sold in the streets. The acid you inquire for is simply an acid nitrate of mercury made by dissolving a little quicksilver in some aquafortis. It is most injurious to brass, copper, and all other metals, and its sale as a silvering mixture is a shameful fraud.—G. E. B.

Electrical Experiments.—J. A. (*Birkenhead*).—The Editor has a short series on Experiments with Induction Coils. My book on Induction Coils is published by Messrs. Whittaker & Co. at 3s. This deals entirely with coils and the apparatus for working them. A Henley's discharger can be purchased from any dealer in electrical apparatus. The names and addresses of several have frequently been given in WORK.—G. E. B.

Wire—Pestle and Mortar.—IN DUBIIS.—The very thin wire that you got out of the old electric gas lighter is platinum; whether it is absolutely pure or not I have not tested, but I suppose you do not require that. The samples of cotton-covered copper wire are: the smallest, No. 26 B.W.G.; and the largest, No. 22 B.W.G. As you seem bent upon making your own mortar, I give you a sketch



Pestle and Mortar.

of a marble one of my own, which, I think, is suitable for your purpose. You want yours of cast iron, and this is very nearly of a uniform thickness all through—a great thing in any iron casting. If you will take my advice, you will have it cast of the best malleable iron; it is not so liable to crack. But can't you purchase a marble one, say, second-hand? you will find it cleaner and more useful on other occasions.—J. B.

Railway Signals.—W. F. (*Pendleton*).—Thanks. Send your MS. in on approval.

Book on Electric Bells.—BELL.—You will find Mr. Bottone's book, advertised on page 72, Vol. IV., of WORK, a good book on the subject; but no one can foresee all the troubles likely to be encountered by the amateur bell-hanger, since he brings many of those on himself by acting in defiance of electrical laws and rules laid down for his guidance. Your battery is run down because wrongly made up and fixed. You do not require porous cells with agglomerate blocks, as these do away with the necessity of porous cells. The battery must be set up in a cool place. The solution in your cells simply evaporated through being in a hot situation, and the sal-ammoniac then crept out over the edges of the jars. If you must keep the cells in a warm place, smear the tops of the jars to a depth of one inch with tallow or some grease, and cover the solution with a layer of glycerine. I suspect you have also short-circuited the battery by wrongly laying the wires, fixing the pusher, etc. A slight leakage across the lines will soon run down a battery.—G. E. B.

Address of Electrical Firms.—F. P. (*Bristol*).—I am sorry not being able to oblige you. I do not know of any electrical firm likely to be in want of a new patent dynamo. The trade is full up with dynamos just now, and, therefore, a new type, to command attention, must be exceptionally good, and present some novel features of simplicity and economy in construction, together with efficiency in action. Your only chance of meeting with anyone willing to take up your patent is to advertise in our "Sale and Exchange" column for the person you require.—G. E. B.

Waterbury Escapement.—TIMA.—See if the pin projecting from the balance is bent or worn; if so, put it straight or put new one; or perhaps the staff is loose in the balance or has been shifted; if loose, tighten up. If all this is right, and it has still too much drop, grip the staff in a pin-vice or slide-tongs, and move round the balance a little, and try the drop—it should have about as much drop as the thickness of a tooth; if less, it may catch on some teeth, especially when the holes get a little worn; if more, it may miss catching some teeth, and so the vibration falls off. See that staff and 'scape-wheel holes fit nicely; if at all wide, put new ones, as that is a frequent cause of poor vibration and stoppage.—A. B. C.

Metallic Paper.—PERPLEXED LAD.—The reason why the leaves of your metallic note-books stick when gilding is simply that your size is too strong. There is no special treatment for this paper; it can be treated like all others, the only thing necessary being particular care as to the size. Try it a little weaker than usual and watch the result, and go on weakening until you get the proper strength.—G. C.

Magnetoscope.—YOURS TRULY.—I do not know the instrument you name—at least, by the above term—so I cannot give you any information. Try and find if it has another name, and I will do my best to help you.—W. D.

Enlarged Designs.—T. H. (*Burnley*) says he has seen many pretty designs for fretwork in the pages of WORK, and wishes to know how to enlarge them. Most methods of enlarging require a certain amount of skill in freehand drawing to fill in the curved lines between certain points, the positions of which have been ascertained. With the pantograph all kinds of lines, whether curved or straight, can be drawn either to enlarged or reduced scales; but a pantograph is a very expensive instrument to buy if a good one be required, and the cheaper forms are almost worthless. The best way that I can recommend T. H. to set to work is to take a sheet of tracing-paper or thin tissue-paper the size of a page of WORK, and rule it into squares of ½ in. or smaller. Write in the top row of squares A, B, C, D, etc., from left to right; and down the left-hand side number the rows 1, 2, 3, 4, etc., from top to bottom. If ½ in. squares be ruled, there will be about twenty of them in one direction, and fifteen in the other. This ruled sheet T. H. can keep by him for regular use. Now, then, suppose T. H. meets with a design which he wishes to enlarge to three times the size of the engraving: let him place his ruled sheet of tracing-paper over the design, and put some weights on the corners, to prevent it shifting its position. Now, then, let him measure the length of the design, and on a sheet of clean white paper set off a line three times as long as this dimension. The next step is to count the number of squares on his ruled sheet that are included in the length which he measured, and then to set off the same number of squares on the enlarged dimension on his clean sheet. Of course, if the length is three times as great as the length which it represents in the original design, the new squares will measure just three times as much across as the original squares. The whole of the drawing-paper must now be ruled with squares of the same size—that is, of the enlarged size—and the details of the design are copied by noting which squares they occupy in the original, and drawing them in the same squares of the copy. The letters and numbers should be repeated on the enlarged squares, and serve as a guide in picking out the right square quickly; thus, if a certain corner of the design is found in square D 3, or the third square under D, it will be easy to find D on the enlarged squares, and then the third square under it. The smaller the squares are drawn on the original tracing sheet, the greater will be the accuracy of the copy, but at the expense of so much more trouble.—A. B.

Cane Window Blinds.—BAPTISTE.—If you write to Messrs. Elmore & Son, High Street, Leicester, for their price list, I think you will find exactly what you want.

House and Shop.—ANXIOUS INQUIRER.—Before spending as much time on the above subject as it requires, I must ask you to furnish me with a few more particulars. For instance: is the site at the corner of a street? On how many sides could you put windows or doors? Are there any restrictions as to ancient lights or heights of adjacent buildings? Do you want a w.c. in the house? What business do you propose to use the shop for? And lastly, but not least, how much do you propose to spend?—E. D.

Hand Camera.—W. A. (*Watford*).—Instructions have been given from time to time in WORK. Consult the Indexes to Vols. I., II., and III. of WORK.

Watch Centre.—AMATEUR.—From your note, I cannot understand whether it is a staff or cylinder you want to put to the watch, or whether it is only a pivot. Is the watch a lever or horizontal, and have you done anything to turning and pivoting before? If not, I do not think for a moment you will succeed, as it is the most delicate piece of turning in the watch, and every measurement must be so exact; but if you will give further particulars, I will try to assist you. The tools you will require are turns, gravers, bow, screw and cement ferrules, pivot files and burnisher, pinion gauges and Douzième gauge, eye-glass; and which, unless you are intending to keep at it, will not pay you to buy for one job, as they will cost more than half a dozen cylinders at trade prices.—A. B. C.

Tool for turning Cast Iron.—G. B. (*Dulwich*).—To take off the first rough coat, use a tool shaped as shown at Fig. 1, with the cutting edges ground acute and keen, running the lathe slowly. After this, use a tool shaped as shown at Fig. 2, with the nose rounded a little, and the cutting edge less acute. The speed must be slow for cast iron, or you will grind away the edge of the tool. This work is best done in a back-geared lathe furnished with a slide-rest. You have either been running your lathe too fast, or the castings for your field magnets must be much too hard to be of any use to you. They will be useless if they have not been annealed soft.—G. E. B.

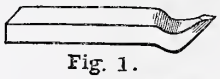


Fig. 1.

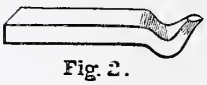
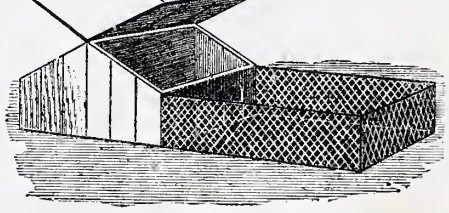


Fig. 2.

Tool for turning Cast Iron.

Safety Lamp.—G. B. (*Edinburgh*).—We do not know any particular firm our correspondent should apply to to take up his plan. There are a great many in Birmingham who occupy themselves in taking up and introducing novelties of this kind, but we do not know any of them. Our correspondent should examine the Birmingham directory, and select one or more names, and introduce the matter to their notice. We have an idea that the *means* adopted for actuating has been covered by a prior patent some years since, but at the moment we cannot decide this point. If this is so, the manufacture would have to be carried under licence from the prior patentee. We should strongly advise that this print be fully ascertained by means of a careful search before filing the complete, in order to ascertain exactly what novelty there is and what may be claimed, and so prevent the addition of another useless and invalid patent to the huge mass of such waste paper which the looseness of the Patent Office system permits to be poured into what might be a useful Government Office.—C. E.

Rabbit Hutch.—FRED.—Being a joiner's apprentice, you ought to have no difficulty in modifying the design of the rabbit hutch in WORK, No. 159, to your own particular fancy. As you think the front too open, you could make a double hip roof instead of a plain lean-to, and let the hips be on hinges so that the rabbits may be easily put in and out. In this case you need not have an open


Rabbit Hutch.

front at all, but doors in the back and front. You will, as you require accommodation for four rabbits, have to feed the animals somewhere else, and this is why the space in the one illustrated is so open, because the rabbits are supposed to be fed in that opening. You could have a wire run made to fit up close to the doors—covered in or not, as you like—while feeding (see sketch).—L. G.

Tin Extract.—A. R. (*Aberdeen*).—Melt it off in a furnace.—J.

Bellows.—LLUDWIG.—Melt and mix glycerine with glue.—J.

Charcoal Iron.—H. W. H. (*Heathfield*).—Samples sent are too thick. Use 23-gauge. If you can get guillotine shears, so much the better, but how many of our readers could obtain them? Snips will do. You can get the iron of Whiteley, Westbourne Grove, at 10d. per lb.—J.

Profitable Employment.—H. A. H. (*Leeds*).—You should know your aptitude better than anyone else. Try and make something, and offer for sale, or compete for WORK prizes.—J.

Bicycle Enamel.—C. A. (*King's College*).—To have your bicycle enamelled to look like the new

machines in shops, you must have it stove enamelled by a proper enameller. The machine must be taken apart, and every part properly rubbed down smooth and clean. Even in stove enamelling there are different grades, according to the price you are willing to pay for it. One coat is the cheapest, and may cost from 8s. to 10s. A high-class enamelled machine has at least three coats, each coat carefully rubbed down before the other is applied; the machine is then baked in the stove or oven three times. If you wish to do it yourself with a brush, get club black hard-drying enamel, which is very thin. Lay on one coat somewhat copiously; when hard, rub smooth with a woollen rag and flour emery, and apply another coat.—A. S. P.

Zither.—Subscriber from Beginning.—(1) No slip has occurred. Rosewood or maple make excellent bellies for zithers; and it is not the belly alone that vibrates, but the whole body of the instrument, back and front being connected by the inner long stay, which acts as the sound-post does in the violin. (2) The measurements given for the cross-stays—viz., 5½ in. and 10½ in. from the *bottom* on the straight side—are reckoned from the centre of stay. (3) The upper bridge is to be *on* the beech block, and the bridge pins go just through bridge and belly into the block (see Fig. 5, p. 292, Vol. III.). (4) Messrs. Chilvers & Co., 10, St. Stephen's, Norwich, will supply the necessary wood, Swiss pine backs and bellies being, I think, about 1s. 6d. each. —R. F.

Tailoring Articles.—S. W. (*Ashton-under-Lyne*).—These are under weigh.

Engineering Pupils.—F. W. (*Southampton*).—As to firms who take engineering pupils, I can only indicate the names of a few, leaving it to you to ascertain if any vacancy exists for pupils, conditions of entrance, and amount of premium payable:—R. Lloyd & Co., 135, Steelhouse Lane, Birmingham; Tangyes (Limited), Cornwall Works, Birmingham; Charles Taylor, Edmund Street, Birmingham; James Archdale & Co., Ledsam Street, Birmingham; Buckingham & Adams, Arthur Street, Small Heath, Birmingham; S. A. Daniell, Edward Street Parade, Birmingham; J. Watt & Co., Soho Foundry, Smethwick, Birmingham.—N. M.

Cabinet-making Designs.—C. D. D. (*Hammersmith*).—So many designs have already been given in Work, Vols. I., II., and III., it would be difficult to enumerate them. Consult the volumes or indices.

Printing Outfit.—Universal Amateur.—The papers are in hand, and shall appear shortly.

Sewing-Machine Adjustment.—C. K. (*Fitzroy Square*).—There is very little wrong with your machine. It is evidently a "Medium" on the Singer principle, and you seem to have got a "Family" shuttle, which is of course too small. You can never hope to do any sewing with such a shuttle, because, instead of taking hold of the top cotton loop left by the needle, as it should do, it is apt to miss, and thus miss stitches in the sewing. The shuttle should have at least $\frac{3}{16}$ in. *easy* play all round to allow of the thread passing easily round it, and the hook on the carrier should certainly fit in the slot on shuttle point, or the shuttle will "chuck," and catch against the top slides or miss stitches. The threading you show on the shuttle in sketch is right. Your next mistake is in the threading of the needle. The thread should pass from front to back—that is, *away* from the operator, not towards him, as you show in your sketch. With that exception, the whole of your threading is correct. As your needle is now threaded, the loop which it forms for the shuttle to catch is on the wrong end of your thread, and will draw, not from the reel, as it should, but from the loose end, and thus make stitches without either tension or regulation. The *short* groove in the needle should be on the shuttle side, and the eye in such a position that it throws out a loop at right angles to the travelling direction of the shuttle.—Cyclops.

Work Volumes.—W. S. (*Appleby*).—You should advertise such matters in the "Sale and Exchange" column of Work, which you can do for a few pence.

Clay Modelling Classes.—M. E. F. (*Stockton-on-Tees*).—We know of no classes specially open in August. Possibly some of our readers may enlighten you.

III.—Questions Submitted to Readers.

**** *The attention and co-operation of readers of* Work *are invited for this section of "Shop."*

Clock Case.—S. C. (*Ashton-under-Lyne*) will be obliged to any reader for a suitable clock-case design to match the prize bookcase given in Work, No. 48, p. 760.

R. H. A. Monogram.—R. H. A. (*Forest Hill*) will thank a reader for monogram of R. H. A. in circle.

Urn.—Ironmonger asks how to touch up a brown enamelled urn.

Birds' Eggs.—W. L. J. (*Swansea*) writes:—"Could any reader tell me where I could get information as to how to make use of birds' eggs for ornamental purposes? I have seen butterflies arranged in cases for hanging on a wall, but I hardly know how to fix the eggs."

Lathe Change Wheels.—Turner will be glad to know the best maker of these.

Firewood Splitting Machine.—Merchant writes:—"Will any reader give me the name of a good machine?"

IV.—Questions Answered by Correspondents.

Coffins.—Chopstick writes, in reply to W. P. W. A. (*Aylesbury*) (see No. 170, page 222):—"To give full instructions for making a so-called panelled coffin would take up too much space for the 'Shop' columns; but it may be of some assistance to you to state that the coffins are first made plain, same as ordinary coffins, and then strips bradded on to represent the framing, the plain board, of course, forming the panels. To make the raised panel lids, proceed as follows:—First fit the ordinary plain lid; then about 2 in. all round plant on strips with rounded edges, and on these strips plant on top

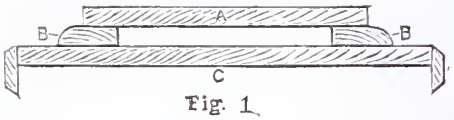


Fig. 1.

Fig. 2.

Coffins. Fig. 1.—Section of Coffin Lid. Fig. 2.—Plan of Top of Lid. A, Panel; B, B, Raising Strips; C, Lid.

panel. The accompanying sketch, which shows section and also view of lid thus made, will assist you to understand. The usual width of head and foot of a full-sized coffin is 10 in. and 8½ in. respectively, whatever the width of shoulders may be. I myself consider any flourishing on a coffin plate decidedly out of character, though it is often used. The Editor has a paper in his hands, written by me, giving instructions (with examples) for coffin-plate writing, and I shall be pleased to write on coffin-making at any time, if required to do so. In case you cannot wait until my paper appears, I should advise you to use block and plain Roman letters, written with gold. This is what I have always found to give satisfaction, and I have written largely for the trade."

Lathe Attachment.—M. (*Bishop Auckland*) writes (see No. 167, page 171):—"I send sketch of fret-saw attachment for lathe. Fig. 1 is the saw-frame of cast iron; the section is T-shape. Make the length 12 or 11 in. A and B are holes ½ in. square, in which two pieces of iron with split ends for holding saw are fixed; a screw in each holds the saw; a screw is formed on the top with fly-nut for tightening saw; the end is fixed by a pin in a double eye, C, the lower end of which is fixed in the rest-socket. Fig. 2 is the eccentric, which is fixed between the lathe centres, and works in the slot in the saw frame. Drill holes in each end ¼ in. from centre. A carrier is fixed on one end at D, by which it is turned. The table is of wood, with an

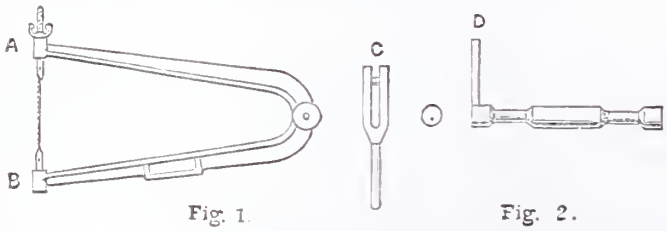


Fig. 1. Fig. 2.

Fig. 1.—Saw-Frame. Fig. 2.—Eccentric.

iron pin fixed underneath, which can be fixed in another rest-socket, a saw-cut being made in it for the saw to work in. The saw will not have a perfectly upright motion, but by having a short stroke you can make very good work. The top of the table will be level with the centre of the frame. This is soon removed when the lathe is required for turning."

V.—Letters Received.

Questions have been received from the following correspondents, and answers only await space in Shop, upon which there is great pressure:—T. B. P. (*Winlaton*); M. W. (*Notting Hill*); J. H. B. (*Pendleton*); A. J. P. (*Manchester*); H. L. (*Finsbury Park, N.*); F. J. K. (*Tufnell Park, N.*); F. B. H. (*Sheffield*); W. R. R. (*Derby*); J. L. (*Wimborne*); Young Organist; M. & C., Limited (*Manchester*); A. E. G. (*St. Albans*); W. S. (*Oswestry*); Snap Shot; W. R. (*Shrewsbury*); H. F. M. (*Ramsbury*); A Subscriber (*Akyab, Burma*); Camera Obscura; Phono; Music; A. M. (*Glasgow*); Oval; D. B. (*Batley*); S. W. (*Fitzroy Square*); G. A. (*Stockton-on-Tees*); G. W. (*Birmingham*); Veno; Hammered Sheet Brass; A. E. N. (*Broadstairs*); D. B. (*Plymouth*); L. & P. (*Marlborough*); G. W. (*Carnoustie*); Cast Steel; J. R. (*New Brompton*); W. B. (*Howden-on-Tyne*); T. B. (*Kirkbythore*); Arbor.

"WORK" PRIZE SCHEME.
THIRD COMPETITION.

Escape from Fire Device.

Following on with our Prize Competitions we ask public co-operation in a subject of world-wide interest, viz., Escape from Fire. This is a matter which concerns every individual, and as the moment of emergency arises when we least expect it, and, as events too often prove, when we are little prepared for it, not a small service will be rendered to the readers of Work and to the public at large by bringing the subject to the front in Work. Thousands of people must have ideas of their own, already developed, or to be carried into effect *some day*, which will be none the worse for being made known to the world at once. It is the purpose of the present competition to elicit some of these ideas, and to gain an insight into the utility or dependableness of the plans at hand, in the event of anyone being called upon to make an escape from fire under circumstances which are never very favourable, and which sometimes are hopelessly the reverse. For the three best suggestions for an appliance, plan, or practical idea for Escape from Fire, the following prizes will be awarded—

First Prize, £3;
Second Prize, £2;
Third Prize, £1.

Conditions and Rules of the "Escape from Fire Device" Competition.

All Descriptions to bear the Work Prize Coupon, cut from one of the numbers of Work in which the Prize Scheme is announced.

Each Description to be signed with an original *nom de plume*, and to have the writer's real name and address securely attached to the manuscript in a sealed envelope.

Each Suggestion should be fully described in respect to its construction, conditional surroundings, and working, and, where possible, should be illustrated with a drawing of the device itself and its various parts to elucidate the description.

A Suggestion not illustrated will have an equal claim in the competition provided the description be sufficiently in detail to convey a full idea of the value of the device.

The Prize Devices and Drawings, and any others, to be published, if desired by the Editor, in Work, but the copyright thereof to remain with the authors.

Copies of MSS. and Drawings to be retained by the competitors, as in no case can the return of MSS. be undertaken.

The Editor of Work will supervise the judging of the Suggestions, and the selection as determined upon is to be final.

All manuscripts intended for the "Escape from Fire Device" competition must be addressed to the Editor of Work, c/o Cassell & Co., Ld., Ludgate Hill, London, E.C. They must reach him on or before Saturday, August 27, endorsed, "Escape from Fire Device" Competition.

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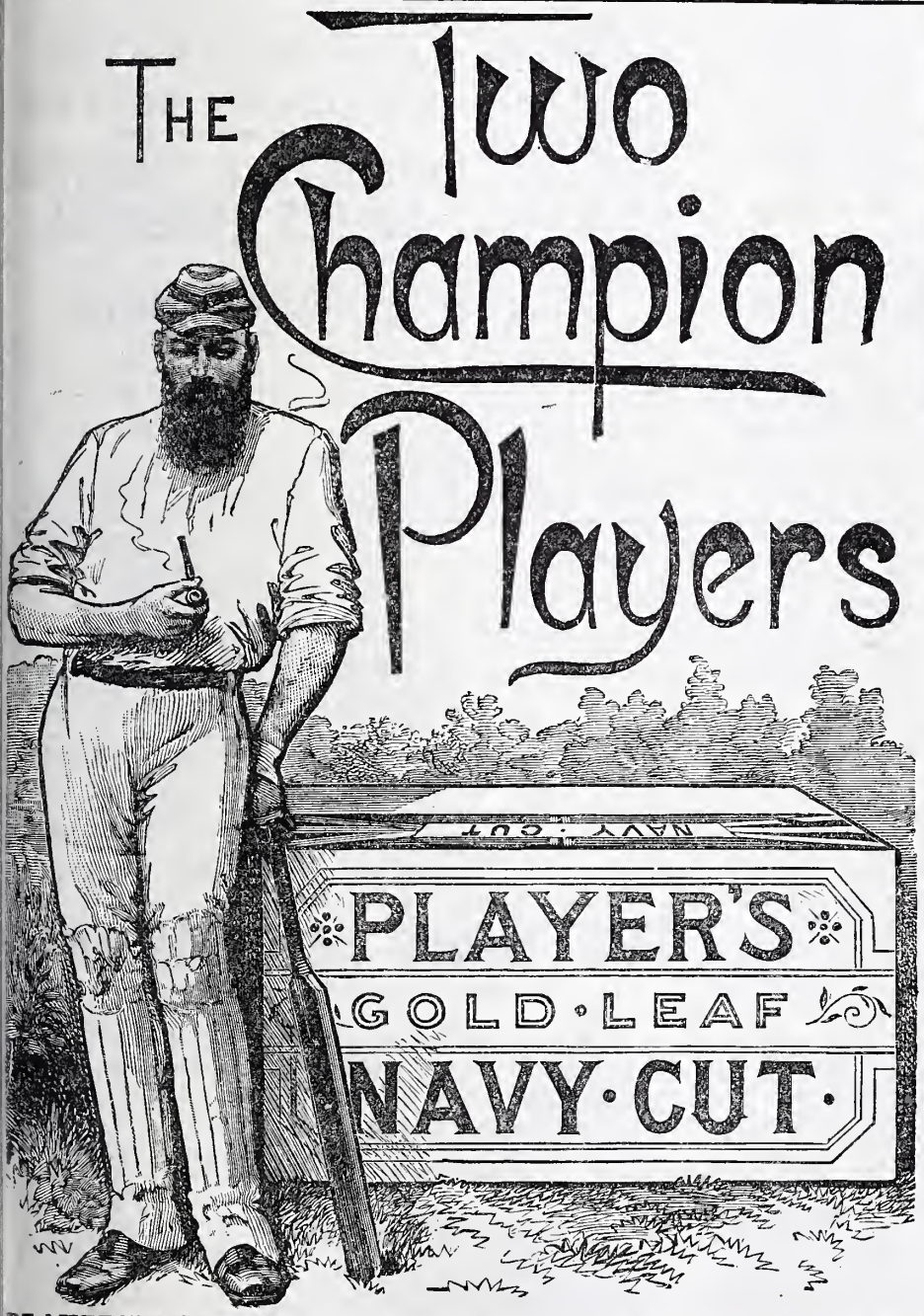

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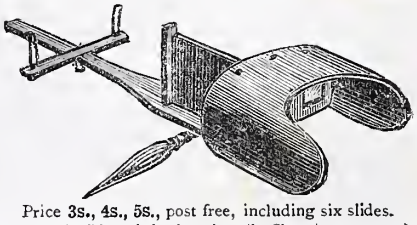

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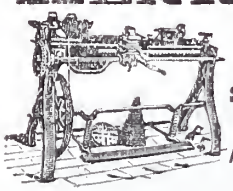

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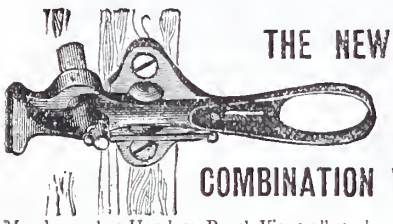

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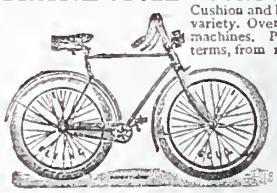

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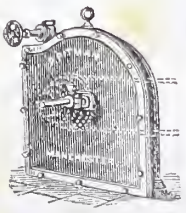

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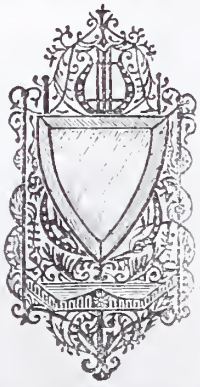

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WORK

An Illustrated Journal of Practice and Theory

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VOL. IV.—No. 178.] SATURDAY, AUGUST 13, 1892. [PRICE ONE PENNY.

WORK WORLD.

THE longest tunnel in the world will be that about to be made through the Simplon. According to the final plans adopted, it will have a length of $12\frac{6}{10}$ miles, which is $3\frac{1}{10}$ miles longer than the St. Gothard Tunnel.

* *

The Board of Trade experts are now determining the exact weight corresponding to the attractive force of an ampère under certain fixed conditions, with the view of defining a standard to be called the legal unit, so that electrical measurements may be well "understanded of the people."

* *

At the Manningham Mills stands a power loom by which Utrecht velvets—mohair—can be made. The production of this material has hitherto been confined to the Continent. By a new method of combining the back or ground with the pile, a perfect cloth is woven, face to face, with fineness and evenness of surface, and a greatly increased brightness and superiority of colour. For many years past the material for the production of mohair velvet has been sent from Bradford to the Continent to be worked up and returned to England.

* *

An investigation made shows that the spectrum of burning magnesium approaches most nearly of the spectra of artificial light to that of the sun. The temperature of the magnesium flame is about 1,340° centigrade, though the character of its spectrum would correspond to 5,000° centigrade in a light due to ordinary incandescence. The radiant energy of burning magnesium is 75 per cent. of the total heat of combustion. In ordinary illuminating gas this is only 15 to 20 per cent. Considering the greater luminosity of the rays of the visible spectrum of burning magnesium, its light-giving power per unit of energy expended is from fifty to sixty times greater than that of gas.

* *

The largest masonry dam in the world has just been completed in India in connection with the Waterworks of Bombay. It is about two miles in length, 118 ft. high, 100 ft. thick at its greatest depth, and $15\frac{1}{2}$ ft. at the top. The lake which will be formed when the valley is filled with water will cover an area of eight square miles, and it is estimated that it will supply 100,000,000 gallons per day throughout the year. In the construction of this work nearly 15,000,000 cubic feet of rubble stone have been used, 2,200,000 cubic feet of lime, and 3,300,000 cubic feet of washed sand. The water is distributed through 50,000 tons of pipes, some of which are 4 ft. in diameter.

* *

Band saws may be joined as follows:—Bevel each end of the saw the length of two teeth. Make a good joint. Fasten the saw in brazing clamps with the back against the shoulder, and wet the joints with solder water, or with a creamy mixture made by rubbing a lump of borax in about a teaspoonful of water on a slate. Put in the joint a piece of silver solder the full size thereof, and clamp with tongs heated to a light red (not white) heat. As soon as the solder fuses, blacken the tongs with water, and take them off. Remove the saw, hammer it, if necessary, and file down to an even thickness, finishing by draw-filing lengthwise.

* *

An immense fortune awaits the man who will invent a cheap and effective system of purifying the sewage of our large towns. Land filtration is out of the question because of the large areas of land required, and it seems as though the only refuge was in some system of chemical precipitation. Almost every kind of chemical substance has been tried for this purpose—lime, alum, alumina, iron salts, and a host of others—but the fact remains that the perfect system has yet to be discovered. The authorities in Lancashire and Cheshire are getting anxious on account of the approaching completion of the Manchester Ship Canal, when it will be impossible to discharge their untreated sewage into the canal without serious danger to health.

* *

At the Newbottle collieries great improvements are being made by an important electrical installation. A current from dynamos is taken to a distributing centre about 390 yards from the bottom of the shaft, from whence it is conveyed to the pump, the haulage engine, and the winding engine, the latter being 2,800 yards from the distributing centre. In another part of the northern coal-fields three-throw electric pumps are being fixed at a distance of 2,700 yards from the shaft. In some coal mines also, compressed air coal-getting machines are being displaced by electrical devices. The facility of transmission gives electricity its great value as a motive power for mining uses.

* *

To successfully photograph the successive phases of motion, a dead black background is required, and the object should be painted white. To prevent superposition of the successive images, an opaque disc, with a series of holes cut in it, is placed behind the objective of the camera and caused to revolve at a known speed. The speed of revolution may be very high, as under favourable conditions an exposure of $\frac{1}{25000}$ of a second is sufficient to act on the plate, though more usually an exposure of about $\frac{1}{5000}$ of a second is used. The sensitive film is mounted on rollers and rotated by clockwork at a suitable speed. By such means twenty to thirty exposures per second can be made, and amongst other things, the movements of the wings of flying birds have been clearly shown. This may help the flying apparatus inventor.

* *

Brass has been made by the compression of its constituents at ordinary temperatures. A specimen, reddish in colour, was made by compressing a mixture of nine parts of copper with one of zinc; a pale yellow brass was produced by compressing seven parts of copper with three of zinc. Both these specimens had been filed up twice and consolidated again by pressure. The reddish metal is softer than cast brass, and can be slightly flattened under the hammer; the yellow metal is harder than common brass, and is also brittle. Both varieties appear to be amorphous, and show a uniform granular appearance without any trace of the beautiful crystallites found in copper-zinc alloys obtained by fusion. There is evidence of flow in the yellow alloy, but nothing to indicate an actual liquid condition of the alloy or one of its constituents. It seems probable that by the compression of mixed metallic powders some alloys may be produced which are not to be obtained by fusion.

FISHING-GUT: HOW IT IS PREPARED, AND HOW TO TIE IT.

BY F. CROCKER.

REARING THE SILKWORMS—TYING—TYING ON HOOKS—TYING THE GUT TO THE FISHING-LINE.

SOME time ago a correspondent asked to be supplied with information respecting the manufacture of the above, and as it may be of interest to many WORK readers to know how it is prepared, I here devote a short paper to its production, and how to tie it; although, for an angler to prepare fishing-gut for his own use, the writer can safely say from experience that it will be found more expensive, and the article produced will be inferior to that which may be obtained from the tackle shops, cheaper than the cost of rearing the silkworms; still, some of our readers may like to take the matter up as a hobby, and hobbies are not always expected to be financially a success.

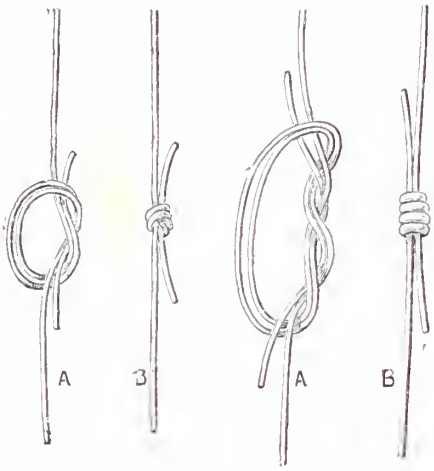


Fig. 1. Fig. 2.

Fig. 1.—Overhand Knot—A, Loose; B, Tight. Fig. 2.—Double Overhand Knot—A, Loose; B, Tight.

Rearing the Silkworms.—Procure some silkworms' eggs, place them in shallow cardboard trays, and put in the sun to hatch. As soon as the worms appear, feed them with mulberry, or, failing these, lettuce leaves. The trays must be cleaned out and fresh leaves put into them every day until the worms are ready to spin. At this period they get darker in colour, and refuse to eat. Put them into hot vinegar for three or four hours, take them out, and pull asunder, when three or four strands of gut will be found. Stretch these between pins driven into a board 8 in. or 9 in. apart, according to the length of the gut, and place in the sun to dry. The gut is not the intestine of the silkworm, but the silk before it is spun. When dry and hard, wash the gut in strong soda-water, dry it, and draw each strand between two pieces of india-rubber, and it will be ready for tying.

Tying.—Gut may be bought tied up into bundles of 100 strands. It is generally tied with purple thread, and if this is faded in colour it may be inferred that the gut is old, and perhaps brittle; it may be tested by tying into a knot, when—if brittle—it will split or break.

As the strands of gut are not long enough for fishing purposes, several are tied together to form a length of from 1 yard to 2 yards, according to the fancy of the angler. For this purpose the best and roundest pieces are selected, the rough ends are cut off, the thicker strands are arranged to be at the top, the finer at the bottom, nearest the hook. The ends to be tied are then placed into warm water or into the mouth, which

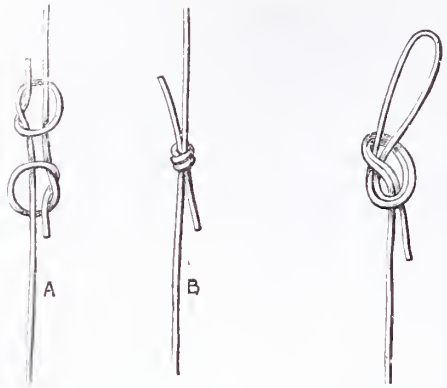


Fig. 3. Fig. 4.

Fig. 3.—Fisherman's Knot—A, Loose; B, Tight. Fig. 4.—Loop.

will soften them, and make it easier to draw the knots up tightly. Several kinds of knots are used, a few of which are illustrated.

Fig. 1 is made by placing the strands side by side, tying an overhand knot, as shown at A, and drawing tight, when it will have the appearance shown at B. In this case it will not be advisable to cut the ends off quite close to the knot.

Fig. 2 shows the same kind of knot tied double; A shows the method of tying, B the knot when finished. This is a good method of tying, and the appearance of the knot may be improved by rolling between two pieces of wood. The ends may be then cut off close up to the knot.

Fig. 3 shows a fisherman's knot. This is made up of two single overhand knots, the method of tying which may be gathered

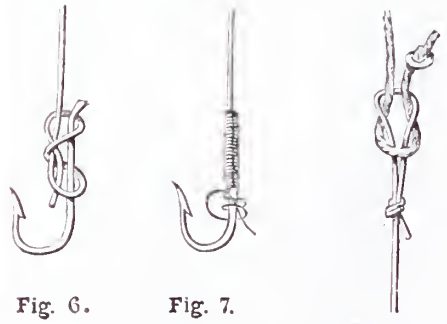


Fig. 6. Fig. 7. Fig. 8.

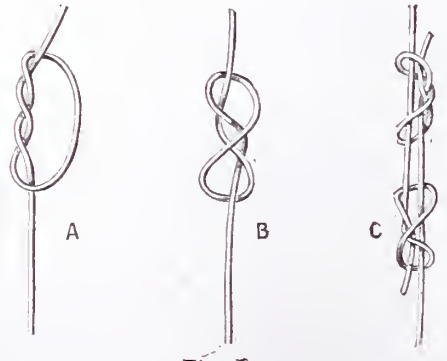


Fig. 5.

Fig. 5.—Method of tying a Double Fisherman's Knot. Fig. 6.—Method of tying on Hook with flattened End. Fig. 7.—Method of whipping on Hook. Fig. 8.—Method of securing Gut Collar to the End of Fishing Line.

from A, and the appearance when finished from B.

Fig. 4 shows the method of tying a loop, the knot in this case being similar to Fig. 1. If greater security is required, the knot may be tied double, as Fig. 2.

Fig. 5 gives a double fisherman's knot. A double overhand knot is first tied as shown at A, the two ends are pulled, when it will assume the form of a figure 8, as shown at B. Both pieces are tied in the same manner, then the free ends are put through both loops of the 8 on each piece. The two knots are then drawn tight and pulled together by pulling the free ends. The appearance may be improved by rolling as mentioned for Fig. 2, and the ends cut off close. The finished knot will be similar to B (Fig. 2). This is the strongest and neatest knot that can be used.

Tying on Hooks.—Fig. 6 shows the method of securing those hooks that are provided with a flat end to the shank to prevent the knot slipping off. A double overhand knot similar to A (Fig. 5) is first tied; this is pulled into the form shown at B (Fig. 5), and

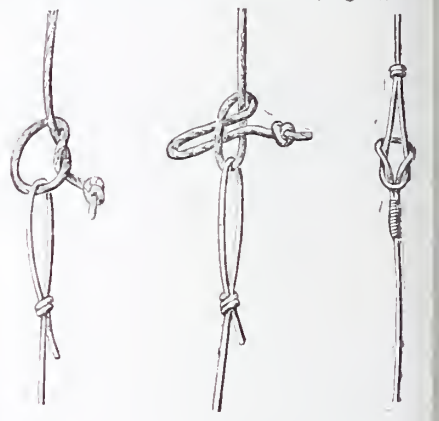


Fig. 9. Fig. 10. Fig. 11.

Figs. 9, 10.—Methods of securing Gut Collar to the End of Fishing Line. Fig. 11.—Method of securing Hook to the End of the Gut Collar.

the shank of the hook is put through the loops of the 8, when the knot may be drawn tight.

Fig. 7 shows the hook whipped on. For whipping, a piece of fine silk is used. It should be waxed: a convenient method of doing which is to dissolve some black wax in methylated spirits and dip the silk into it. The silk should then be bound tightly and evenly round the shank of the hook and the gut, and finished by putting the end through the last two coils, as shown at Fig. 7. It will be found necessary to slightly grease the silk at the end, to allow of the finishing tie being drawn tightly. The appearance may be improved by rolling, and when the wax is hard, varnishing. For the varnish dissolve a little shellac in methylated spirits and colour with vermilion. The colouring will brighten the appearance of the worm when on the hook. A loop is made on the opposite end of the strand of gut to which the hook is attached, by turning back and whipping, shown at Fig. 11, which also shows the method of attaching the gut of the hook to the collar.

Tying the Gut to the Fishing-Line.—Fig. 8 shows one method of doing this by a reef knot. Fig. 9 shows an overhand knot for the same purpose. Fig. 10 shows a tie that may be loosened by pulling the end, but there is danger of this catching against the ring at the top of the fishing-rod, and setting the gut collar, float, hook, and perhaps the fish, free.

ELECTRIC CARRIAGE.

This novel and useful vehicle is an American production. The motor is mounted centrally on the front axle, with the armature above, and parallel with the axle; on each end of the armature shaft is a crank disc, from which extend connecting-rods to clutches below the axle, these clutches being mounted upon short shafts, arranged to revolve beneath the axle, with pinions mounted upon the outer end, and set to mesh into gears mounted upon the hubs of the wheels. The motor is of a closed field type, working at 1,000 revolutions per minute, with a potentiality of forty volts. Upon level grade, a speed of from ten to fifteen miles an hour can be accomplished. The steering apparatus and brake are ingenious, and readily operated by the person in charge of the vehicle. Relying upon these auxiliary attachments, the steepest hills may be climbed. The vehicle cannot go backwards unless so directed. Should the motor fail to act, a connection break, or an accident of any kind occur, the carriage will stop, and this irrespective of the brake. Incidentally it may be mentioned that the storage cells with which the carriage is fitted will also furnish light and heat, if requisite, at but slight increase in cost of running. Taken as a whole, the combination is decidedly in the line of progress. A careful investigation and test disclose no defects that cannot be easily remedied. For the transportation of passengers and baggage over routes where travel is insufficient to justify the laying of rails, or over hilly or otherwise difficult roads, coaches could thus be run with success.

A RUSTIC PEDESTAL FOR SUNDIAL OR FLOWER-VASE.

BY ARTHUR YORKE.

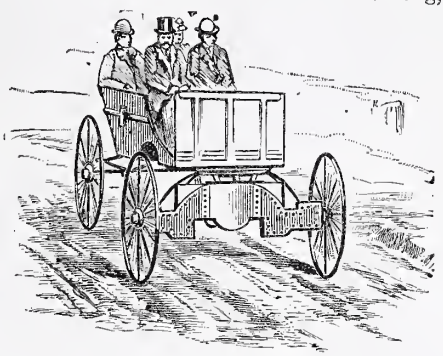
An Opening Word on the Design—Materials—Construction.

An Opening Word on the Design.—A pedestal such as that shown in the accompanying illustrations is a piece of garden decoration easily made, and if not required to support a horizontal dial, may well serve for a flower-vase; such as one of those for the adaptation of which from waste materials directions are given in Vol. III., p. 129 (No. 113).

If a sundial is to be mounted, it will be necessary that the top of the pedestal should be true to the plane of the horizon, or, in other words, lie perfectly flat, and also that it should be firmly fixed. As the pedestal is a hollow box, the easiest way of fixing will, perhaps, be by letting a piece of wood into the ground like a post, adjusting the pedestal accurately upon it, and then securing it by a screw or two. But if a vase only is to be set on the pedestal, it can be slipped over a stake merely driven into the ground, and this will suffice to keep it from being thrown down. It can then readily be removed at pleasure: as, for instance, before winter, to be put under shelter. The scale of the illustrations is 1 in. to the foot.

Materials.—The body of the pedestal is made of 1 in. elm board, the top being a piece of 2 in. slab. Some tolerably large pieces of rough stuff are required for the base, but for that position it will not greatly matter of what kind of wood they are, so long as they are moderately straight. The split rods used in the rustic mosaic work are shown as rather larger than usual—say, 2 in. in diameter. This size will be most effective. Wych-elm or maple, with a little mixture of peeled withy, will perhaps look best. A few bits of crooked stuff—say, apple-tree—will also be wanted.

Construction.—The horizontal section (Fig. 2) shows how the carcase is nailed together in 1 in. boards, and that it is 1 ft. square. For the given height (3 ft. 6 in.), these boards need to be 3 ft. 4 in. long,



Electric Carriage.

which allows 2 in. for the solid piece of slab or plank which forms the top. This top is 16 in. square, so that when split rods have been nailed round its edge it may be about 18 in. square.

The base is made of four pieces of rough round stuff, 5 in. in diameter by 21 in. long, which will need to be trimmed a little on that side which lies against the board. The vertical section (Fig. 3) shows how these

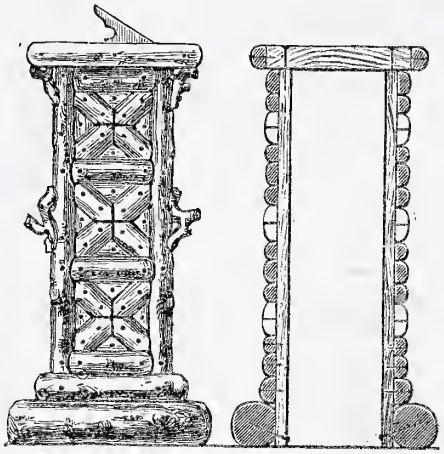


Fig. 1. Fig. 3.

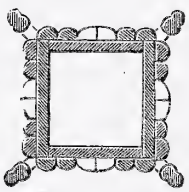


Fig. 1.—Elevation. Fig. 2.—Horizontal Section through Centre.

Fig. 3.—Vertical Section through Centre.

Fig 2.

pieces are fixed by nailing through the boards into them; they should also be nailed to each other at the corners. Next above, a 3 in. rod runs round. Two lengths of 2 in. split rod run up each corner, as shown in Fig. 2, and between these the ends of the small projecting pieces of crooked stuff are fitted in. They should be neatly trimmed for this purpose, and as their position may expose them to be knocked off, it will be better to screw than to nail them into the board. The arrangement of the rustic mosaic pattern is so clearly shown in Fig. 1, that it can need no explanation.

CYCLE TIRE ACCIDENTS: HOW TO REPAIR.

BY ONE WHO KNOWS.

The object of this article is to enable possessors of a pneumatic-tired machine to make good a puncture or damage whilst on the road, and without calling in the aid of a professional repairer.

The pneumatic tire for cycles seems destined to be the tire of the future, the small solid, and even the cushion, being even now only used on the ground of their cheapness, as compared with the pneumatic. There are now numerous makers of pneumatic tires, and new tires are coming out almost every week. Among the first of the pneumatic or compressed air order of tires, and one which still holds a high place, is the Dunlop tire. Among the other now well-known tires may be mentioned the "Clincher," which is said to be non-puncturable; the Boothroid, also said to be unpuncturable; the Silvertown "Closure," composed of a raw rubber (*i.e.*, pure rubber) which, on being punctured, closes and adheres of itself; the "Smith" Balloon tire, which, instead of having the canvas cemented to the rim, has it laced together between the spokes. The "Dunlop" tire is said to be the fastest on the racing-path; why this is so I am not prepared to say.

The rim of a wheel for a "Dunlop" tire is about 2 in. broad, and but slightly curved in section. The tire itself is made up of: first, an inner inflating tube made of good rubber, and furnished with an inlet or valve for pumping in the air. This inner tube is encased in a second tube made of a canvas composition, this canvas tube serving to keep the inner rubber tube of a uniform size throughout the circumference of the wheel, which it would not otherwise do, as any thinner or weaker parts in the inner tube would bulge out with the air pressure. On the outer or hollow side of the rim is cemented a strip of canvas covering the heads of the spokes, and on this is placed the canvas-covered air tube, having the valve passing through a hole in the rim between the spokes. To hold the tire in place and take the wear, the outer tire is placed over the canvas one; this consists of good rubber, and may be termed a rubber tube with one side cut open; it is about ¼ in. thick in the middle, and thins down to nothing at the edges. When in position, it covers the canvas tire already described, and overlaps the edges of the rim about ½ in. on each side. It is held in place by a strip of canvas cemented to its edges, the canvas being first cemented to one edge, then slit half-way across to pass the spokes, and cemented to the other edge. This completes the tire so far as we have it at present. It is inflated by a small force-pump, which is carried in the tool-bag. If the tire and the valve are perfectly air-tight, the hard-pumped tire will remain up for an indefinite period; if, however, the valve leaks, the tire gradually gets emptied of air. Many riders are troubled with their tires going down, the true cause being, not a puncture, but a leaky valve. Punctures do take place, however; then the sorrows of the rider begin, as the slightest puncture is fatal to the tire until repaired, and the repairer will not undertake the job under a charge of 7s. 6d. or 10s.

An outfit for repairing these tires is got from most cycle shops for 2s. 6d. It consists of a tube of rubber solution, a small tin of French chalk, a small web of canvas, and a small web of thin rubber for patching.

It is only when the *inner* tube is damaged by puncture that the compressed air escapes; consequently, it is the inner tube that has got to be repaired, and in order to find the puncture the tube must be removed from its double casing.

First of all, about 12 in. of the canvas on the under side of the rim must be detached from the edge of the outer rubber covering, the valve being in the middle of the part so detached: this will expose the canvas tube which encloses the rubber air tube. This canvas tube is ripped carefully for four or five inches on either side of the valve, exposing the inner rubber tube. This tube will be found to have been joined in making in the vicinity of the valve; dissolve this joint by applying benzene, and part the tube. Tie a long cord round the end of the tube that has *not* got the valve attached, pull the valve end gently, and the tube will be easily extracted entirely from its casing, taking care that the cord is long enough to pull it back again when repaired. Search now for the puncture; it is usually found by the appearance of a small white mark on the surface of the rubber. Having found the hole, clean the surface thoroughly, and coat a surface about ½ in. in diameter (having the hole in the middle) with the solution in the collapsible tube; also cut a small round patch of the rubber web, and coat one side. Before applying the patch, let the solution dry for an hour or so, then apply the patch, pressing it carefully, and taking great care that the tube is not smeared with the solution other than under the patch. After patching, leave to dry, then rub with French chalk to prevent the tube adhering to its canvas covering. Now proceed to draw the tube through its casing with the cord back to its former position, clean the lapping ends, and smear with the solution; in joining them, great care must be taken that they are perfectly joined all round. Now pump in a little air, to see that the tube will inflate properly at the joining; again rub with French chalk, and cover in the air tube by stitching together the canvas covering, a needle and thread being part of the aforesaid outfit. The canvas stitched, wrap a bit of the canvas web of the outfit round the part so stitched, and sew it also. Now cement the outer canvas to the rim and edges of the outer tire, and the job is complete. It will be seen that the task is somewhat tedious, and the rider who elects to do his own repairing while on a journey must carry his repairing kit with him, and must calculate upon spending about two hours at his inn or by the roadside.

To test a diamond in the dark, draw the diamond smartly over the surface of smooth unpainted wood, and it will show a phosphorescent streak.

SEWING-MACHINES: HOW TO BUY AND USE THEM.

BY CYCLOPS.

The Wilcox and Gibbs' Chain-Stitch Sewing-Machine—General Description of Machine—Particular Formation of Stitch—The "Take-up"—Regulation of the Tension—Position of Needle in Relation to Hook—The Feed and Stitch Regulator—The Complete Action.

General Description of Machine.—This machine, as I said in the previous paper, is among the most beautiful in construction and arrangement of modern sewing-machines.

Fig. 6 gives a view of the machine from the front, with under cap open, showing rotating hook, or looper, and feed arrangements. The main shaft, A, runs through the base of the machine, and under raised work-table, carrying at one end the small grooved balance-wheel, B, which is rotated by a band, or belt, C, and the two eccentrics, D and E, one operating the rocking arm, F, and the other the automatic tension, G. At the other end it carries the eccentric cam, H, operating the feed mechanism, and the rotating hook, or looper, J, for forming the stitch.

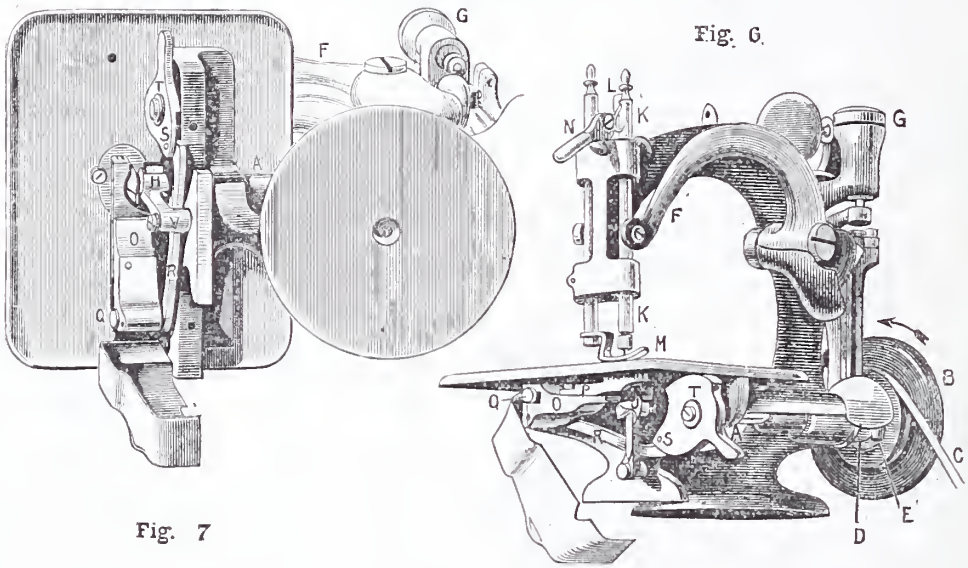


Fig. 6.

Fig. 7

Sewing-Machines. Fig. 6. Front View of Wilcox and Gibbs' Machine with Cap open. Fig. 7.—Under View of Machine with Cap open.

All the bearings on this machine are thoroughly hardened, and true and accurate in their fitting, and the makers claim for it that at low speeds it is perfectly silent. Owing to having no shuttle, with its consequent friction and dead points, it is very easy running, and can be operated at extraordinary speeds.

In one test it was operated ten hours a day for eight months, at the rate of 1,500 revolutions per minute, without any adjustment or repairs whatever.

Particular Formation of Stitch.—The formation of stitch in this machine is peculiar, and rather difficult to explain. The rotating hook, J (Figs. 6 and 7), makes one revolution to every downward movement of the needle-bar, K. The needle descends, and forms a loop exactly in the way of the point of the rotating hook, so that the hook takes hold of the loop, and twists it round in such a way that on its second descent the needle passes the thread through the first loop, and forms a second loop, to be caught by the point of the rotating hook. It is this action which gives to the work the appearance shown in Figs. 1, 2, and 3 (see No. 168, page 178).

The "Take-up."—It will be easily understood that the quantity of thread required to go round the rotating hook at each stitch is much greater than is required for the stitch, and as there is no means of holding it below the needle, as in the Wheeler and Wilson, which we shall describe hereafter, some mechanism has to be provided for taking up the superfluous thread, so that the stitches will be drawn tight and not lie slack, as would be the case without such an appliance. In order to overcome these seeming difficulties, an arrangement has been provided called the "take-up" (see L, Fig. 6). The thread is passed through a kind of slide, L, and a projection on the needle-bar, K, raises the thread up when the hook is ready to release it. This action, combined with the tension which we shall now describe, is perfectly automatic, and requires no attention or adjustment from the operator.

The Tension and its Regulation.—The automatic tension shown at G (Fig. 6) is designed to hold back the thread while the take-up is drawing away from the hook the superfluous thread, and release it when the needle requires a fresh supply, both of which movements take place at each revolution of the shaft. The eccentric, D, on the shaft, A (Fig. 6), opens and shuts the tension, G, at the required time.

The most notable feature of these machines is that whatever the length of stitch the work may require, the tension and take-up require no alteration. And in this lies its claim to the name given it by the makers—the "Automatic."

Position of Needle in relation to Hook.—It will be seen, on a closer examination of the hook, J (Figs. 6 and 7), that it revolves in the direction of a right-hand screw and point first. It is this point which catches the loops made by the needle on its ascent, and the position of the needle should be such that when the loop is thrown out the rotating hook shall be advancing ready to catch it. This relation of one movement to another entirely depends on the position of the eccentric, E, on the shaft.

The Feed and Stitch Regulator.—The arrangement of the feed, or appliance for moving the work on at the end of each stitch, is shown under the cloth plate in Figs. 6 and 7. It consists essentially of a lever, having on its end, teeth, which project through a hole in the cloth plate, called the throat, and engage with the material being sewn, pushing it on at the conclusion of each stitch, and when, of course, the needle is at the top. In order to accomplish this, two movements of the feed lever are required—one an upward one, to allow the teeth to take hold of the material being sewn, and one an onward one, to carry the material along. These two movements are accomplished by an eccentric cam on the

shaft, A, just behind the rotating hook, and a system of levers, which we shall now explain.

The lever, O (Figs. 6 and 7), carrying on its upper surface the toothed feed bar, P, is free to move backwards on the pivot-screw, Q. At the farthest end from the pivot it rests on the eccentric cam we have mentioned, and which gives its upward and downward movement. A lever, R, pivoted on to the lever, O, is carried across the front bed of the machine, and has at its end a long slot, or sliding way, in which a pin, S, on the adjusting cam, T (Figs. 6 and 7), is free to move backwards on the turning of that cam.

Another lever, V (Figs. 6 and 7), pivoted at its bottom end on a screw-stud, is attached at its top end to the cam on the shaft, and by the action of that cam rocks backwards and forwards. This is the lever giving the onward movement to the feed in the following way:—

A projection on the lever, R, presses, by the action of a spring not shown in our sketch, against the right side of the lever, V, so that as the lever, V, rocks backwards and forwards, it gives to the lever, R, a backward and forward movement, carrying with it the feed lever, O. Now, it will be seen that the point of contact of the lever, R, with the lever, V, can be varied by turning the cam, T, which has the effect of raising and lowering the end of the lever, R. And if the point of contact is near the top of the lever, V, it will have a very much longer stroke than if it were at or near the bottom. This, then, constitutes the adjustment of the length of the stitch.

Let us now briefly go over the complete action. The needle descends through the work, and the automatic tension lets the thread run; the hook advances and catches the loop, the needle ascends, and the take-up draws away the superfluous thread, while the feed draws on the material ready for the next stitch, all of which actions take place at every revolution of the shaft.

Before leaving the consideration of this machine it will be well to say something about the chain-stitch. Its great disadvantage is that it so easily comes undone, and it takes nearly three times the quantity of thread that is required by the ordinary lock-stitch; but at the same time, the advantage of doing away with the shuttle, and all its inseparable wear and loss of time in winding and threading, gives to this machine an advantage which, in the opinion of many, counterbalances its disadvantages.

HAND-WORKING OF SPECULA FOR THE NEWTONIAN TELESCOPE.

BY EDWARD A. FRANCIS.

The Polisher and Polishing.

The finely-prepared glass surface is polished with rouge, carried on a pad formed of pitch, which easily assumes and temporarily retains any desired curve.

The glass tool must be covered with a coat, about ¼ in. thick, of pure black pitch; and the pitch must be facetted as in Fig. 14, in order that the surface may be free to expand, and that the moisture which carries the rouge may easily circulate. It is better not to arrange the facets so that the centre of the central facet coincides with the centre of the tool, or a short, straight stroke may cause the speculum to be polished in rings. Fig. 15 shows a method of arrangement adopted after exhaustive experiments with polishers of many shapes. By such an arrangement a great part of the polishing can be safely done with straight strokes, and this is a decided advantage to an inexperienced workman. The white spot in the centre of the engraving indicates the centre of the glass tool.

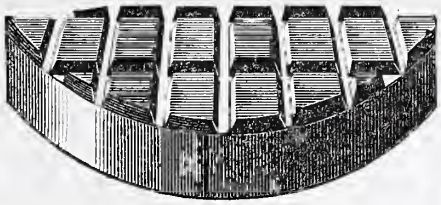


Fig. 14.—Facets of Pitch on Glass Surface.

I shall give one method only of forming the facets. Fig. 16 is a little tool formed of three pieces of wood screwed together. The blades, A, A, should be about ¼ in. thick, and very slightly bevelled at the lower edge, which edge should be of the same curve as the metal gauge (Fig. 11, page 183). The centre-piece, B, will need to be of the same

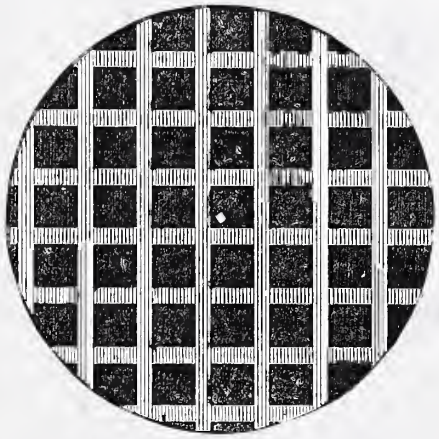


Fig. 15.—Arrangement with Polishers of many Shapes.

width as that proposed for the facets—that is, about ¾ in. The facets are stamped out by pressing the little tool, wetted to prevent adhesion, on to the warm pitch.

Pitch, as obtained from the chemist, is practically free from grit; but if any doubt exist as to its purity, it may be strained through a sieve of distended muslin. It is safest to melt pitch in an oven and in an earthenware vessel. If it be allowed to boil, air bubbles will form and destroy the homogeneity.

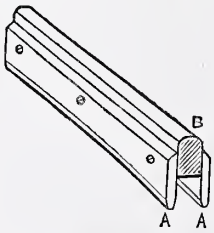


Fig. 16.—Wooden Tool with Brass Screws—A, A, Blades; B, Centre-Piece.

All things being ready, a bowl of lukewarm water, sufficiently large to permit the speculum to be immersed, should be placed near to hand, together with the little stamping tool. A strip of stout paper, wetted with rouge and water, should be fastened round the edge of the glass tool, so as to form a rim about ¼ in. high, and thus prevent the liquid pitch from flowing off. The tool being then carefully dried and slightly warmed, the pitch may be poured out. The black mass, which will spread slowly and cover all the surface, should be immediately shaped to proper thickness by the aid of the wetted speculum, and, the stamper being brought into play, the facets should be formed as speedily as possible. If necessary, the pitch may be warmed again and again, but, of course, not sufficiently to cause it to run.

In practice it will be found that facets moulded by a stamper will present a slightly concave surface. This may be remedied by bevelling their edges with a sharp chisel or an old razor, and then shaping the whole surface again, after warming, by the aid of the wetted speculum. The greatest care must be taken not to allow the speculum to dry, and so adhere to the pitch, and for this reason its position should be constantly altered a little, and rouge and water should be used, instead of water only, for the damping.

Finally, the facets having been trimmed square and regular, the paper rim and any superfluous pitch should be neatly cut away.

A properly prepared polisher should be everywhere in contact with the speculum. To test this, paint the facets separately with rouge, and lightly apply the clean, dry speculum. The imprint will indicate where contact is imperfect.

The rouge will require no further preparation than is entailed by placing a portion of it in a bottle and mixing it to a loose paste with water. It is best applied to the pitch with a flat camel's-hair brush. Every precaution must be taken to prevent dust or grit from settling on it. It is difficult to describe how to determine the proper hardness of the pitch, but it will be speedily perceived if it be too yielding or too rigid. When cold, a moderate pressure with the nail should indent it. The pitch purchased from a chemist is commonly of a quite suitable consistency. To soften pitch, add oil of turpentine; to harden it, add resin.

The remaining processes are two: polishing and figuring. The term "polishing" is self-explanatory; "figuring" is the giving to the polished surface the necessary parabolic curve.

The processes may be combined or performed separately. The former course was that pursued by the old workers. It is based on "rule of thumb," and needs a wide experience. In the latter course the spherical curve possessed by the smoothed glass is maintained unaltered until polish is complete, and is then deliberately changed to the parabola, the work being carried out under the guidance of the Foucault shadow test, to be hereafter described.

We shall first roughly notice the method of working by "rule of thumb"—a method which, however, by its very nature, cannot be satisfactorily taught on paper. Let it be borne in mind that a spherical mirror can be made parabolic and perfect for the telescope either by *deepening* the curve regularly from edge to centre, or by *flattening* the curve regularly from centre to edge.

If the fine grinding has been properly performed, the prepared speculum is spherical. Work is proceeded with, using short (one-third to one-fourth) straight strokes, the direction of each stroke being, of course, carefully varied, and an occasional irregularity being introduced. As the polish approaches completion, the stroke is changed to a very short curved stroke, the edge of the speculum overpassing the edge of the tool but very slightly. This flattens the curve from centre to edge, and thus parabolises it. At the close the straight stroke is again, for a very short time, reverted to.

The result may be successful, but lack of experience necessitates almost blind working, and tells severely in favour of failure; for the success or failure depends on a knowledge, only to be gained by experience, of the length of time for which each variety of stroke should be used. If unsuccessful, one of the methods of testing to be referred to in the next notes will indicate where the imperfection lies, and the curve must be corrected by careful work.

The second, or scientific, method is that which should be followed by an inexperienced worker. The same short straight stroke is used, with slight variation, until the polish appears. It will then be perceived that abrasion is taking place equally on the whole surface, or in excess either at the edge or at the centre—most probably the latter. The stroke is accordingly maintained or modified, as it is found that the wear is equal, or more at the centre than at the edge, or *vice versâ*. The object is to determine, by a little slow experiment, the exact stroke which will distribute the polish equally. The work should then be steadily continued until the polish is sufficient to permit the shadow test to be applied. As in elutriation of emery, so in polishing: every workman worthy of the name has a private method.

After a mirror is quite polished on the large polisher, it is sometimes discovered, under test, that some particular narrow zone of the surface needs reducing, and that this cannot be easily accomplished on the main polisher without endangering the rest of the otherwise perfect curve. In such a case the speculum is laid face upwards on the bench, and a tiny polisher of faceted pitch, formed on a basis of turned wood, is moved with spiral stroke over and over the faulty zone until enough of the glass is cut away. This, for obvious reason, is termed "local polishing." It is advocated by some experienced speculum polishers and deprecated by others.

Sometimes the spherical curve with which the glass leaves the tool at the close of the fine grinding is mechanically deepened to the parabola by the use of a shaped polisher. The ordinary square facets are gradually and very slightly diminished in width from the centre to the edge, so that the abrasion, with a stroke which would otherwise secure uniform action, becomes greatest at the centre and least at the edge.

The same principle applies when the spherical curve is flattened to the parabola by the use of a polisher rather larger than the speculum, so that, instead of equal wear, the abrasion is greatest at the edge and least at the centre.

During polishing and testing (*and the polishing should not be proceeded with until the notes on testing have been studied*), manuscript record should be kept of the observed result of any given mode of working. Reference to such a record at later stages will to some extent compensate for lack of experience.

Hard cement for barn floors and outbuildings is made of two-thirds lime, one-third finely sifted coal ashes, and a small quantity of stiff clay. Well mix with water to make pasty, then let it stand heaped for ten days. Mix up and turn over to temper it. When yielding, tough, and gluey, lay it 2½ or 3 in. thick on a well-rammed foundation. Sleek it smooth on the surface with a bright trowel; it will soon harden.

INDUCTION COILS: HOW TO MAKE AND WORK THEM.

BY G. E. BONNEY.

Long Spark Coils—Dimensions of the Various Parts—Coils Giving Sparks from 1 in. to 6 in. in Length—Special Care required in making Large Coils—Coils wound in Divisions—Breaks for Large Coils—Repairing Faults in Coils.

Long Spark Coils.—Coils to give sparks in air (from the ends of the secondary wires), ranging from 1 in. up to 6 in. in length, are made according to the same principles which have guided us in making the small coil just described. The same rules must be observed, but must be more rigidly enforced. The dimensions of the various parts will be, of course, different from those of a small coil, and these I will now give. The general rule for length and size of core, is to have the core three times the length of the diameter of the finished coil, and rising ⅛ in. in diameter for each additional inch in length of core and of spark desired from the coil. The length and size of primary should be

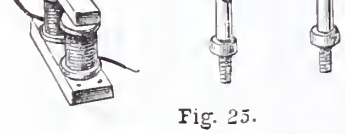


Fig. 25.

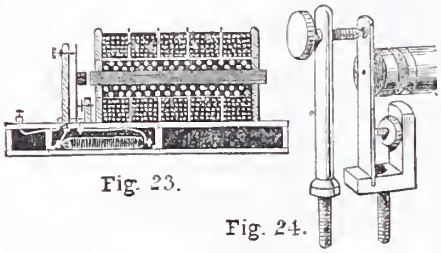


Fig. 23. Fig. 24.

Fig. 23.—Diagram of Coil with Secondary wound in Divisions. Fig. 24.—Vertical Contact Breaker for Large Coils. Fig. 25.—Horizontal Independent Contact Breaker.

just enough to magnetise this core without unduly heating the wire. The length and size of secondary wire depend upon the desired length and fulness of the spark. Thick sparks are obtained from thick wires, but the sparks are short unless a great length of wire is employed. Long thin sparks are obtained from long thin wires. The rule is—Multiply the strength of the current in the primary wire by the number of turns in the secondary wire to get the total E.M.F. at the ends of the secondary coil, and reckon 1 in. of spark for each 50,000 volts. But we may expect 1 in. of spark for each mile of No. 36 silk-covered copper wire used in the secondary coil. This supposes everything in the coil to be perfect, including a condenser of the right proportions.

Dimensions of Parts for Long Spark Coils.—The following dimensions have been employed in making large coils. 1 in. spark:—Core, 9 in. by 1 in.; primary, two layers of No. 18 silk-covered copper wire; secondary, 1 lb. No. 38 silk-covered copper wire; condenser, 100 sheets of tinfoil, 7 in. by 5 in. 2 in. spark:—Core, 10 in. by 1¼ in.; primary, two layers of No. 16 silk-covered copper wire; secondary, 3 lb. No. 38 silk-covered copper wire; condenser, 100 sheets of tinfoil, 9 in. by 7 in. 3 in. spark:—Core, 12 in. by 1¼ in.; primary, two layers of No. 16 silk-covered copper wire; secondary, 5 lb. No. 36 silk-covered copper wire; condenser, 150 sheets of tinfoil, 9 in. by 7 in. 6 in. spark:—Core, 14 in. by 1½ in.; primary, two layers of No. 14 double silk-covered copper wire; secondary, 12 lb. of No. 36 silk-covered copper wire: condenser, 200 sheets of tinfoil, 9 in. by 9 in. These coils may be all worked with current supplied by from four to six cells (of quart size) in series of a Bunsen, Grove, bichromate, or chromic acid battery. The bobbin ends of each should have a diameter three times that of the core.

Special Care required in building Large Coils.—In building large coils to give a 1 in. spark and upward, great care must be exercised in selecting, insulating, and winding the secondary wire. The strain on the insulation increases with the number of turns of wire wound on the coil, as each turn increases the tension of the induced current, and this tension is present in every part of the secondary coil. If, therefore, the insulation of the first layers are imperfect, the coil will break down at the defective spot, although all the other parts may be good. As explained before, in the opening papers of this series, this breakdown is brought about by sparks piercing the insulated covering of the wire, burning this away, and establishing communication between contiguous coils of wire. These coils then unite to form one large conductor, in which the inductive effects set up by the other coils are absorbed, thus causing a loss of power from this cause, in addition to that caused by ineffective turns of wire. It will now be clearly understood why greater care is needed in winding coils to give from 1 in. to 6 in. sparks, and why the danger of defective insulation increases with the size of the coil. This danger of internal sparking with 6 in. coils has led makers to wind such coils in divisions, to minimise as much as possible the tendency of the induced current to spark back through the insulation. This method of winding will now be considered.

Winding a Coil in Divisions.—When more than a mile of very fine wire is wound on a coil, the tension of the induced current increases enormously with each extra layer of wire, and this tension is greatest at the ends of each layer where the wire turns back on itself. It is just at these points we need more careful and perfect insulation than in the middle of the coil, for, just here, the higher tension current in the ends of the overlying layer of wire has a tendency to overcome the resistance of the insulation, and send a spark through it to the underlying layer of wire next below the last layer. For this reason it is always safer to increase the thickness of the insulation at these points by placing an extra layer of paraffined paper at the ends of each layer. It should be understood that each layer of wire in a large spark coil should be insulated from the next by a layer of thin tough paper well soaked in melted paraffin. It will also conduce to the safety of the coil if the top layers are gradually reduced—say, by one turn on each layer—so as to give an egg-shaped appearance to the coil when finished. The coil can be levelled when finished by filling up the end space with worsted, so as to give the whole a good appearance.

In the construction of large coils it is even safer to wind the secondary wire in divisions, as shown at Fig. 23. In planning a coil of this kind, it will be advisable to make the primary coil and the secondary coil on two bobbins, the primary and core forming one small bobbin, made to slip into the interior of the secondary bobbin. For this purpose

the exterior of the primary must be left even and smooth, and the interior of the secondary tube must also be smooth and true, for all unnecessary air space between the coils must be avoided. The tube for the body of the secondary bobbin may be of sheet ebonite rolled whilst warm on a former of wood, with joints of shellac made with a hot iron; and the dividing discs may be of the same material, but both tube and discs may be made of papier-mâché well soaked in melted paraffin, or may be built up of sheets of paper glued together, and the dividing discs of good thin cardboard, all well soaked in melted paraffin. The discs must be made to exactly fit the tube, and should be not only well glued to the tube, but all space between the inner edges of the discs and tube filled up with shellac. Whilst winding one division of the coil, all the unoccupied spaces must be kept well filled with half-rings of wood or of cork bound with twine to keep them in their places. The divisions must all be filled with the secondary wire wound continuously, so as to have all the turns in the same direction, for if one division is wound with a right-hand spiral, and the next with a left-hand spiral, they will neutralise each other. A wooden mandrel must be kept in the tube whilst winding on the wire, to prevent collapse of the tube. If the ends are all made of wood, and the tube and discs of paper, it will be advisable to soak the whole in melted paraffin when finished.

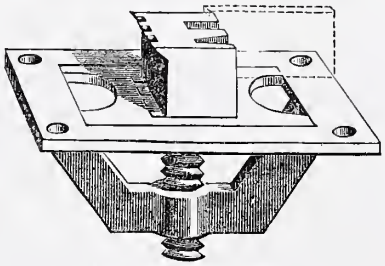
Coil Winder for Large Coils.—Large coils may be wound in a lathe, but lathes are not found in every household, and the amateur may not wish to purchase one. It will, therefore, be advisable to consider how a coil may be wound without the use of a lathe. This is a most simple matter, and may be overcome by making a coil winder out of a few scraps of wood and iron. Procure a stout board several inches longer and wider than the baseboard of the coil, to ensure steadiness; erect on this two wooden standards at a sufficient distance apart to receive the coil bobbin. In each of the standards, cut holes near the top to just fit the mandrel placed in the coil, then have this long enough to allow a protrusion of 1 in. at one end and 2 in. at the other end, after being placed in the coil. One end should then be squared to fit a winch handle. Press the mandrel into the coil bobbin after this has been placed between the standards, leaving the squared end to the right for the handle. If there is too much play between the standards and the ends of the bobbin, put a few washers on the mandrel to fill up the space, and keep the bobbin from shifting endwise. This is the most simple and inexpensive form of winder that can be obtained. Those who have the means at their disposal can improve upon this suggestion by having an iron or a steel spindle to the mandrel, and run this in properly constructed bearings mounted on iron standards. It will be found, however, that the wood standards and bearings will outlast the winding of one coil, and may never be wanted again.

If the bobbin of wire, for winding on the coil, is placed on a stout wire held in the standards, so as to run the bobbin between them a little below the coil, the wire may easily be run on by hand from this position, and guided on regularly, the bobbin slipping freely to and fro on the stout wire as the fine wire is being guided on, and thus facilitate the winding.

Breaks or Interrupters for Large Coils.—The breaking or interrupting apparatus previously described and illustrated will do fairly well for small coils, and has been described because of simplicity and ease of construction. When using large coils giving long sparks, it is necessary to provide a substantially made interrupter, because the current employed in working large coils is stronger than those employed in working small coils, and the stronger current has a tendency to burn away the contact points of the break spring and screw. The spring of the interrupter must also be made longer and stronger, so as to work slower, and thus allow the core of the coil to become fully magnetised before the current in the primary is interrupted. Unless this is done, the sparks will be short and feeble, instead of being long and strong.

The breaks for moderately large coils may be of the ordinary type worked by the cores of the coils, if modified as shown in the annexed sketches.

It will be seen, on reference to Fig. 24, that the break spring is made long, the hammer is fixed at a point one-third the length of the spring from the top, the contact spot is placed near the top, and the foot of the spring is fixed in a brass bracket furnished with a set-screw pressing against the spring from the back. When thus constructed, the



American Bench Stop.

spring bends a little when the hammer is attracted by the magnetised core, and thus the actual interruption does not take place until the core is strong enough to pull the spring clear away from the contact-screw. The set-screw at the back also keeps the spring stiff, and allows of the hammer being kept at a proper distance from the end of the core. The hammer of this spring should be heavy, having a diameter equal to that of the core. The platinum contacts should also be thick, to withstand corrosion by the spark which passes between them. The dimensions of the various parts must be arranged to suit the coil for which they are made.

Another form of interrupter, or "rheotome," as it is called, is shown at Fig. 25. This is made up of a horseshoe magnet wound with wire of the same gauge as that employed for the primary coil, and an armature of soft iron held over the poles of a magnet at the end of a long brass spring, the other end of which is attached to a brass pillar connected with the primary wire of the coil. This spring passes through the arch of the contact breaker, as shown in the sketch, a platinum-tipped screw passing through the crown of the arch to make contact with a platinum speck on the spring. This form of rheotome is not favoured very much by coil makers, as it takes up more space than the form previously described, and has no compensating advantage.

The mercury break has a similar arrangement to this. It has a long lever pivoted to the back pillar, and a spring beneath the lever to keep it in contact until the armature is pulled down by the electro-magnet. An extension of the lever behind the back pillar is made into the form of a hooked fork, the prongs of which dip into two iron cups filled with mercury, but insulated from each other. These cups are connected with two portions of the wire leading to the primary coil, the two parts being connected as with a bridge when the two prongs of the fork dip into the cups. When the armature at the other end of the lever is drawn down by the electro-magnet, the prongs are lifted out of the mercury and the primary current is interrupted. This arrangement is worked by a separate cell—the primary current being furnished by a strong battery; it is, therefore, not subjected to the strong current employed in working the coil, and the spark at the back is, in consequence, small. This form of rheotome is employed with very large coils giving long sparks exceeding 6 in. The condenser must, in this form of rheotome, be connected to the two ends of the primary coil as they leave the bobbin, instead of to the separate parts of the break.

Repairing Faults in Coils.—It not infrequently happens that a coil goes on well at first, giving a spark of the desired length and size, but afterwards fails to give such a long spark. As the operator cannot look into the coil for faults, he suspects the cause of his failure to be in the battery, and forthwith proceeds to strengthen this by placing a stronger solution in the cells or by adding more cells to the battery. This remedy may be effectual if the battery solutions are nearly worn out, the battery plates dirty, or the connections of the various parts of the circuit corroded; but it is clear, even in this case, that the remedy is worse than the disease. If, however, the failure is not due to these causes, but is caused by defective insulation of the wire or of the condenser, then the addition of more cells will intensify the evil, for the higher tension current will be sure to complete the destruction of the insulation, with the result of causing a fainter spark or no spark at all.

The fault sometimes lies in the interrupter, which works too rapidly or has not enough play; or the contact points may be worn and corroded. A close examination will soon detect a fault here, and a touch with a fine file remove the corroded part. The insulation of the condenser may have broken down. It is well to have a spare condenser at hand, when the suspected condenser may be readily taken out and a new one substituted. If the coil sparks all right with the new condenser, the fault has been located, and may be found in the old condenser by pulling it in pieces and examining each sheet as it is held to a strong light, which will show up the pin-holes pierced by the sparks. If the condenser is all right, we must proceed to unwind the secondary and search for the fault here, paying close attention to the ends where one layer turns back on the other. The smallest bare spot must be freshly insulated, and the whole coil wound again, with special care to have the insulation perfect this time. Only by such heroic measures as these can faults in coils be repaired.

BENCH STOP.

We give above an illustration of a new American invention in the shape of a bench stop. It has no set-screws, springs, or eccentrics. To raise or lower the head, it is necessary to remove the lock-plate and turn with the fingers. The head has slots to hold strips edgewise while being dressed, as shown by dotted lines.

"WORK" PRIZE SCHEME.
NOTICE.
"WORK" COMPETITION COUPON
will be found on page 351.

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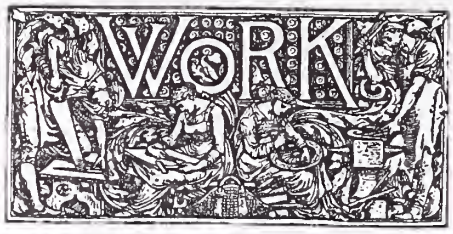

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HANDICRAFT EDUCATION FOR ARMY AND NAVY.—The Duke of Devonshire has been uttering some well-judged remarks upon the subject of Technical Education, laying stress upon the advantage of knowledge concerning the resources of our own country. All interested in the various branches of technical work, and especially those who wish to see the great trades of this country restored to that position of supremacy which they might again occupy, will rejoice to find this nobleman interesting himself in a subject as akin to the welfare of the country as any phase of politics can be. Could the noble Duke take up the question of technical training of some kind for the soldier and sailor? Thousands of these, when their service to the country has expired, are thrown upon the labour market with absolutely no resources beyond the fact that they have been in the army or navy. They know practically nothing, and are only useful as porters or messengers. Time lies heavily on their hands, whether in barracks or on board, and thousands of them would probably welcome a plan by which, when leaving the service, they would be, to some extent, qualified for marketable work. The Post Office and railway companies have considered the matter—which in itself proves its urgency—but they give it up. Now it remains for the authorities to determine whether ground really exists for public interest in discharged sailors and soldiers. If it does, men of influence ought not to be wanting to take up the cause. Opportunities for learning handicrafts in barracks and on board ship seem to us to offer a natural and easy solution to what, judging from that we read, is becoming quite a question of public interest. The British Services are not yet a disgrace to the country, but it is a sorry spectacle to behold thousands who have worn Her Majesty's uniforms thrown upon the labour market with no better recommendation behind them than an intense anxiety to find employment. We could wish this subject brought under the notice of soldiers and sailors, and would thank our readers to help in this. The views of both would be of service in deciding whether, while many best years are being spent in training for emergencies which rarely happen, it would not be a merciful provision for our soldiers and sailors to gain some insight into craft training, so that when discharged they would have some chance in the labour market. "Shop" is open for correspondence.

WORKERS' RENTS AND WAGES.—Rent is a serious item in the outlay of the weekly wage-earner—so serious, indeed, that as rents range now it is difficult to see how the mass of workers in large cities can command adequate and wholesome house accommodation. A married man cannot do with less than a couple of rooms and a kitchen, and for these he will pay at least 6s. a week in a block of "models." If he cannot get into models he must go out of town, incurring thereby the expense of a daily railway journey. Even so he will have to pay 6s. a week for a cottage, and have another shilling or two per week added for railway fares. A house in London—except it be in a slum, where he sub-lets in single rooms to families—is impossible for the workman; in fact, it is impossible for classes usually supposed to be far removed from those that form the so-called working classes. Such people take London houses, but they depend on boarders and lodgers to enable them to face the rent and taxes, just as poorer people depend on lodgers to enable them to face the weekly collector of rents for slum property. Now, 30s. a week is above the average wage—a man with constant employment at that figure is considered nowadays a lucky man—and out of that, for the modest accommodation of two small rooms and a smaller kitchen, he has to yield up 6s. It is a big slice, and the hard worker is apt to wonder why, since he has to pay so much for so little, he is himself paid so little for so much work. By the time a man in constant employment has paid his landlord, furnished his table, paid his club money, kept his own and his wife's clothes up to the mark, there is little left for an occasional doctor's bill or to bring up children with. With figures like these it is impossible for him to make provision against old age or to lay by for a rainy day. The consequence is, when misfortune comes and slack work he soon gets ejected from his tenement, and naturally thinks himself rather harshly used. Rooms which working men can live in, and have some inducement to remain in during the leisure evenings, at rents bearing some fair relation to the wages earned, constitute a subject which has yet to be solved for the working classes.

GRAPHITE PAINT.—Iron-ore paint, as it is sometimes called, or oxide paint, as it is occasionally named, has been the regular thing for use by iron and tin roofers, as well as by mechanics in many other lines. More recently, however, leading roofers have been experimenting in paint materials, and have reached the conclusion that iron-ore paint is not necessarily the best, and, accordingly, we find numerous authorities giving their approval to other kinds of paint. Oxide of iron has the dubious advantage of requiring the least oil for the largest amount of pigment. Since oil is the preservative agent in paint, this would seem to indicate that oxide of iron paint is one of the poorest that could be used for any purpose whatsoever. The new paint which seems to have greatest favour in various directions is graphite, made from the highest grade of Ceylon graphite. It is not affected by creosote, by gases, by salt water, by acids, by dampness, or by various accidents liable to occur to roofs, sidings, ceilings, etc.

ABOUT BORDER ORNAMENT.

BY CHARLES KELSEY.

Guilloche Borders.

Introduction—Definition—Antiquity and Extent of Usage—Description of the Illustrations—Applicability to Modern Work—As Objects of Study—Conclusion.

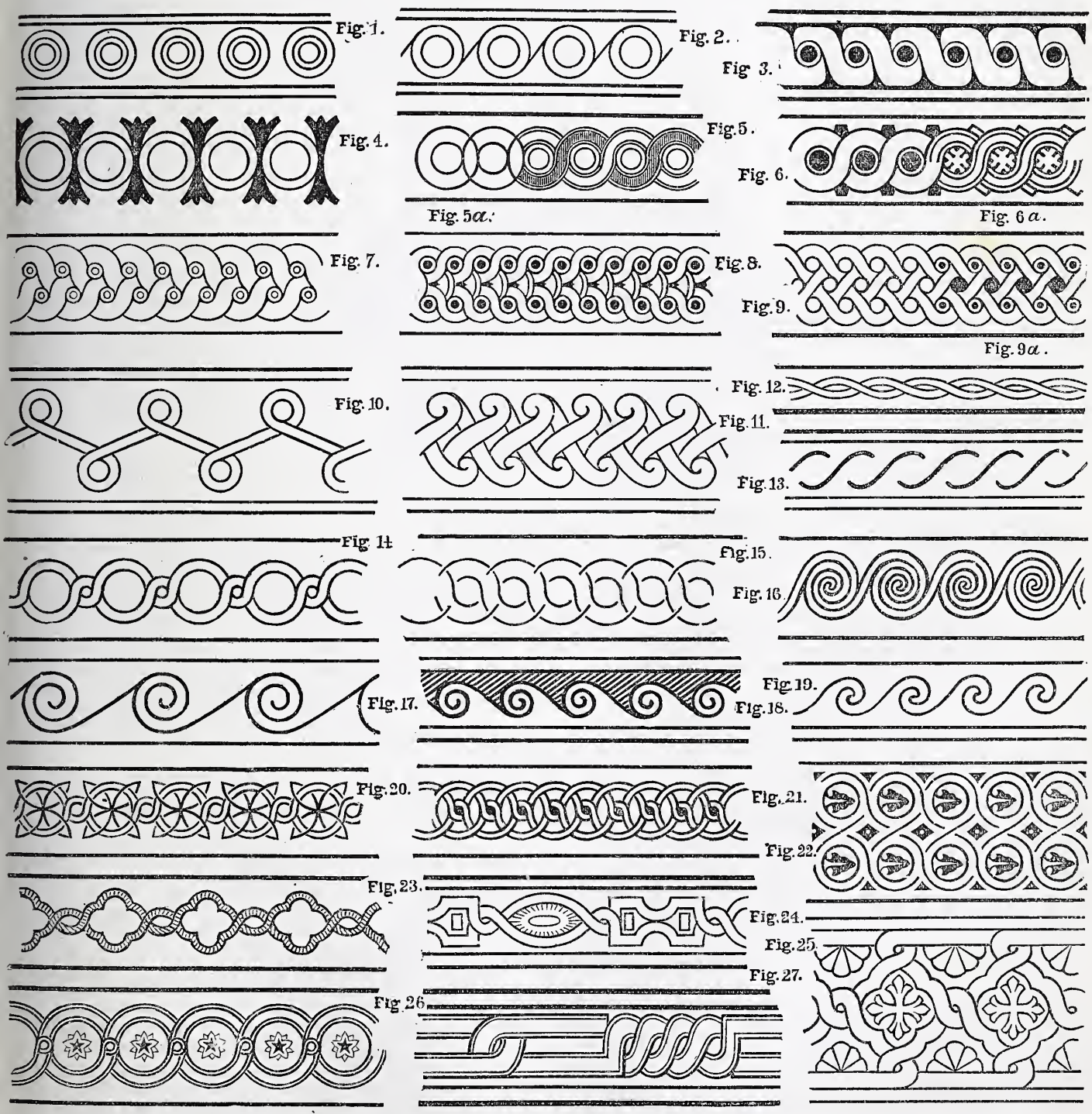
Introduction. — The previous paper on "Border Ornament" (see No. 162) dealt with fret or key borders, showing their gradual development and some of the modifications they underwent in the hands of the art workers of subsequent periods, tracing their progress through the various nations of the past to modern times. In the present paper it is proposed to deal with guilloche borders in a similar manner.

Definition.—The term "guilloche" (derived from the French) is used to designate ornament of the character here illustrated, formed by two or more bands intertwining, so as to repeat the same figure in a continued series by the spiral returning of the bands. Many of the early writers on ornament used the terms "fret" and "guilloche" in a very indiscriminate manner, frequently interchanging them; but the settled practice with modern writers is to apply the terms as now used.

If this fact is borne in mind by those who intend to prosecute their studies in this subject further, much perplexity and confusion will be avoided. The guilloche patterns have some affinity to the frets; but their distinguishing feature is the curvilineal shape as contrasted with the rectilineal character of the frets.

Antiquity and Extent of Usage.—This type of patterns have been in use for twenty-five centuries, and are still "stock patterns" with the designers of modern articles. This prolonged use is in itself ample evidence of their decorative value.

As evidence of antiquity, it may be stated that fully-developed specimens of the type shown in Fig. 5 have been discovered amidst the ruins of Nineveh, being there used for mural decoration, and also upon vessels and drapery. It seems probable that the Assyrians drew the idea, if not the actual form, from the still more



Guilloche Borders. Figs. 1—4, 10, 13, 16—18.—Archaic Greek. Fig. 5.—Assyrian. Figs. 6—9, 19.—Greek and Roman. Fig. 6 *a*.—Hispano-Moresque. Figs. 14, 15, 20—22, 25.—Byzantine. Fig. 23.—Buddhistic. Figs. 11, 26.—Elizabethan. Figs. 12, 24, 27.—Renaissance.

ancient Egyptian works, in which patterns of the type of Fig. 16 frequently appear. These are supposed to have been suggested by coils of rope, and may have been developed into the guilloche.

The Assyrian craftsmen do not appear to have carried the pattern further: a fact which adds weight to the view that it was a borrowed form.

It is to Greek art that we turn as the fountain-head of the ornament of the civilised western nations. It is quite possible that the Greeks, in their turn, received this idea from Asiatic sources, as much of their early work shows signs of such influence. For example, Fig. 16, from the so-called treasure-house of Atreus at Mycenæ—one of the most ancient Greek buildings extant—resembles closely the "coiled rope" ornament of the Egyptians. This type of pattern, however, is frequently met with in the work of many barbaric people in different parts of the globe, and so may have been developed, as in their case, without external influence, or have been derived from some ancient common stock. Indeed, if Figs. 1 to 4 are examined—specimens culled from the archaic Greek pottery in the British Museum, dating about 500 B.C.—it seems difficult to believe that the Greeks are not entitled to the credit of inventing, or at least re-inventing, these patterns.

Be that as it may, these patterns were greatly developed and perfected in Greek hands. As in the case of other forms taken up by Greek artists, they practically made them their own by a refining and perfecting process, carried to such a pitch of perfection that it is scarcely possible to add or take away anything without marring the beauty of their work. This is as true of the minor ornamental forms as it is of their grand architectural works.

Since the Greek era many developments have been made (as shown in the illustration) by the art workers of Rome, Byzantium, and of other vanished nations.

At the period of the Renaissance this, with other classic forms, was revived and modified by the workers in Italy, France, and England, and varied according to the spirit of the age and the nationality of the worker.

Description of the Illustrations.—Figs. 1 to 4 have been previously spoken of as prototypes of the pattern; whole ranges of examples similar to Fig. 1 are exhibited, apparently the first step. An advance is shown in Fig. 2, which is carried still further in Figs. 3 and 4. Fig. 5 shows the example from Nineveh, the intertwining bands being in different colours. In Fig. 5*a* the working lines are displayed. Fig. 6 exhibits a perfect Greek specimen—a painted treatment from pottery in the British Museum. The prototype of the additional feature on the outer margins may be seen in Fig. 4. It is a valuable addition, contrasting with the curved forms and giving piquancy of effect. An echo of this treatment is seen in Fig. 6*a*, from an old Spanish tile in South Kensington Museum. In the Greek carved examples a rosette was worked in the centre and a fillet round the margin of the coils (as in Fig. 6*a*). This imparted a richness to the effect, and secured the necessary variety in the light and shade.

Further developments are shown: in Figs. 7 and 8 double, and Fig. 9 treble varieties. These were used by Greeks and Romans principally as carved enrichments of the torus in the base of their columns, and also as painted or carved ornamentation on the soffit or under side of the architrave beams in their porticos, and for interior ceilings.

Fine examples are met with worked in Mosaic pavements in Roman buildings. Many appear in the Roman villas discovered in England. Specimens may be seen in the British Museum and elsewhere.

Fig. 10 is a suggestive archaic Greek specimen from pottery in the British Museum.

Fig. 16 has been before referred to. Its antiquity bears a relation to the perfected Greek works, similar to that of Stonehenge to our Gothic buildings. Figs. 17 and 18, from archaic Greek pottery, are echoes of this, tending toward the development of the "Greek wave scroll," shown in Fig. 19. This latter was used as an enrichment of the wide fillets or fascias in architecture, and also largely round the upper edges of vessels holding liquids, typical of their rippled surfaces. It was used in other connections to indicate the waves of the sea. It is a beautiful example of the simple grace of Greek work. Students should observe the beauty, not only of the form itself, but of the intervening background space. Ornamental-shaped spaces of this kind should be aimed at when coloured ornament is being designed. By judicious colouring, an additional grace may be thus secured.

Byzantine examples are shown in Figs. 14, 15, 20, 21, and 25, carved examples; and Fig. 22, a painted example. Patterns of this character appear in the Mosque of St. Sofia, Constantinople, in St. Mark's at Venice, and in other buildings of that period. Figs. 14 and 15 were frequently elaborated with detail (as shown in Fig. 25).

These examples show additional variety, gained by using circles of varying diameters, by intertwining two specimens, and by using foiled shapes—all very suggestive of further modifications.

The seat of the Roman Empire being removed to Constantinople—the ancient Byzantium—western workers came in contact with Oriental art, and ornament entered into a new phase as the result. An inkling on this may be gained by comparing Fig. 23, a Buddhistic example, the original of which appears upon a Burmese shrine exhibited at the Crystal Palace. Here the intertwining bands have a rope-like surface ornament.

Fig. 12 is a Renaissance example from Italian majolica in South Kensington Museum.

Figs. 24 and 27, French Renaissance from carved oak furniture, originals in the Hôtel Cluny; and Figs. 11 and 26, English Renaissance, the originals from Burton Agnes, in Yorkshire. These are suggestive in their combination of right-lined forms with the curved convolutions.

Applicability to Modern Work.—It is hardly necessary to point out how useful these examples may be made by readers of WORK. They can hardly be misapplied, being suitable to any flat or relief decorative process; far preferable as decoration to much of the flimsy ornament ofttimes used. The least skilled draughtsman, with a little patient industry, aided by a pair of compasses, may, by working from these examples, "set out" a satisfactory border design. They will be most effective and also most easily executed, either upon flat or convex surfaces, and may be elaborated by working the centres into rosettes and enriching the coils with lines or fillets. They are specially suitable for bands round articles circular or curvilineal in plan; their rope-like appearance and compact nature harmonise with the function of bands and borders, whose duty it is to bind looser ornamentation into a whole.

In working, each band should pass alternately over and under its fellows. In flat treatments a little shading at these points may be introduced.

As Objects of Study.—The chief lessons the student in design may learn from these examples are the decorative value of the circle in its simple, combined, and intersecting forms, and the principles of repetition and continuity of line.

The circular form is always a pleasing one, apppearing so perfect and complete; while the shapes made by its combinations and intersections are not less beautiful. The gradual gliding of the one circle into another, exhibited in these patterns, adds an additional charm, and carries the eye along the whole length of the border.

Repetition is an essential requisite in most ornament designed to be mechanically reproduced; but apart from that, it has great decorative value. A pattern may be made from any form if it is repeated upon some well-defined plan; whilst if the form is well chosen, the regular recurrence of the figure cannot fail to produce a satisfactory effect. In these patterns the original element is very small, the effect being produced by the process of repetition. Continuity of line is a principle possessing considerable decorative value. There is always a certain amount of interest aroused in tracing the course of lines through a pattern, especially when beautiful curves are formed. This is well exemplified in these examples; but the principle is not less valuable in other types of pattern, where it is, as it were, suggested rather than displayed.

Conclusion.—No doubt these examples will prove useful to my readers, whether they simply wish to utilise such patterns for the embellishment of some article, or for those who are desirous of designing satisfactory patterns of their own. The latter class may learn much by studying the growth and developments of the patterns illustrated, and absorbing their fundamental decorative principles, which give them their value as ornament, and have enabled them to survive all the changes involved in so great a period of time, and yet retain their popularity. Every workman in the land ought to know something of the history of design and ornament, occuring, as these constantly do in all work.

TIPS FOR TYROS.

To fasten lamp tops to glass, use 3 parts resin, 1 part caustic soda, and 5 parts of water boiled. This forms a resin soap to which half its weight of plaster-of-Paris must be added. It hardens in forty minutes. This resists petroleum.

Glycerine and litharge mixed thoroughly is a cement to join iron to iron or iron to stone, unaffected by water or acids.

Starch and chloride of zinc is a durable cement for blowholes in castings.

A glass cement is made of two ounces of the best glue and one ounce of linseed oil varnish thoroughly stirred and boiled. It needs three days to set the joints firmly.

SOME GOOD THINGS.

Enamelling.—Enamelling and varnishing are such necessary accompaniments to much of the constructive work carried out by our readers, that we have no hesitation in attracting their attention to any really good thing which presents itself in the way of paint or enamel. Thus we draw attention to "Porceleine," an invention to supersede enamels and paints. It is non-poisonous, durable, and will dry quickly; nor will it crack, chip, blister, or peel off. The sole manufacturer and inventor is Mr. T. R. T. Maurice, whose advertisement appears in our columns. Porceleine is the result of long, careful, and exhaustive tests and experiments, and is held to be a perfectly pure chemical composition entirely free from lead or other deleterious mineral. It is prepared in any colour—even of the most delicate tints—and it sets with a hard, bright face, which does away with the necessity and cost of varnishing. For economy, adhesiveness, durability, purity, and cleanliness, we predict a great future for "Porceleine."

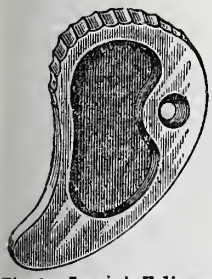


Fig. 1.—Lewin's Eclipse Cam Grip.

Window Fastener.—Lewin's Eclipse Cam Grip is an ingenious patent for the better protection of window-sashes, panels, and sliding doors, from the intrusion of either the curious or the unprincipled visitor. It is constructed with a grooved and biting edge, as seen in Fig. 1. When the fastener is properly fixed on to the window frame this edge catches the sash and grips it, making it next to impossible for a burglar to enter your house through the window without breaking the sash or glass. The Grips are automatic, simple, and durable, their price being from 2d. each, so that, considering their utility, they should command a very large sale. Fig. 2 shows the application of the Grip to the window.

Nutshell Carving.—We like our pages to be serviceable to the fancy worker, as well as others, and willingly draw attention to some interesting specimens of nutshell carving, in the shape of miniature baskets with handles, sent us by Mr. Frederick Tennant. In commendation of the work it may be said that the materials are costless; the tools required are only a penknife and a small file, while the production is unique. Poor invalids wanting something to do, find occupation in carving these pigmy baskets for bazaars, etc., where they sell well as the work of poor cripples. When the nuts are carved they are suspended upon a "stand" card, with a rhyme or some motto written under the carving.

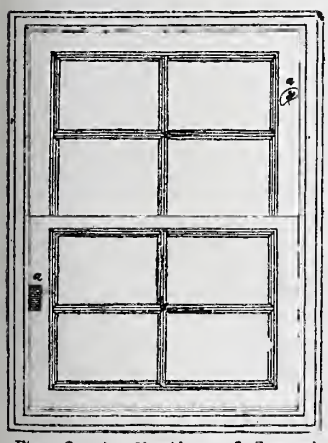


Fig. 2.—Application of Lewin's Cam Grip to Window.

Broom Fastener.—We present the drawing of a fastener for brooms, patent for which has been applied for by Mr. C. Copus. That shown in Fig. 1 is made of brass or malleable iron, price 6d., the socket of which is slightly tapered and cut lengthways into four divisions, which thus allows for expansion and contraction. The handle of the broom is thus held firmly by the fastener, and can be used on any number of new brooms by the unscrewing of small screws. No. 2 is made of sheet metal, price 3d., and will last a short time in comparison with the other. There is practically no wear in the fastener, and therefore it will last until the metal perishes. They are easily fixed by anyone, and the same handle can be used over and over again.

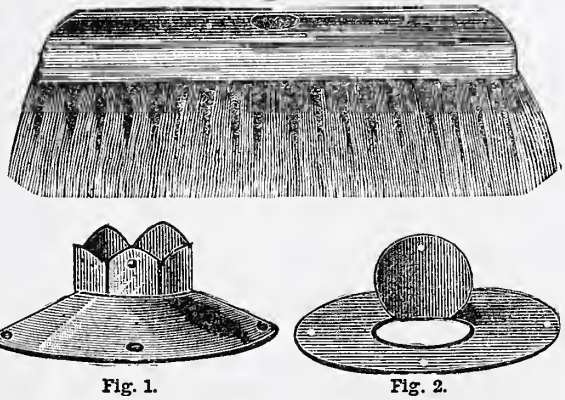


Fig. 1. Fig. 2.

Fig. 1.—Brass Form. Fig. 2.—Cheaper Form. Fig. 3.—Fastener attached to Broom-handle.

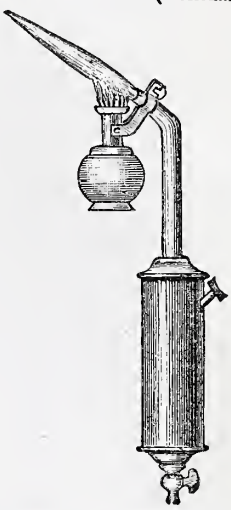
Blowpipe.—We give an illustration of a new mechanical blowpipe, for gas or spirit torch, patented by Mr. George Herbert. It is specially adapted for electricians, jewellers, gas fitters, plumbers, and general mechanics, where a continuous blast is required. It is worked by a finger on the pressure of the lever when the operator gains the effect required—an advantage over other blowpipes, as the workman can get a better flame, and give his whole attention to the work. The spirit lamp is so constructed that when not in use with blowpipe it can be used for ordinary purposes. For jewellers, mechanics, amateurs, and others, this will supply a long-felt want; it will entirely do away with the injurious effects of the gas inhaled, and will also be found to comprise a double tool. The article complete costs 12s.

Fig. 3.

Hinge.—Here are two figures illustrating an ingenious device in the form of a reversible hinge. Fig. 1 shows the patent as designed for ordinary clothes horses, where it is screwed or made fast on the edges. Fig. 2 illustrates it as more especially adapted for folding screens, and is screwed on the side instead of on the edge. Its inventor, Mr. Glazier, of Messrs. Gibson and Glazier, Limited, says:—"This invention has for its object a hinge that will fold both ways—that is, 180 degrees; but it is also applicable for cheaper hinges that will only fold to a less number of degrees. I form the two edges to be united of a semicircular contour, and place in each semicircle a rack gearing one into the other. These racks have lugs that are firmly screwed to the woodwork like hinges; the two centres of the racks are united directly by a link. There may be two or more pairs of racks, and two or more links; one pair and a link being near to the top of the door, screen, or other articles, and another near the bottom. The links are immediately on the racks, being pivoted there by rivets or their equivalent. In the place of two racks I may use only one rack let into the edges to be united, and a pad of indiarubber or other elastic material secured to the other edge into which the teeth of the rack work. The hinge is applicable for screens, folding doors, clothes horses, or the like, and when used for doors one of the racks is secured to the door and the other to the post."

Photography.—"Cyclopædia of Photographic Brass Work and Camera Furniture." (Lonsdale Brothers.) This is an illustrated price list of fittings, materials, and workshop appliances, most of them illustrated to their exact sizes, which every photographer should have by him. Many useful hints, recipes, and information are contained in the book. Its cost is threepence.

Photography.—"My Camera, and How to Use It." W. Scorer. (Trivess). A pamphlet and catalogue combined, giving much useful information concerning the points and parts of the specialty for which Mr. Scorer is so well known.



Herbert's Mechanical Blowpipe.

Cordage.—"Knotting, Looping, and Plaiting." Lucy R. Latter. (George Philip & Son.) A useful little manual, intended to instruct and afford examples for children in classes and elsewhere in the work of knotting strings and cords. The instruction is set forth in three stages, and the graduated exercises cannot fail to prove interesting and useful wherever cheap and amusing occupation is wanted for children.

BOOKS.

Telephones.—"Telephones: Their Construction and Fitting." F. C. Allsop. (E. & F. N. Spon.)—At a time when speedy communication is becoming more and more a matter of paramount importance, especially to business men, the development of telephonic machinery must, perforce, be watched with the greatest interest. As a branch of trade, too, the erection and maintenance of telephones is rapidly assuming enormous proportions. Little wonder, then, that the demand has arisen for a cheap and practical treatise—of which the copy before us is a second edition, revised and enlarged—setting out everything that it is necessary to know concerning the fitting-up and maintenance of telephones and the auxiliary apparatus. From such an authority as Mr. Allsop, it goes without saying that the subject is thoroughly handled. We wish the second edition the same rapid sale which was accorded to its predecessor.

Fig. 2.

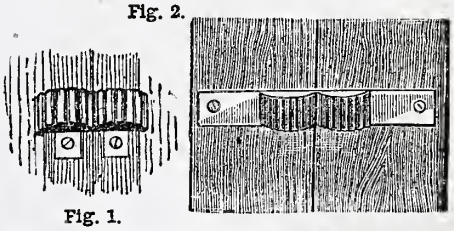


Fig. 1.

Glazier's Hinge. Fig. 1.—As applied to Clothes Horse. Fig. 2.—As applied to Screen.

Decoration.—"The Decorators' Assistant." (Crosby Lockwood & Son.)—This is the fifth edition, revised, of an extremely useful handbook which every decorator might well purchase, containing, as it does, upwards of six hundred receipts useful alike to decorative artists, amateurs, painters, writers, and gilders. The price is 1s.

TRADE: PRESENT AND FUTURE.

**** Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

SILVER TRADE.—There is a great lack of activity in the silver trade.

HAT TRADE.—The Stockport hat-making firms are now experiencing, for the first time, the effects of foreign competition. The industry is an important one, as is evidenced by the fact that the exports for the first half of the current year exceeded £500,000 in value. The Stockport Town Council are wisely taking steps to meet the changed conditions of manufacture, and special technical classes are to be formed for the teaching of the methods of hat making, dyeing, etc. Financial assistance is being given to the scheme by various local bodies.

STEEL RAIL TRADE.—A good order has been secured by a leading firm for steel rails at a large advance on last month's prices—viz., 7s. per ton. Firms are now getting £4 8s. per ton for rails of 41 lbs., and £5 per ton for lighter sections. India is the principal market to date. Germany has also afforded some good orders. The Australasian demand is quiet. Tenders are expected to be invited shortly in connection with railway extensions in South Africa.

TIMBER TRADE.—The increase in the timber trade is still going on, and several good sales are reported. The F.O.B. trade is fairly active, but at the present sale prices there is little encouragement for shippers to consign goods for the market. The dock deliveries show an increase, being 454 standards of deals and battens and 237 standards of prepared boards more than the corresponding week last year. Mention was made in WORK some time ago that prices for spruce and pine were likely to remain firm throughout the year, and the great fire at St. John's will strengthen them, as a large amount will be required for rebuilding purposes.

COTTON TRADE.—The suggestion to enforce a 10 per cent. reduction of wages in the cotton-spinning industry is receiving the general support of the employers, especially of those in the Oldham district. The operatives contend that the reduction of wages suggested will not materially improve the situation, and that the only satisfactory way of reducing the abnormal stock of yarn is to work three or four days per week. The masters, however, will not agree to this arrangement, and, as each side professes to be equally determined not to yield to the proposals of the other, there is every prospect of a prolonged and severe struggle. Our Rochdale and district correspondent writes:—The result of the bad trade has been that the Masters' Federation has under consideration the question of putting all the mills on short time.

BUILDING TRADE.—The Bolton building trade dispute has been settled. The plasterers of Colne and Nelson are, however, now on strike, demanding an advance of wages of from 7d. to 8d. per hour. The masters offer an advance of ½d. per hour, but the men refuse to accept this. In Aberdeen matters are very brisk. In the masons' and stonecutters' branch of the trade there is rather a scarcity of men.

IRON AND COAL TRADES.—There is an improved tone in the Sheffield markets, and prices are firm. Hematite pigs, 55s. to 57s. per ton according to brands. Forge iron, from 40s. to 41s. per ton. Our Bishop Auckland correspondent writes:—The northern coal trade continues active. Steam coals are firm. Gas coal is in full demand, and higher prices are asked. Bunker coals are dull. Smithy coals are firm. Household coals are quiet. Coke is in fair demand, and is quoted from 15s. to 17s. per ton free on board. In the Middlesbro' iron trade makers are not prepared to take less than 40s. per ton for prompt deliveries of No. 3 G.M.B. The stocks in Connal's warrant stores show a week's decrease of 4,112 tons. No change can be reported in the finished iron and steel trade, either in price or demand, and prospects are not encouraging.

CUTLERY TRADE.—The only present prosperous branch of cutlery is to be found among manufacturers of reaping machine knives and such-like agricultural implements.

CHEMICAL TRADE.—Chemicals are quiet. Soda crystals are £2 17s. 6d. Bleaching powder is firm at £7 10s. South Durham salt is steady at 9s. 6d. to 10s.

ENGINEERING TRADE.—There is a decided improvement in the engineering industry of the Manchester district. Stationary engine builders have orders of some importance, while the leading machine tool making firms are better employed than for some time past. The locomotive engineering branch shows no improvement, nor does the Mersey shipbuilding trade. Makers of textile machinery are feeling the effects of the depressed condition of the cotton trade, as no new mills of any size are being built. Boiler makers are somewhat better off for work, but in many cases the prices taken for the work are very low—a fact that indicates a scarcity of orders in this section of the industry. A slightly better tone characterises the iron trade, and although the prospects are by no means satisfactory, there is certainly more business being done. Some of the manufactured iron makers are rather busier than they have been for some months, but in the steel trade the orders coming forward are almost all for immediate delivery, while there is only a moderate weight of business being done.

SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

I.—LETTERS FROM CORRESPONDENTS.

Co-operative Home Industries' Society.—J. P. (*Newton Abbott*) writes:—"The premises and interest of the 'Home Industries' Agency' have been taken over by the new society at 15, Princes Street, Hanover Square, where further information may be obtained."

Novelties in Arithmetic.—WORKER writes:—"Write down any amount under £10 in pounds, shillings, and pence, and any less amount under it composed of the same figures reversed in position; then subtract this from the upper row of figures; again reverse the figures of this amount, and add them together: the total will always be £12 18s. 11d., no matter what figures are used under £10 and over £1. Thus:—

£	s.	d.
9	19	8
8	19	9
0	19	11
11	19	0
£12	18	11

or,

£	s.	d.
2	1	1
1	1	2
0	19	11
11	19	0
£12	18	11

Why is it?"

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Testing Lightning Conductors.—J. N. (*York*).—Lightning conductors should be frequently tested for electrical continuity and conductivity. There can be only one effectual method of doing this. A light wire cable of known resistance must be taken to the point of the conductor, and there made fast by a thimble passing over the point, or a sleeve or a shackle clamped to the conductor, so as to make a clean metallic contact with the rod. At the ground end of this cable there must be a testing battery giving a strong current, and a direct reading ammeter or a galvanometer and set of resistance coils. We have to find the resistance of the lightning conductor, and compare that with its normal resistance with sound joints. This may be done with a direct reading ammeter and a strong battery in circuit by first noting the number of ampères obtained through the testing cables alone, and then noting the difference with the lightning conductor on circuit. For instance: a copper conductor ½ in. in diameter and 200 ft. in height should have a resistance of 0·011 ohm.; and a 7/22 cable of the same length should have a resistance of 0·49 ohm. With a battery of six Hellesen testing cells in series, we should get two ampères of current through cable and conductor, connections being made at point and base. If the current obtained is 1 ampère, or only the fraction of an ampère, we may suspect a corroded joint, and should test the conductor joint by joint until it is found. If the conductor appears to be all right above ground, it must next be tested at earth by driving a stout copper rod into the earth near its base, and connecting this with the battery and testing instruments. Faults are common here at this point. They are, mainly, corroded junction of rod with earth plate and dry earth. Several pails of water will remedy the latter defect. Tests made by the aid of a bridge, set of coils, and galvanometer are most accurate, but previous training in the use of these instruments is necessary. Tests made with an ordinary galvanometer alone are not reliable, as only the continuity of the electric conductor can be thus ascertained, whilst its capacity is the most important feature.—G. E. B.

Iron for Electro-Magnet.—J. M. (*Kirkham*).—Swedish iron is best for cores of electro-magnets, because it is tough and soft, but any good soft iron will serve your purpose. It may be obtained from any ironmonger or tool merchant. (See advertisements in WORK.)—G. E. B.

Cottage Designs.—W. H. B. (*Salford*).—In reference to the letters E M I represented on plan, E represents the scullery or back kitchen; the size of same is 10 ft. by 8 ft. The letter M represents the asbpit, which is only 3 ft. by 3 ft. square, which is quite large enough for the cottages they are intended for; and the letter I does represent the back yard, as you say. The plans and specification would be sufficient for you to get an estimate from. I have omitted in my specification what you say: "gas and water pipes, and fire-grates." The reason for my so doing was that if they were erected in a country place, they could not have gas or water pipes, as they generally use oil lamps, and the water they use is from a well, and is therefore pumped up. If you wanted to get an estimate from three or four contractors, you would almost be compelled to have bills of quantities taken out, and in these quantities there would be a lump sum set down for pumps and fire-grates. You also ask me if I would advise you to engage an architect to superintend their erection or not. No, certainly not, if you engaged a thoroughly practical builder. My originals were drawn to a scale of 4 ft. to 1 in.—W. B.

Plates for Micro. Photography.—MICRO.—There are no plates on the market specially suitable for your purpose; but if you used some developer which gives very transparent glass in the high lights of the picture, you ought not to get any grey surface when magnified. Have you tried hydroquinone or ferrous oxalate? I presume you made your transparencies by reduction from a large picture, which, of course, allows for considerable magnification. If you made them direct it would account for the grain. Failing the above developers, or if they will not answer your purpose, you must sensitise your plate yourself with collodion, etc., as for the wet process in the "good old days." This should not give you the faintest shade of grey in the high lights, as it will give perfectly clear glass.—A. R.

Continuous Alarm Bell.—C. S. L. (*Manchester*).—Your correspondent aims at a continuous alarm bell for cycle; his idea would certainly work. The arm marked 2 would have to be of an elastic or springy nature, so as to press the wheel 3 down on the tire of the bicycle. The small rubber tire on the wheel 3 would be better flat, or even hollow, than round as shown. In continuous alarms it is desirable that the bell should be silenced on occasion; there is no arrangement shown to accomplish it. About a dozen patents exist of continuous alarms. I may refer to two which your correspondent may procure of Mr. R. E. Phillips, Patent Agent, Royal Court Chambers, 70 and 72, Chancery Lane, London, W.C.—Purdon's Patent, No. 3717 (1877), price 2d.; Rudling's Patent, No. 3182 (1883), price 8d., with drawings.—A. S. P.

Motor.—AMATEUR.—The price per lb. of No. 36 silk-covered wire is about 11s., but in buying small quantities you may have to give a little more; as to how many yards go to the lb. in such a fine wire greatly depends on the quality of the silk covering. You are anxious, you say, of making the little model in Vol. III., No. 154; if you manage to get 20 yards of No. 36 on to the armature you will be right, and this will cost you about 2s.—J. B.

Dry Plates Baeking.—J. M. (*Derby*).—The following formula will be found to answer every purpose:—Obtain some burnt sienna, ground in water, from the oil and colour shop, say, a quarter of a pound—the exact quantity is immaterial—add a little mucilage of gum-arabic, and then thin down to the consistence of a thick cream with equal parts of methylated spirit and water; to this quantity add about an ounce of burnt sugar or caramel, and stir it well together, and then with a stiff brush paint thinly on the back of the plates, and set them in a dark room, face to the wall, to dry, which they soon will do. Caramel *alone* is not suitable as it is too long drying, and when mixed with spirit the colour is too much diluted to be an effective backing. The mucilage is added to prevent the colour rubbing off when dry. This backing will not interfere with the development in any way if left on the plates, but it is more convenient to wash it off under the tap of the dark room before beginning.—D.

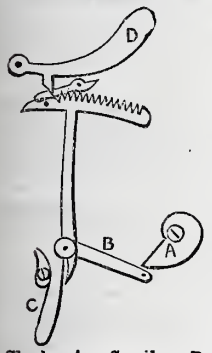
Piano Iron Frame.—AN OLD SUBSCRIBER.—I do not comprehend your reason for making a pattern for iron frame, since you can purchase them ready-made; but probably you intend to make one that differs from the ordinary. They, generally speaking, allow ⅛ in. to the foot for contraction in casting iron frames. Make your scale to shape of your frame, where the pins are wanted, out of a piece of zinc, and punch holes through, and send to Birmingham with your pattern. You can make a cheap bronze for your iron frame by mixing bronze powder with French polish; in this way it forms a lacquer. But I can recommend to you Ardenbrite Liquid Gold—advertised in the pages of WORK—if you require good results and brilliancy. Write to E. Whitfield, Regent Foundry, Small Heath, Birmingham, who makes every description of iron frame, and casts from your own pattern.—T. E.

Coach-Painters' Books and Pencils.—YOUNG BEGINNER.—The best kind of pencils you can buy for fine-lining are sable and ox-hair. I do not know of any retail seller who issues a list of same. Coach-painters' pencils or liners can be bought at most shops where they sell colours. I send for mine to James Smith & Son, goldbeaters, 39, Bridge Street, Manchester, who keeps very good lining pencils of every description, made specially for liners. The sable and ox-hair are sold by numbers,

from No. 1 to No. 8. The seller calls them by a different name to what a coach-painter would, namely: No. 1, lark; No. 2, crow; No. 3, duck; No. 4, goose; No. 5, extra goose; No. 6, swan; No. 7, large swan; No. 8, extra large swan. The painter calls No. 1 a fine liner, No. 2 strong fine liner, No. 3 fine quarter liner, No. 4 quarter liner, No. 5 strong quarter liner, No. 6 picking-out liner, No. 7 three-quarter liner, No. 8 broad picking-out liner, which stripes a line over an inch wide, useful for mouldings. The prices range from 1½d. for No. 1 fine liners, up to 1s. for No. 8 broad picking-out pencil. You should read carefully the articles on "Sign Writing and Lettering," by H. L. Benwell, in the first volume of WORK. A most useful little book to carry in one's pocket, to refer to when working, is "The Ornamental Penman's Pocket-book of Alphabets." It can be bought at most of the large booksellers'. There is a good shilling book on "Heraldry" published by J. Barnard, and on page 30 it gives the metals and colours used in heraldic work, giving the heraldic title, and showing how they are engraved. To understand it, you must refer to the first plate of engravings, under the title of "Furs, Partitions, Lines, etc." This is the first step towards learning heraldry painting. There is a "Handbook for Coach-painters," edited by G. A. Thrupp, price 1s., and Boag's "Practical Guide to Coach-Painting," price 12s. 6d. Some articles on this subject by a practical hand will shortly be given in WORK.—W. P.

Cycle Works.—ANXIOUS ONE makes a mistake in proposing to commence cycle making without some practical knowledge of the business. There seems to be a prevailing notion that fortunes are to be made in cycle making, and that anybody can make them, whether butcher, or baker, or candle-stick maker. I know a butcher who has actually started a cycle hiring and repairing shop, and who cannot intelligently tighten a pedal nut with a wrench. In starting cycle building, ANXIOUS ONE would have to employ a skilled practical man to conduct his business. The output of machines per week would very much depend on the plant provided. For instance, with a plant costing £1,000, seven or eight men would turn out a dozen machines; with plant costing £50, twelve to fourteen men would be required, as a much greater part of the work would have to be done by hand. Labour wages run from 30s. to 36s.; a competent foreman or manager from 50s. to 60s. A great many fittings for bicycles are in the market by manufacturers who do not make machines, but parts only, such as hubs, ball heads, ball bottom brackets, chains, chain wheels, cranks, pedals, saddles, bells, etc.,; the stampings are bought at about 6d. per lb., steel tubes in 14 ft. and 15 ft. lengths, rims made up, tires of all kinds. A proper plant, to turn out, say, a dozen machines weekly, would comprise a gas engine, several lathes, verticals, milling machine, slotting and planing machine, hub boring vertical, spoke header, two enamelling stoves, three or four forges, and the same number of blowpipes, a dozen or so vices, rim dividing and coring apparatus, spoke-cutting and screwing machine, wheel welding stands, with a large lot of smaller tools, and the lot would cost several hundred pounds—probably £1,000.—A. S. K.

Grandfather's Clock. — TRY AGAIN. — From your note, I am of opinion that you have not got the spring which throws the rack in its place; or, if that is right, then perhaps the rack-tail, which falls on the snail, is bent, and gets caught against something. See that the spring is in its proper place; also that the rack is perfectly free, and that the tail part of it falls fair on the snail or graduated circle that is fixed to the hour wheel. I think you will find it is one or other of the above faults. The spring should throw the rack-arm down to bottom part of notch in snail, and he still pressing slightly when there, so as to ensure it striking the long hours correctly. See to this, and if still wrong, write again.—A. B. C.



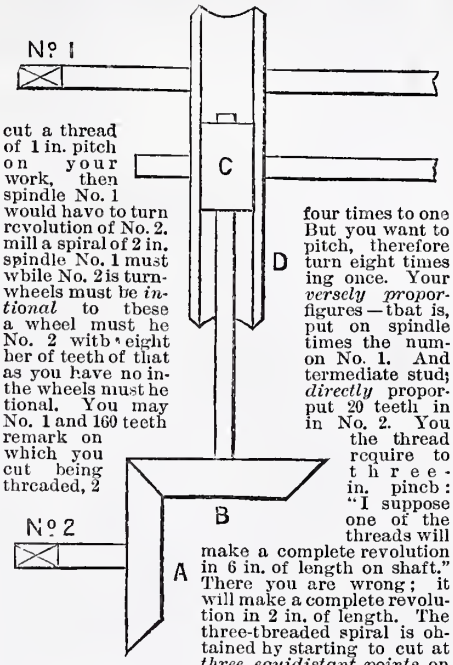
Clock—A, Snail; B, Rack Arm; C, Rack Spring; D, Rack Hook.

Gilding.—NOVICE.—When you have gilded the ornaments, you can burnish the parts you wish to look bright, and leave the other; or you can apply either of the following:—Take a little vermilion ground up with white of egg and red lead, or yellow ochre and red lead mixed with parchment size, or the terra di Sienna slightly burnt and mixed with a small proportion of red lead; apply with a camel's-hair pencil to the parts you wish matted.—W. E. D., JR.

Tire Solution.—F. L. (*Tunstall*).—Cut the ends of the tire clean—the longer the slant, the better; get *rubber solution* (not tire cement); smear both the slants of the tire with it. Let stand before joining for an hour or two; then join carefully and press together. Of course, the tire must be entirely off the wheel while doing this.—A. S. P.

Magic-Lantern. — LUX. — Before you read this you will probably have seen an article on magic-lantern construction. See WORK, Nos. 174 and 179.

Milling Machine. — SWINTON. — I wish your sketch and questions had been more clear, as I am not sure that I quite understand them. But, taking your apparent data, the case stands thus (see sketch). Bevel wheels, A, B, are equal. Worm wheel D has forty teeth, and worm C is single-threaded. Therefore, it will take forty turns of spindle No. 2 to turn the worm wheel D, and *the work*, as I understand your sketch, round *once*. Your "bar" or "slide" is traversed by spindle No. 1, which has a double-threaded screw of eight threads per inch, taking, therefore, four turns to traverse it 1 in. Consequently, if you wanted to cut a thread of 1 in. pitch on your work, then spindle No. 1 would have to turn four times to one revolution of No. 2. But you want to mill a spiral of 2 in. pitch, therefore spindle No. 1 must turn eight times while No. 2 is turning once. Your wheels must be *inversely proportional* to figures—that is, these a wheel must put on spindle No. 2 with times the number of teeth of that on No. 1. And as you have no intermediate stud; the wheels must be *directly* proportional. You may put 20 teeth in No. 1 and 160 teeth in No. 2. You remark on the thread which you require to cut being threaded, 2 in. pinch: "I suppose one of the threads will make a complete revolution in 6 in. of length on shaft." There you are wrong; it will make a complete revolution in 2 in. of length. The three-threaded spiral is obtained by starting to cut at *three equidistant points* on the circumference. The general "rule to get wheels for any pitch of spiral" is to make the wheels *inversely proportional* to the required speeds of the two spindles. If I have misunderstood your meaning, you must please make a complete sketch of arrangement of machine.—J.



Milling Machine Parts.

Check Cash Till.—S. A. L. (*Portsmouth*).—Your query is very vague; you do not say whether you want an automatic till, or a revolving paper on which amounts taken are to be written through an opening. Nearly every conceivable motion for check tills, electrical and otherwise, has been patented. If you want a till to distinguish and register coins according to their values, you should have in your till an inclined channel with different-sized slots in its bottom, according to the coins to be entered, commencing with the smallest, then each coin will roll on until it reaches its proper slot, in slipping through which it may make an electrical contact, and through a small electro-magnet prick, or otherwise mark on paper wrapped round a revolving barrel placed parallel to the selecting channel, and ruled with spaces for each denomination of coin. The electrical contacts may be made by causing the coins in falling to pass between and press against light spring wires of each side. A Leclanché cell would be sufficient to work this arrangement.—F. C.—[An article will appear shortly.—ED.]

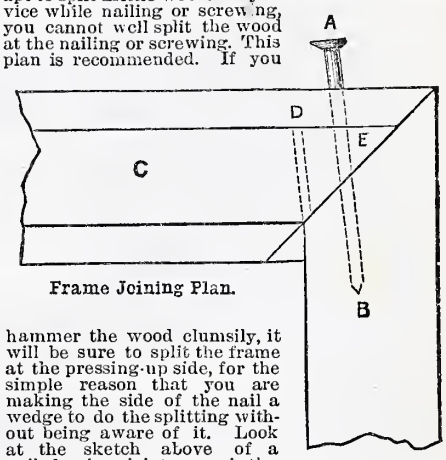
Phonograph.—W. F. (*Birmingham*). — These articles appeared in Nos. 167, 169, and 174.

Balloon Making.—AMATEUR BALLOONIST.—We presume that our correspondent does not propose to construct such machines as will enable him to endanger his own neck and those of his friends, but toy balloons only. For making these he will find directions in WORK. In Vol. III., p. 134, No. 113, is an article, with diagrams, on the construction of fire-balloons in paper, and more on the same subject, also illustrated, in Vol. II., pp. 245 and 427, Nos. 67 and 81. In Vol. II., p. 762, No. 99, are instructions for making gas-balloons in silk. There are besides various hints on balloon making scattered through the columns of "Shop."—M. M.

Trousers Stretcher.—KORIC.—Unless KORIC is a wood-worker, he would not make a good job of this in wood, and I cannot advise him to try to make one in metal.—B. A. B.

House Painting and Decorating.—W. H. C. (*Homerton*).—Yours is a very worthy and commendable desire. The best school wherein to learn "better-class work" is, of course, in better-class houses and firms than the one you have qualified with. If you are without "encumbrances," and have confidence in your own intelligence and smartness, you should make a change. This, I know, is a serious matter: leaving a constancy for the vicissitudes of the "casual" London journeyman's life. But there is nothing like such a change for opening the eyes of the young journeyman. A trip to the North of England or to Scotland—the large cities, of course—would be a revelation to you. You would doubtless soon get a job if you deserved it, and would have a *fair chance;* any tradesman coming from London usually gets this. Some of the leading Scotch decorators have saloons like art galleries or palaces. This is a fact. And the work done up in the North is, if anything, superior to the best West End trade of London. "The race is always to the swift" nowadays, so spare no pains to improve your craftsmanship whilst you are young. Now with regard to books: I can confidently recommend the papers on plain work in Vol. I. of this magazine. If you have not read them, then send 7s. 6d. to the publishers for the volume. Vol. II. contains a series on graining, practical and "understandable." Vol. III. contains much that is useful in your line, besides several practical papers on decorative work. You should first understand common work not "pretty well," but *thoroughly;* not only *how* 'tis done, but *why* it's done that way. I can recommend nothing more valuable to the professional worker than the "Journal of Decorative Art." (See advt. in WORK back numbers).—LONDON DECORATOR.

Picture-Frame Mitre Splitting.—J. B. (*St. Helen's*).—J. B. wants to know how to put together without splitting the ends of the wood. This is a learner's trouble always, and may proceed from various causes: as at one corner he might start the split by faulty boring for the pin or screw, or in sawing for the mitre slip or dowel. The next corner he may split by putting in nail, screw, or slip too large for the hole or cut; the next corner he may drive at the wood in nailing too hard; the next he may punch in the nail or turn in the screw to be below level of surface without having well countersunk the edge of the hole. In any of these cases a little forethought averts the evil. As the answer is for others as well as yourself, each shall be reviewed to see which fits your trouble. A good joint well glued needs nothing else to hold it; or, if a light frame, when the glue is dry drive in a needle (these are sold for this purpose), or by "cleats," illustrated in WORK No. 163. If you use nails or screws for a heavier frame, bore the holes with the archimedean drill: this will not split the hardest cross-grained wood. They can be bought—the stock and six drills—from 9d. upwards; it is far better than bradawls or gimlets. For screws, the separate pieces of the frame have to be bored with drills of two sizes; the hole in the pressing-up joint-piece that takes the stem of screw or head part of the nail must be large enough for the screw or nail to go in with the pressure of the finger if in hard wood, and the drawing-to parts of frame joint must have the hole only as much smaller that the nail will drive or screw thread-cut in without splitting. It is a good plan to roughly cut a mitre to two pieces of wood, and try how tight the nail or screw can be forced in without splitting the wood; this will decide what size drills you must use for the job. Use a rose-bit to countersink for head of screw; let the cone of head of screw press most on the heel of joint, not the toe; if on the toe, it acts as a blunt wedge, and is quite apt to split brittle wood. If you hold the mitre in a vice while nailing or screwing, you cannot well split the wood at the nailing or screwing. This plan is recommended. If you hammer the wood clumsily, it will be sure to split the frame at the pressing-up side, for the simple reason that you are making the side of the nail a wedge to do the splitting without being aware of it. Look at the sketch above of a nailed mitre joint; A B is the nail; by over driving the part C it slides down the joint (here shown far beyond what it would ever be driven to show the effect); the hole which was in the direction of A is carried in the direction of D, and the rigid nail becomes a cleaving iron to split the wood towards E. For very heavy frames that will have rough driving, it is usual to allow for this sliding-down of joint by boring holes for nails or screws a little up out of line, to allow for drawing-down of joints.—J. C. K.



Frame Joining Plan.

Gilding Cards, etc.—AMATEUR.—To gild the edges of books and cards is not a very easy operation for an amateur, but it can be done, and I will give the necessary instructions in as few words as possible. For the operation the following apparatus and materials will be required: A lying press (described in WORK), pair of gilding boards, one or two steel scrapers, a hard brush, a piece of hole, a square of blacklead, some size, a flat camel's-hair brush, cushion, knife, and leaf gold, flat burnisher, etc. Having procured all these things, proceed in the following manner. Take the book and place it carefully between the gilding boards, which are

simply two pieces of hard wood about ½ in. thick, longer than the book, and about 3 in. broad. The book should have been previously cut on the edge. The gilding boards should be flush with the book edge; this is now placed in the press, keeping the boards flush with the press cheeks. A lying press is really a bookbinder's vice; the press must be screwed up very tight. The edge should now be scraped with a steel scraper until perfectly smooth. A little bole (which is a red earthy substance) and blacklead are mixed and applied over the edge with a wet sponge; the edge is then brushed over with the hard brush until it is perfectly dry and shining. The size is composed of white of egg and water, 1 of egg to 7 of water. As much leaf gold as will cover the edge is taken out of the book and carefully laid and blown out straight upon the cushion; it is cut with the knife to any desired size; each piece is taken up from the cushion with a broad piece of paper which has been previously passed over the hair of the head; all the gold required for the edge must be so taken up. Now, having done so, apply the size to the edge with the flat camel's-hair brush, and while the size is wet take up one of the slips of paper with the gold leaf adhering to it, and carefully transfer the gold to the edge. When the entire edge has been covered with gold, leave it to dry, which will be some time. When almost dry, take a piece of hard paper, such as cream-laid note, and one of the burnishers, and rub over the edge with the burnisher, keeping the paper between the edges and the burnisher. This is called rubbing down. The edge should now have a dull appearance, and neither holes nor patches in the gold should be seen; if any do appear, they should be made good by cutting small pieces of gold and lifting them from the cushion with a small pad of cotton-wool and breathing upon the place to be mended, the gold being afterwards pressed on with the cotton wool. The edge should be again rubbed down and left to become "bone" dry. When in this state it should be burnished. Burnishers for this purpose are made of agate, iron stone, and pebble; they are flat-shaped, and vary from 1 in. to 2 in. in breadth. The burnisher is held in a convenient position in the hand at an angle of 45° to the book, and pressure is applied from the shoulders, which is worked backwards and forwards during the operation. The *modus operandi* for cards are quite the same. It will be difficult, I know, to understand all this from a written description. I cannot give drawings which would make the matter any plainer. However, AMATEUR must just try, and if he comes to a difficulty he must write again.—G. C.

Piano Making.—IRON FRAME.—The back for iron frame piano is the same as described in WORK, with the exception that you will only require six uprights or bracings, as the strain is taken off the back, in a great measure, by the iron frame. You can obtain frame from W. Hughes, 37, Drury Lane, W.C.—T. E.

III.—QUESTIONS SUBMITTED TO READERS.

**** The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Ribbon of Bruges.—A. C. G. (*Hampstead*) writes:—"Will a reader kindly tell me how to make 'Ribbon of Bruges'?"

Piano Panels.—J. D. (*Ipswich*) writes:—"I shall feel obliged if any reader could advise me what to put in the panels of my piano instead of the silk."

Stain.—AMATEUR writes:—"I have a kitchen dresser which is grained and varnished oak colour, and I want to stain it mahogany. Will some brother reader kindly advise?"

Masons' Marking Red.—MASON writes:—"Could any kind reader inform me where I can buy a kind of red stone, which is commonly called 'masons' marking red'—it is used to mark on stone—and the price?"

Bamboo.—RUFUS writes:—"I have a quantity of bamboo canes which I am desirous of working up into fancy articles. Will some fellow reader kindly inform me the easiest way of bending them for curves, etc.? I am only an amateur, and shall be obliged for explicit directions."

Soap.—SOAP writes:—"Will any reader inform me where I can get a text-book on the latest methods of soap manufacturing; also the names of a few makers of the necessary machinery used in the making of soap?"

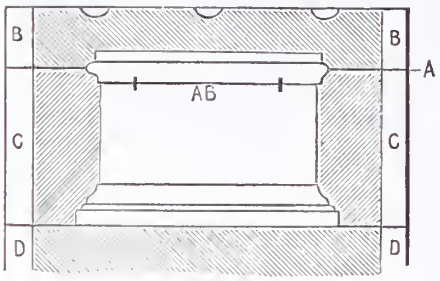
Monogram.—MORENO writes:—"Having of late seen such tasty designs for monograms in WORK, I should be much obliged if some of your artists would design one for me with my initials, J. J. H."

Perpetual Fountain.—T. J. K. (*Upper Holloway*) writes:—"Would any reader be kind enough to explain how to make a perpetual fountain, or to refer to a back number giving diagrams, etc., for making such?"

Refuse Destroyer.—COLONIST writes:—"I should feel very much obliged to the kind readers of your excellent paper, WORK—the like of which does not exist in Australia—if one or more of them would furnish me with information as to the best known things in the way of destructors for dealing with town and city refuse."

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Lead Weight.—EDDIFRA writes, in answer to W. W. W. (*Nottingham*) (see No. 169, page 62):—"I see the sketch I sent is not quite plain enough. A in the former should be opposite the joint of the two lower boxes—*i.e.*, the drag and the middle box part. I have sent another view; in this AB is the position of the joint of the pattern. You will see that the joint of pattern must be where it is, or it would not be possible to draw the pattern out of the sand."



Lead Weight Pattern.

Camp Cot.—V. D. (*London, W.*) writes to F. K. (*Staveley*) (see No. 167, page 174):—"'The best sort I know is a very simple one, consisting of two ends and two side poles, with a bottom of strong canvas and leather, sewn so as to slip over one pole and buckling to the other side and at the head and foot, so as to be tightened as required. The ends should be strongly fastened together, and the sides should slip easily into holes cut in the four legs. Thick male bamboos are best for the sides; the length and width should be according to the size of the person requiring it.' This is copied from A. A. A. Kinlock's book, 'Large Game Shooting in Thibet and the North-West.' If F. K. could have the sketch of the bedstead, it would give him more idea of it, for the copied written description is rather limited. The bedstead is well worthy of a proper portrait in WORK, as it is so simple, and so quickly and easily put together and taken to pieces; and wooden poles for the sides might be substituted for the bamboos, which might be expensive and not so easily got."—[V. D. should submit a sketch—a rough one could be set right by our artist.—ED.]

S.S. "Great Eastern."—G. J. M. (*Liverpool*) writes, in reply to MODEL S.S. (see No. 155, page 811):—"The following are the particulars of the dimensions of this steamship: 24,000 tons; length over all, 692 ft.; depth from deck to keel, 60 ft.; breadth, 80 ft.; breadth across paddle-boxes, 120 ft.; paddle engines, 1,000 h.-p.; screw engines, 1,600 h.-p. Built by Messrs. Scott-Russell & Co., from designs by I. K. Brunel, Esq."

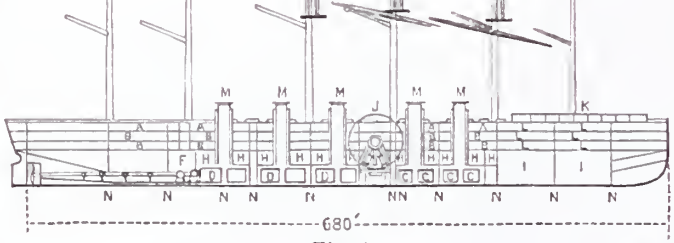


Fig. 1.

Fig. 1.—Longitudinal Section.

Fig. 2.

Fig. 2. — Transverse Section.

Tin Canisters.—W. M. J. R. (*Bishopston, Bristol*) writes, in reply to YOUNG READER (see No. 168, page 190):—"I shall be pleased to find him a market for the tin canisters, if they are of any value at all."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—A. S. C. (*Oldham*); S. H. (*Preston*); A TAILOR; TINKER (*Reading*); J. H. S. (*Hanley*); A. L. C. (*Camberwell*); S. N. M. (*Kilburn*); E. C. (*St. John's Wood*); TAMAR; APPRENTICE ENGINEER; LOOKING GLASS; H. H. (*Hopworth*); W. C. (*Wallington*); W. W. H. (*Glasgow*); A. R. (*Scorrier*); J. S.; G. H. (*Natal, S. Africa*); A. D. C. (*Pitcaple, N.B.*); W. T. S. (*Goddenham*); AMATEUR DENTIST; J. G. (*Port Elizabeth, S. Africa*); E. D. (*Burslem*); J. E. G. (*Cormarthen*); G. E. V. B. (*Worcester*); J. H. (*Birmingham*); H. B. S. (*Liverpool*); F. P. (*London, W.*); C. E. (*Finsbury Pavement*); H. S. (*Maidstone*); READER OF "WORK."

NOTICE TO READERS.

AMONG next week's contents will be:—WATCH AND CLOCK CLEANING AND REPAIRING; WHITENING THE KEYS OF MUSICAL INSTRUMENTS; HOW TO BUILD A PORTABLE STAGE; NOVEL TURNING; RUSTIC SEAT.

"WORK" PRIZE SCHEME.
THIRD COMPETITION.

Escape from Fire Device.

FOLLOWING on with our Prize Competitions we ask public co-operation in a subject of world-wide interest, viz., ESCAPE FROM FIRE. This is a matter which concerns every individual, and as the moment of emergency arises when we least expect it, and, as events too often prove, when we are little prepared for it, not a small service will be rendered to the readers of WORK and to the public at large by bringing the subject to the front in WORK. Thousands of people must have ideas of their own, already developed, or to be carried into effect *some day*, which will be none the worse for being made known to the world at once. It is the purpose of the present competition to elicit some of these ideas, and to gain an insight into the utility or dependableness of the plans at hand, in the event of anyone being called upon to make an escape from fire under circumstances which are never very favourable, and which sometimes are hopelessly the reverse. For the three best suggestions for an appliance, plan, or practical idea for Escape from Fire the following prizes will be awarded—

First Prize, £3;
Second Prize, £2;
Third Prize, £1.

CONDITIONS AND RULES OF THE "ESCAPE FROM FIRE DEVICE" COMPETITION.

ALL Descriptions to bear the WORK Prize Coupon cut from one of the numbers of WORK in which the Prize Scheme is announced.

Each Description to be signed with an original *nom de plume*, and to have the writer's real name and address securely attached to the manuscript in a sealed envelope.

Each Suggestion should be fully described in respect to its construction, conditional surroundings, and working, and, where possible, should be illustrated with a drawing of the device itself and its various parts to elucidate the description.

A Suggestion not illustrated will have an equal claim in the competition provided the description be sufficiently in detail to convey a full idea of the value of the device.

The Prize Devices and Drawings, and any others, to be published, if desired by the Editor, in WORK, but the copyright thereof to remain with the authors.

Copies of MSS. and Drawings to be retained by the competitors, as in no case can the return of MSS. be undertaken.

For further particulars see previous number.

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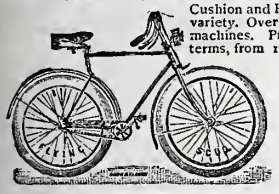

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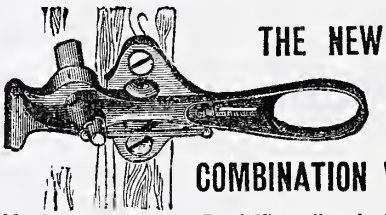

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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VOL. IV.—No. 179.] SATURDAY, AUGUST 20, 1892. [PRICE ONE PENNY.

WORK WORLD.

THE addition of only 0·08 oz. of aluminium to a ton of zinc makes a galvanising metal of permanently brilliant and very adhesive character.

* *

A leather belt, without cross joints, to transmit 500 indicated horse-power, at a Rouen cotton mill, has been manufactured. It is of double thickness, 115 ft. long and 58 in. wide.

* *

The Mannesmaner process rails are tubular. Before the rail is quite finished the interior is filled with sand or any silicious powder. In the final passage through the rolls the heat and pressure applied forms the rail into a solid block of silica.

* *

A new counting machine has been erected at the Mint for "telling" bronze coin. This machine has four distinct sets of counting apparatus, each of which can be worked independently of the others. When all four are in full work upwards of 3,000 pence can be counted per minute.

* *

An automatic regulator for electrical pumps is made by connecting a ball-float in the tank with a switch in the circuit of the motor. As the ball rises it opens the switch and stops the pump, and as the water is drawn off the descending ball closes the switch and starts the pump again.

* *

The Gwynfynydd is a veritable gold mine. The diggers have struck a vein of gold-bearing quartz reported to be 4 ft. thick. Assayed specimens show a yield of 12 oz. per ton. The company started in December last, and in six months distributed £6,000, a return of 1,200 per cent. Who is in this?

* *

"The lightning was incessant," is a very common and inaccurate expression. The greatest frequency of lightning flashes ever observed in England was during the storm of June 6, 1889, when during the two hours ending 11.10 p.m. 1,244 distinct flashes of lightning occurred.

The newest addition to the first-class battle-ship of the British Navy will measure —length, 385 ft.; beam, 75 ft.; with a displacement of 14,180 tons. The estimated speed will be 17·5 knots per hour. She will be the heaviest vessel so far launched—her weight, at present, on the stocks, being not far short of 7,500 tons.

* *

On the Albany U.S.A. Railway forty-two heavy electric cars have been fitted with roller bearings. The rollers are three series of steel tubes side by side. The two outer series overlap: central and steel rods passed through all keep them in position. The central tubes are twice the length of the outside ones. Results with these roller bearings are very satisfactory.

* *

China has been noted for centuries for the purity of its lead, and that used for lining tea-chests is considered the finest of its kind. In making the sheets a large brick is covered with paper, the molten lead poured on it, and another brick laid on the top to flatten it out. The sheets are soldered together to the size of the interior of the tea-chest. This lead is used for the best kinds of solder.

* *

Cut flowers may be artificially coloured by placing them in solutions of aniline and other dyes. Aniline scarlet has a very rapid action in colouring flowers pink and scarlet. Indigo carmine produces beautiful blue tints; the two combined produce different shades of purple, and green is obtained by using blue dye with yellow. Narcissi are changed from white to scarlet in twelve hours; lilies of the valley are beautifully tinted with pink or blue in six hours.

* *

Aluminium plating for six-ton cast-iron columns is an American recourse. The castings are first soaked for a day in caustic soda to remove grease, then for another day in acid pickle to remove scale. They are then cleaned with steel brushes, and a heavy coating of copper applied, upon which the aluminium is deposited. There are about 100,000 square feet of iron to be plated, which will take about forty-two tons of metal. The plating is about $\frac{1}{16}$th of an inch thick.

A new hand camera for the use of amateurs who do not care to purchase a more expensive instrument is made for three sizes of negatives—A, $2\frac{3}{4}$ in. by $3\frac{1}{4}$ in.; B, $3\frac{1}{2}$ in. by 4 in.; C, 4 in. by 5 in. The cheaper forms have a single lens, and the more expensive ones a double lens; the negatives are taken on gelatine, which is fixed on a revolving spool containing material for twenty-four exposures. They can be fitted with a patent automatic locking and registering device, which prevents overwinding the film, and records the number of exposures made; they can also be fitted with revolving stops, adjustable speed to shutter, view finder, and focussing lever and index. The cheaper forms have fixed stop, and require no focussing.

* *

The "Graphonome" is a device consisting of four laths, loosely jointed at the angles so as to resemble a frame which has lost its slate and has worked loose. To the middle of one of the sides is fixed a fifth arm, susceptible of folding flat with the side or of turning up against it at right angles with a stop. A slotted protractor, graduated to 120°, is also fitted to one of the sides near its joint, a threaded pin in an adjacent side moving in the slot, and by means of its milled nut clamping with the sides at any angle (up to 120°) to which they may be set. An inside acute angle is measured by simply applying to it that part of the instrument which is opposite the protractor, when the angle may be read off from the scale by means of an index on the pin, which moves in the slot; and the angle may also be marked off directly on paper by the sides of the instrument. For measuring an inside obtuse angle, one side of the instrument is applied to one side of the angle, and the fifth arm is turned up perpendicularly to the other side of the instrument, the outer end of this fifth arm being formed in such a manner as to make with its side an angle of 45°. This latter angle, added to that read off from the protractor, will give the obtuse angle measured. An outside angle, whether acute or obtuse, is measured and may be marked off directly by folding together the two arms on which the protractor works over the two remaining arms, and applying the instrument to the angle.

HOW TO MAKE A MAHOGANY MAGIC LANTERN.

BY O. BECKERLEGGE.

The Optical Arrangement.—For the construction of this we shall require sheet brass 12 in. or more square and $\frac{1}{8}$ in. thick, also sundry pieces of tubing. We will take for granted, for the present, that our condenser cell is made—and here I might say that for very little more than the price of the lenses they can be purchased ready mounted—and that its diameter outside is $4\frac{1}{8}$ in. Procure a piece of tubing, 1 in. long, and of a size to take the cell spring tight. If a piece cannot be procured the right size, then put a saw-cut in a piece a little too large and resolder it; by this means the proper size may be secured. Put it in a lathe, and cut the ends true. Out of the sheet brass cut a piece 6 in. each way. I have found in practice, without special appliances, that the quickest way to cut sheet brass this thickness is to use a fret-saw, and I have only a hand-saw, not treadle. I use a fairly strong blade, and allow it to cool occasionally, which it does in a few seconds. Choose the fairest side of the brass, and hammer it out as true as possible; remove bruises, and with emery bring up the face fair. On the inside strike a circle a shade larger than the diameter of the ring just made; this is to enable us to adjust the ring to the centre of the plate. They must now be firmly soldered together. A circle may be scribed on the front of the plate $\frac{1}{4}$ in. less than the cell; and if we are wishful to economise our metal, this may be cut out with the fret-saw. Turn down a piece of wood on which to chuck the ring, and finish off the edge of the opening, which must be left a little smaller than the ring, so as to form a flange to stop the condenser cell. At the four corners (see Fig. 4, No. 174, p. 277), holes must be bored about $\frac{3}{16}$ in., with the back countersunk; into these, rods must be riveted and soldered. Before doing so, the other end must have a thread cut on it to take the boss C. Four pieces of tube, of a size to go over the rods, and 1 in. long, must be slipped on them.

A second plate of brass must be prepared in the same way as the other, with a 4 in. opening, and four holes large enough to admit the tubes on the pillars; the sides must be curved forwards as E, Fig. 2. Four spiral springs must now be placed on the pillars, as shown. A third plate must now be prepared as the first, with a central opening 4 in. diameter and four holes at the corner coincident with, and the same size of, those in the first plate; this will rest on the four tubes, and be retained eventually in its place by the bosses. The spiral springs acting against this plate will naturally force the middle plate against the slide carrier, and retain it in its position. We must now either get 8 in. of tubing 4 in. diameter, or else 4 in. of 4 in. diameter and four of a size that will pass over it spring-tight. If the latter plan is not easy to adopt, then we must proceed as follows: Cut the tube into pieces of four inches. Make a saw-cut in one piece, and with a file take off sufficient to allow its diameter to be reduced that it will pass tightly into the other half, and solder the joint. Put it on a mandril, and turn the ends true. Let the circular opening in the plate be sufficiently large to fit the tube tightly.

If the ends of the tube are perpendicular to its axis, and the plate perfectly flat, there will be no difficulty in setting the tube perpendicular to the plate. When this is so, then solder them together.

Procure a piece of brass $\frac{1}{4}$ in. thick and $4\frac{1}{8}$ in. diameter, to make a ring, as K, Fig. 1. If a piece of brass that thickness is not to be had, then two rings of $\frac{1}{8}$ in. sheet can be soldered together. This must be soldered to the second piece of tubing. Put it in the lathe and turn down, milling the outer edge, and chasing the opening to receive the pinion tube, H, one end of which must be chased to screw into K, and the other must have a ring soldered on and milled. A tube, I, to fit without shake, must be procured to slide into H, ; this must be supplied with a rack. The rack and pinion can be purchased; and I should recommend anyone to do so in preference to making. Racks are made in large quantities at a time in a lathe, and can be purchased for a few pence each; but to make one would require some considerable time. When procured, two or three teeth must be filed away at each end, and a hole must ultimately be drilled in the projecting pieces to take a screw.

Draw a line on the tube coincident with its axis, and on each side one, the outer lines being equal to the width of the rack. Measure and mark off the length of the rack. Along the central line drill a series of holes, and cut away by this means as much of the metal as possible; then file away the remainder up to the lines.

Place the rack in position, and see that the top of the teeth are exactly level with the outside of the tube; with a touch of solder tack it in its place, and drill a hole at each end of the opening into the tail-pieces of the rack, and secure with screws. In H a square hole must be cut, to receive the pinion. With a rat-tailed file as much of the tube must be taken away on each side as will allow the pinion to engage firmly in the rack. A cover must be made as Fig. 8, A, B, C, and fixed with four screws. The outer end of I must be finished off with a milled edge, as shown, and the inner end must receive a thread to take the cell with the front lenses. A stop, J, must be placed as shown.

We have gone on the assumption that the condensers have been purchased mounted, but it is possible that some would prefer to mount their own. Each lens must be mounted in a separate cell, and screwed into a tube $\frac{1}{4}$ in. longer than the combined thickness of the two lenses, so that they do not touch each other. When the cell is made either out of a casting or built up, a thread must be chased on it, and the inner edge turned down thin. Fix the cell in a chuck, and place the lens in its place; get someone to press a finger against the lens to retain it in its place, and with a burnisher turn down the thin edge of the brass over the lens. Care must be taken that it has a slight shake, else, if perfectly rigid, the expansion of the glass may result in a fracture.

One or two holes should be made in the tube for ventilation. Fig. 5, A, gives a section of the cell. In Fig. 5, B, I have shown a cell more simple in its construction. A cell is made in two pieces, to be screwed together as shown. The outer ends are turned out so as to form a bed to receive the lens; the edge is then burnished over, as in the other case.

Front Lens.—These may be purchased mounted. If it is intended to mount the lens, then proceed as follows: Procure a piece of tube 1 in. long: on one end cut a thread to screw into I (Fig. 1). On the inside turn down a bed to receive the lens, and chase an inside thread to receive a screwed ring to keep it in its place. A general working idea may be gathered from the condenser cell.

Two or three front lenses may be provided for exhibiting at various distances—say, for 20 ft. away a 6 in. front lens may be used; for 40 ft. an 8 in. In this case the tube G (Fig. 1) must be drawn out. If a greater distance is required, then a front lens of longer focus must be used, and the length of G must be increased by an additional tube; but in this case the limelight must be used. These separate fronts are made with male and female screws, so that two can be used at a time. This will lessen the distance needed from the screen. Fig. 7, A and B, give an idea of the top. The chimney is placed on the collar at the top, and should be, say, 14 in. high. The top must be arched over, to prevent the escape of light.

Illumination.—I have been writing on the assumption that a lamp is to be used. About the construction of this I have nothing to say; I freely admit it is beyond my ability. The construction of a safe lamp, to give a good light, is not work for an inexperienced worker. I should, therefore, advise one to be purchased—a four-wick—which may be done for about 16s.

I trust that these hints will enable many to construct a handsome and efficient lantern, which certainly could not be purchased for two or three times the sum it will cost in its construction. If the plate, D (Fig. 1), instead of being let into the body, is joined by two hinges at the top, it would admit of its being drawn forward at the bottom so as to raise the disc higher on the screen, if needed. This would render it unnecessary to pack up the lantern, as is often the case, to bring the disc in the middle of the screen.

The lantern is now finished, and must, with all tubing, be blackened inside, whilst the body should be polished and the brass-work lacquered.

BENT IRON WORK, AND HOW TO DO IT.

BY J. H.

Letter Rack and Brackets.

Rack for Newspapers or Letters — Wall Bracket—Back—Supporting Scroll Work—Brackets for Suspension—Suspension Bracket—Another Form of Ditto.

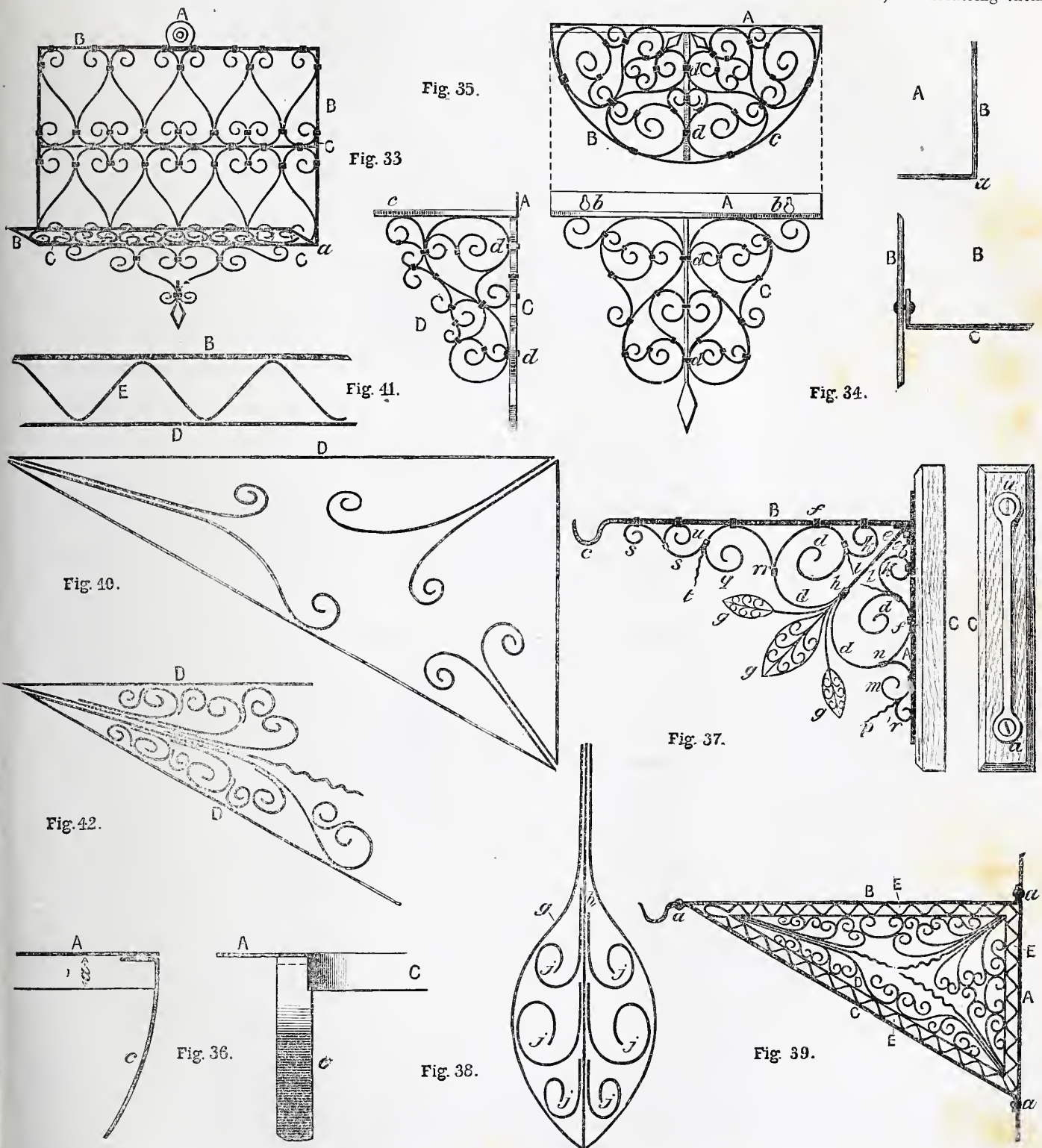
Rack.—Fig. 33 illustrates a rack suitable for holding newspapers or letters. For the first, it may be made from 12 in. to 14 in. long; for the second, from 6 in. to 8 in. long. It is suspended from the wall by the eye, A. If the rack is of small size for letters, the framing, B, may be made of the thin strips, of $\frac{1}{4}$ in. or $\frac{5}{16}$ in. in width. If it is of the large size, the framing should be of stout iron, $\frac{1}{16}$ in. thick by $\frac{3}{8}$ in. wide. The framing, B, consists of a small rectangle, turned round at a right angle at A, shown also in the side view, Fig. 34, A. The rectangle is to be formed in one of the ways mentioned in connection with the screen (see No. 166, p. 153). The neater way in this instance, the frame being so small, is to make a scarfed and brazed joint. If the amateur cannot manage that, then make a plain lapped and riveted joint. Be careful to have the iron straightened and the frame free from winding. The cross-bars, C, C, had better be inserted by bending their ends round (Fig. 34, B), and riveting or clamping them to B.

The scroll work is very simple. The

S curves form a panelling. They are secured with clips at each point of contact, both with each other and with the frames. The clips are shown in the figure. The width of the iron in the scrolls should be the same

cards, etc. Excepting the back, A, it is made entirely of thin bent iron. It comprises essentially the top, B, the back, C, and the central supporting bracket, D. Taking the parts in detail, the top is formed of a back

A strip, *c*, of thin or of stout iron—preferably of the latter—is bent into a semicircle, and attached to the back strip, A, in the manner shown at Fig. 36, by turning the ends of *c* inwards, and soldering them



Bent Iron Work: Fig. 33.—Newspaper or Letter Rack. Fig. 34.—Details. Fig. 35.—Wall Bracket: A B, Plan; C, Front Elevation, with Bracket D removed; D, Side View. Fig. 36.—Detail of Fastening. Fig. 37.—Wall Bracket. Fig. 38.—Detail of Leaf. Fig. 39.—Wall Bracket. Fig. 40.—Detail of Inner Frame. Fig. 41.—Detail of Border: Parts separated. Fig. 42.—Detail of Scrolls: Parts separated.

is that in the framing. The eye, A, at the top is formed of thin iron, bent underneath, and soldered to the top bar of the frame, B.

Wall Bracket.—Fig. 35 shows a handy wall bracket, useful for any casual purpose, as to put by the bedside or writing-table, or in a passage for a candlestick, books, letters,

strip, A, of thin iron, hammered round, as shown in detail at Fig. 36, to form a narrow bottom flange, A. The width, A, of the flange is equal to the width of the strips which are intended to be used on the bracket—say $\frac{3}{8}$ in. Two slot holes, *b*, *b*, are made by drilling, to hang the bracket up by.

to A. The space included between A and *c* is filled-in with scroll work of thin iron, $\frac{3}{8}$ in. or $\frac{5}{16}$ in. wide. There are four similar sets of scrolls, and at all points of contact, both of the scrolls with each other and with the outer curve, *c*, clips should be made use of. They are shown in the figure.

Back.—The back, C, of the bracket consists of duplicated scroll work, with a central arrow point or finial. The curves are united for the most part with clips, but at the top, where they come in contact with the narrow flange of the back, A, clips cannot be used, because the back is of solid sheet. Solder will be the most suitable means of union here.

Supporting Scroll Work.—The supporting bracket, D, is bound with clips to the back and to the top curves at the points *d*, *d*. These clips are all shown in the figure, but necessarily exaggerated in the proportion of thickness. In the actual work, if done neatly, the clips add very little to the thickness of the parts in contact.

Brackets for Suspension.—I want now to say a little about brackets of a different type—those, namely, which are used for the support of lamps and lanterns, of bowls and vases, and other articles of use and ornament. These afford a wide scope for artistic design of a more or less ornate character. I shall give examples of brackets of various types in future articles, in connection with the work suspended from them. In the present article I will describe two examples which will not occur in future designs.

Suspension Bracket.—Fig. 37 shows one of the simplest that can possibly be made. It is also a form that is only suitable for sustaining very light objects. The back, A, and top bar, B, are made of stout iron rod, of from $\frac{1}{4}$ in. to $\frac{3}{8}$ in. square section, according to the size of the bracket. The back bar is upset and flattened at the ends, as shown at *a*, *a*, and holes are drilled and countersunk to screw the bracket to the wall by. The iron bar may go directly against the wall, or a wood backing, C, may be interposed as shown.

The top bar, B, is fastened to A by riveting. The end is turned down at *b* for the purpose. The opposite end, *c*, is formed into a hook, from which the bowl, lamp, or lantern, as the case may be, is suspended.

The scroll work in the example shown is simple. It is of thin iron, $\frac{3}{8}$ in. or $\frac{1}{4}$ in. wide, to correspond with the width of the bars A and B. The main scrolls, *d*, *d*, are exact duplicates of each other, their stalks coming out at an angle of 45° with A and B. The stalks are turned sharp round at *e*, *e*, and are attached to B and its turned-down end *b* with clips or with solder. Clips secure the scrolls to the main bars at *f*, *f*.

Between the bifurcation of *d*, *d*, the three conventional leaves, *g*, *g*, *g*, branch out. Their stalks are embraced between *d*, *d*, and the whole secured with a stout clip, or a couple of stout clips, at *h*. The leaves are made as shown in the enlarged view (Fig. 38). The margin is formed of a strip of bent iron, *g*, bent round to an ovate form, and upon itself, to pass between *d*, *d*. A central strip of thin iron, *h*, forms a midrib, and passes down between the parallel portion of *g*, where it is held with the clip *h*, in Fig. 37. Six or more small scrolls, *j*, are bent to occupy the space enclosed by *g*, and are secured with solder or with clips to *h*. If the leaf is large, they should also be clipped or soldered at their points of contact with *g*.

The smaller curves are: *k*, *k*, fastened with clips to *d*, *d*, the tendrils, *l*, *l*, being pinched between them. Clips also secure them to A and B; the curve *m* is fastened at *n* to *d*, and also to A; the curve *r* is fastened to A, and also to *m*, embracing also the tendril *p*; *q* is clipped at *r r*, and to the bar B; *s* is clipped to *q*, with the tendril *t* between, and also to B; *u* is fastened to *s*, and also to B. This is an easily-made bracket, but only moderately strong.

Suspension Bracket.—Fig. 39 is a much stronger bracket, and also rather elaborate in design. The main framing consists of the back bar, A, the top, B, and diagonal, C. The three are united with rivets at *a*, *a*, *a*, through the ends set off at those positions. This, therefore, makes a strong frame, the diagonal, C, preventing the top bar, B, from becoming bent downwards.

There is also an inner frame, D, carried equi-distantly from the outer one all round. The frame is made in three parts (see Fig. 40), corresponding with the three sides, and one piece of the scroll work. The advantage of making it in this way is that there is no trouble in inserting the scrolls in the corners, as there would be if the frame were made in one, and the scrolls inserted independently of the frames.

The inner and outer frames are united with the waved border, E, a portion of which is shown enlarged in Fig. 41. It consists simply of thin iron strip, of from $\frac{3}{8}$ in to $\frac{1}{4}$ in. wide—that is, of the same width as the frames, bent backwards and forwards with the pliers, and fitted between, and clipped to both frames.

The filling-in of the smaller scroll work is a matter of detail, which can be traced out from the drawing. In Fig. 42 I have shown the series of scroll work nearest the end of suspension, with the parts separated in readiness for clamping together. All the separate portions, therefore, are clamped to the scrolls, which form the continuation of the framing, D, shown in Fig. 40. Also, wherever these come in contact with the straight portions of D, clips will be employed.

WATCH AND CLOCK CLEANING AND REPAIRING.

BY A PRACTICAL WATCHMAKER.

It is intended that this paper shall be the first of a series dealing with the cleaning and repairing of watches and clocks, and the aim throughout will be to make them as plain as possible.

This paper will be devoted to generalities, so to speak, and will not treat upon any special part of either a watch or a clock, but in it a few of the necessary tools and appliances will be brought before readers, and their uses explained. Following the order set forth in the title, those relating to *watch-work* will be first considered.

The first requisite is a bench. For the amateur who only occasionally goes in for horological work, almost any existing bench (except, perhaps, a carpenter's bench) will answer the purpose. The one thing requisite is that it must be quite clean, and the surface smooth. To obtain this, any existing cracks or knot-holes must be carefully filled up with sealing-wax. It is, of course, taken for granted that any respectable work-bench is surrounded by a ledge of some sort, and also stands in a good position as regards *light*.

Those who desire to make a bench especially for watch-work are strongly advised to make it of 1 in. mahogany board. For a plain bench, or *board*, as watchmakers generally call it, upon which no mandrel or lathe is to be mounted, a good size is about 3 ft. long by 18 in. wide, with a 3 in. ledge round ends and back, and a $\frac{1}{2}$ in. ledge along the front. It should be arranged at such a height that the workman can either sit or stand to it comfortably. In such small and tiring work, a change of position is sometimes very welcome. If the reader is in possession of a small lathe or watchmaker's mandrel, by all means mount one or both upon the board, which in that case must be made longer in proportion. Boxes similar to those used to cover treadle sewing-machines should cover these when not in use.

Next to the bench, the vice is the most essential tool in this, as in almost all other work. The vice should shut close, have hard steel jaws, and be provided with centre holes for drilling, etc. (dots on the ends of the jaws, for a right-handed workman, on the left of the vice). I hope I shall not be giving an undue advertisement when I say that undoubtedly the best vice made for watchwork is Boley's parallel vice, shown in Fig. 1. The jaws always close flat, however wide they are opened, and are of hardened steel and interchangeable; new ones can be fitted in case of damage. These vices can be obtained at any watchmakers' tool-shop in Clerkenwell, such as Hunt & Son, Grimshaw & Baxter, and others. This applies to any tools and materials mentioned in the course of these papers.

It will be unnecessary to figure the several pairs of pliers and cutting nippers used, as their form is well-known to anyone. It will suffice to say that a couple of pairs of each, the smallest made, and a size larger, are necessary.

A useful tool is a pair of "sliding tongs" (Fig. 2). These are used to hold any small article whilst being filed or otherwise operated upon, and are, in fact, a kind of hand vice. The slide instantly grips, and as easily releases. The "pin vice" (Fig. 3), as its name implies, is for holding pins whilst they are being filed down, and also for a variety of other purposes. The manner of using this tool and others will be explained farther on. I may mention that that form of pin vice which has a through hole right down the centre is the handiest. Sundry small screw-drivers, the blades of which vary from $\frac{1}{32}$ in. in width to $\frac{1}{16}$ in., are necessary. These are readily made from pinion wire, filed to shape, and the blade hardened. On the tops (they should be about 3 in. to 4 in. long) there should be a flat button riveted, to rest on the finger or in the palm of the hand. Fig. 4 shows a screw-driver made as described. A pair of fine light hollow tweezers, and a somewhat heavier pair, should also be upon the board.

Very good watchmaker's drills can be bought in boxes of 126, assorted, with stocks to hold them, for about 4s. 6d.; but later on, when we come to practical work, the way to make them will be explained, and it may here be said that home-made drills are far and away superior to these shop drills.

Next to drilling holes, tools to enlarge them to any required size must be considered. For this purpose "broaches" are used, small five-sided rimers—or reamers, as some call them—from the thickness of a hair up to about $\frac{1}{8}$ in. in diameter. These are slightly tapered, and follow each other in running sizes. Fig. 5 shows one.

For "tapping" holes—*i.e.*, cutting screw-threads in them—minute taps, similar to those used by engineers, are used. These are made by the workman from a purchased screw-plate, the method to be explained later.

We now come to files. Of these, there should be always upon the board a "pottanee" file, a size and quality known in the trade, and a "pillar" file. These two files will do most of the plain pin filing, etc.,

etc., required in ordinary jobbing. For special purposes, however, such as fitting hands, filing out holes, and a multitude of small operations, a set of smaller files is necessary. These should be square, triangular, round, flat, oval, knife edge, etc., etc. Some are known as "side files," "crossing files," "slitting files," etc. etc. Fig. 6 shows sections of some of these, those known by special names being so denoted. The *dark* lines represent the cutting sides.

Amongst odd tools which will be found very useful may be mentioned a pair of *brass-nosed pliers*. These are usually made from an old pair of ordinary pliers by filing away the faces and soldering flat pieces of brass in their place, and are used for handling articles of polished steel, which would be damaged by hard steel pliers. An ordinary oval tapered *burnisher*, about 4 in. long, set in a handle, is very useful. *Chamfering* tools, both round-faced and pointed, are required for dotting centres of holes to be drilled, taking burrs off edges of holes, countersinking holes, and other purposes. They are easily made from pinion wire, the same as the screw-drivers before mentioned. The pointed ones are sharpened down to a triangular point, having three cutting edges, and must be carefully hardened and sharpened upon the oil-stone. Fig. 7 shows one. The round ones must have semicircular cutting edges of various sizes.

An *oiler* is a very important tool, though very small and insignificant - looking. Fig. 8 shows one. It consists of a piece of, say, No. 60 steel, hammered flat at one end and filed up as shown. The other end is dipped warm into sealing-wax to distinguish it from an odd piece of steel. Its use is to apply oil to watch parts, drills, etc. etc.

A set of punches made of round steel, about $\frac{1}{8}$ in. in thickness, must be provided. They are flat-faced, round, pointed, and various other shapes.

Speaking of punches naturally suggests the *hammer*. The watchmaker's hammer is not a very formidable affair. It weighs $\frac{1}{2}$ oz., and the most gentle taps are sufficient for most purposes of watchmaking.

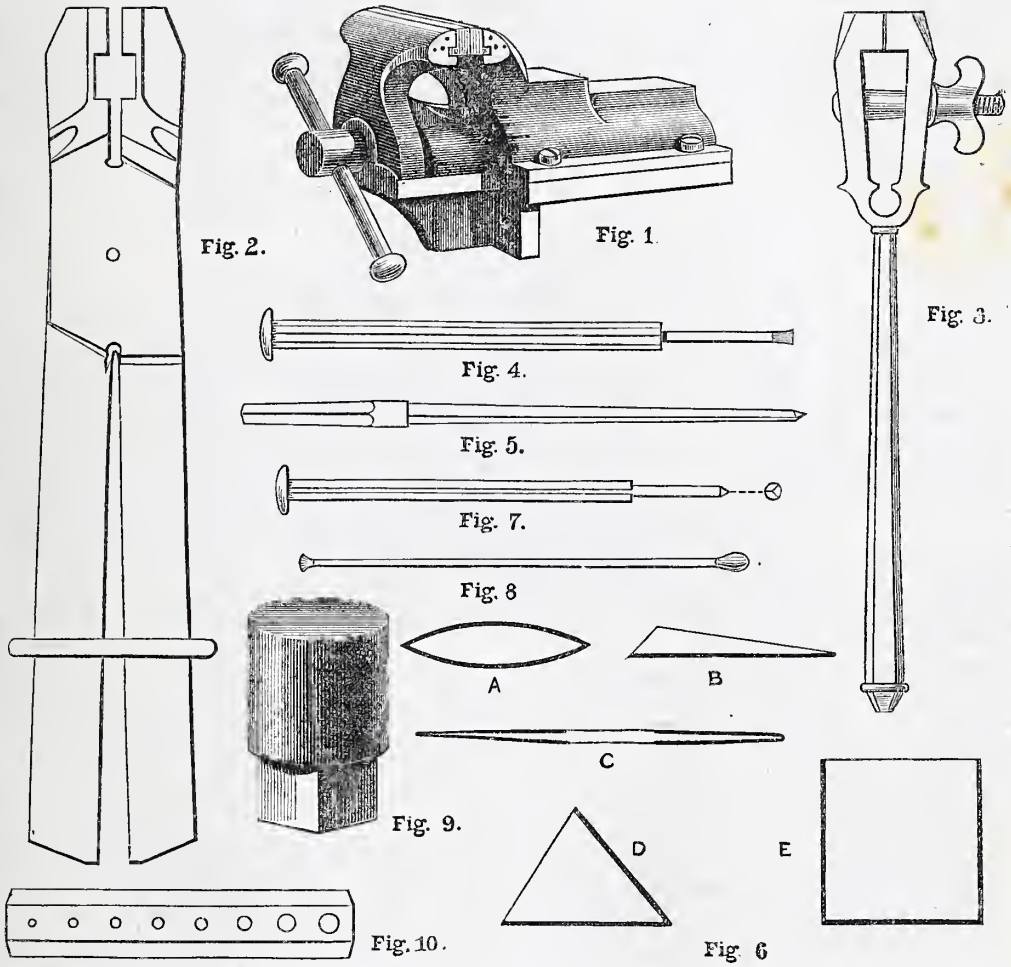
A *stake* to screw into the vice to hammer upon is merely a piece of hardened steel with a circular, flat, polished top. The bottom is squared to grip in vice (Fig. 9). Another kind of stake is also useful. This is provided with a row of graduated holes for punching and other purposes (Fig. 10).

One or two pieces of boxwood for filing upon, and a piece of cork, should be upon the board or within reach.

A bundle of the smallest sized "pegwood" for cleaning out pivot holes, and some "pith" for cleaning pivots are necessary. A benzine pot in which to dissolve off all grease and old oil from the parts should be provided. At material shops proper glass pots are sold having ground-in covers, which effectually prevent the benzine from evaporating; but the amateur may use a glass or china pot with an ordinary cover—say, a tooth-paste pot.

Last, but by no means least, we come to the "eye-glass." It is a great mistake to have a very powerful one in constant wear. A glass of $3\frac{1}{2}$ in. or 4 in. focus is much to be preferred to one of 2 in. or $2\frac{1}{2}$ in., such as are used by many workmen. The glass should have a "stop," which may be cut out of brown paper and fixed upon its surface, allowing only the central $\frac{1}{2}$ in. or so to be used. The rays of light transmitted by the margin of the glass add nothing to the distinctness of vision, but, on the contrary, only confuse the eye by giving a glare of light in the wrong place. There is one other thing in connection with the eye-glass, and that is the method of holding it. The usual practice of holding it by means of the muscles of the eye is not calculated to improve the vision. Objects can be seen much more clearly and with greater comfort if the glass is held by a coil of wire thrown around the head. When held thus, it is pushed up upon the forehead when not in use, and is out of the way; at the same time, it is always ready to hand when required.

If, for the time, we leave turning altogether out of the question, these are the tools, etc., required for ordinary cleaning and putting in order of watches—that is to say, the above are absolutely necessary; and it may be added that the more tools a workman possesses the easier will be his work.



Watch and Clock Cleaning and Repairing. Fig. 1.—Boley's Parallel Vice. Fig. 2.—Sliding Tongs. Fig. 3.—Pin Vice. Fig. 4.—Screw-driver. Fig. 5.—"Broach." Fig. 6.—Files Sections—A, Crossing; B, Side; C, Slitting; D, Triangular; E, Square. Fig. 7.—Chamfering Tool. Fig. 8.—Oiler. Fig. 9.—Stake. Fig. 10.—Graduated Stake.

TIPS.

To convert common ink into copying ink, put in a spoonful of good sugar, stir it till dissolved, so as not to be thick, but sticky.

Another substitute for india-rubber is on the market. It consists of Manilla gum, tempered with benzine, containing two per cent. of Auvergne bitumen also mixed with benzine. These are thoroughly mixed, and five per cent. of resin oil added. The product is stated to be equal in elasticity, solidity, and durability to the best samples of rubber.

For elastic moulds the principal material used is glue or gelatine. Fish glue will answer as well as gelatine and it is much cheaper. To each pound of gelatine three-quarters of a pint of water and half an ounce of beeswax are added. The whole is dissolved by heat. The model must be carefully covered with sweet oil, and the composition poured upon it while warm, but not boiling.

To join marble or alabaster, mix half a pint of best vinegar with half a pint of skimmed milk. Draw the liquor from the curd which settles, mix the curd with five eggs, thoroughly sift fine powdered quicklime to form a paste: used in joints, it will resist water but not much heat. Many household articles might be repaired with it.

A red cement for iron or stone is made of red lead and litharge in equal parts mixed with concentrated glycerine to the consistence of soft putty. When dry it is water- and fire-proof. There are many trades in which this cement would be found extremely useful.

A RUSTIC GARDEN SEAT, WITH CANOPY.

BY ARTHUR YORKE.

REMARKS ON THE DESIGN — MATERIALS — CONSTRUCTION.

Remarks on the Design. — This design, sketched in perspective in Fig. 1, is for a fixed garden seat for two persons. There are certain situations in which such a seat —a something more important than the ordinary garden chair—would have an excellent effect: as, for instance, at the end of a long straight walk. Where shade is required, the back and canopy offer facilities for securing it, as they can be covered with climbers. Fig. 1 is not drawn to scale; the other diagrams are ¾ in. to the foot.

Materials.—The upright posts and all the more important pieces will best be formed of somewhat small larch stuff; the smaller straight sticks may be hazel, birch, or withy. The last named, stripped of its bark, and used in some parts only, will form a pretty contrast with the darker rods. In filling spaces in back and canopy, a few pieces of crooked stuff are used; these will probably be of apple-tree.

Construction.—The two posts, on which almost the entire weight is sustained (marked A in the several diagrams), should be let into the ground not less than 2 ft. They rise 5 ft. above the ground-line. They are set at a distance, measuring from centre to centre, of 4 ft. apart. The smaller posts (marked B), which support the seat, stand 17 in. in advance of those last named, and should be let into the earth 1 ft. The broad seat thus given is essential to comfort when the back of the chair is upright, as it must be in this instance.

It will be seen that two principal cross-pieces are nailed against the main posts. Of these, the lower one, which is of halved stuff, is 15 in. from the ground, and carries the back of the seat. The other is close to the top of the posts, and carries the back of the canopy. The canopy is chiefly supported on the three wall-plates (if I may so call them), C, C, C, in the Figs., which rest at one end on the heads of the posts, and towards the other on the struts, D, D, D (Fig. 3). Fig. 4 shows in plan the arrangement of the principal pieces forming the canopy: E E are the rafters of the gables, the lower ends of which rest on the wall-plates, and the upper against the pinnacle, F. The back rafters are marked G G, and these rest their lower ends on the cross-piece and their upper against the pinnacle. Fig 5 shows the filling-in of the two back panels of canopy; Fig. 6 that of the four side panels.

The filling-in of the back of the seat is so clearly shown in Fig. 2 that no explanation of it can be necessary.

In Fig. 7 the seat proper appears in plan. Its front and ends are of halved stuff, nailed to the posts. The spars forming the seat are placed with spaces between them, that they may not hold moisture; for the same reason, it is advised that they should be of peeled withy.

HOW TO IMPROVE THE KEYS OF MUSICAL INSTRUMENTS.

BY LIFEBOAT.

MATERIALS USED AS COVERINGS — CHANGING COLOUR—HOW TO DISTINGUISH—BLEACHING IVORY — REPAIRS — TO REMOVE THE KEYS FROM PIANOS, ORGANS, HARMONIUMS.

Materials used as Coverings.—Piano, organ, and harmonium keys, the part touched by the fingers when playing, are now covered with ivory, celluloid, artificial ivory, and bone. Time was when a few of the cheaper class of instrument keys were faced with sycamore and French-polished; but the better class were always covered with ivory. But now, owing to the scarcity and consequent increasing cost of this beautiful material, with its pearly whiteness, coupled with an increasing demand for these popular instruments, makers have of late years been compelled, in order to enable them to place their goods within reach of all without unduly increasing the cost of the same, to seek for some other covering than ivory that shall fulfil the same purpose—*i.e.*, present a smooth, bright, white surface. The covering now chiefly used for the cheaper and medium-priced instruments is called celluloid, though some—and particularly the German—manufacturers use bone, which, being well bleached and well polished, is hard to detect from real ivory.

Changing Colour.—Unfortunately, ivory

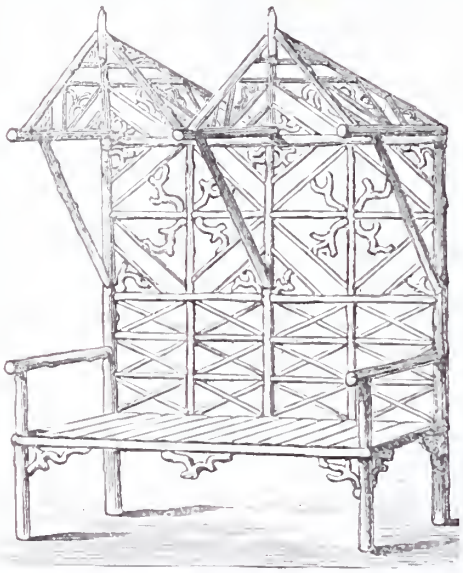


Fig. 1.—Perspective Sketch of Garden Seat.

and its cheaper rivals will not for ever retain their pure white colour.

A correspondent, writing for advice on the subject of pianoforte keys, said "they had turned a beautiful yellow colour: if he could restore them to their natural whiteness, it would make his instrument look twenty years younger." The writer has handled thousands of musical instruments in his day, but has never yet met with one that, by this simple process of whitening the keys, would give this ultimate result; but he can and does say that, in conjunction with French-polishing of the case and well cleaning up the interior, this whitening of keys greatly improves the whole appearance of the instrument.

How to Distinguish.—The distinguishing features of the various coverings used may be briefly said to be as follows:—Real ivory, with age, turns a smoky brown, the colour being pretty evenly distributed; bone may be said to turn a brown, strongly marked in places, also giving a strongly marked veined appearance; celluloid turns a yellow or greenish cast, and is generally most strongly marked in the centre of the key-board, these notes being used more than those at the extreme ends, and appear to be more strongly marked if played upon by persons with perspiring or damp hands. Moreover, they are easily distinguished from bone or ivory by wiping over them a rag fairly wet with methylated spirits, when they will, if made of celluloid, emit a strong smell of camphor.

Bleaching Ivory.—When seeking advice on how to restore the colour of ivory, one is generally told "to wash it, and place under glass in the sun's rays." Now, a little reasoning will show us how this plan—though often adopted, and effective in the case of small ivory figures, brooches, and articles of *vertu*—is impracticable in the case of piano or organ keys, setting aside the fact that in this climate of ours we cannot depend on how long or when we may have sufficient sunshine to answer our purpose. Nor must we overlook the fact that, even if it were possible to wash and place the whole of the ivory under glass, and the sun was powerful enough to bleach them, it would at the same time be powerful enough to—and in all probability *would*—twist the wood-work of the keys into all sorts of fantastical shapes, thus giving us a greater evil for a lesser one—a legacy not at all desirable. Of course, this latter risk might be obviated by removing the ivories from the wood work, when it might be possible to bleach them by the sun's rays, or the peroxide of hydrogen or other bleaching fluids, as used by cutlers for knife-handles, etc. Simply wiping over with spirits of turpentine, and leaving exposed to sunlight, is sometimes found effective.

I point this out as a way in which the ivories might be bleached, or at least improved, though in practice it is never done. If they are so bad as to require such drastic treatment, they are stripped off, to be replaced in most cases by celluloid.

Repairs.—The practical workman—be he dealer, repairer, or tuner—contents himself with replacing by others the most discoloured or worn ones, taking care not to use perfectly white or new ones if the instrument is an old one. Should he not have a sufficient supply of old ivory to select from, the newer ones must be stained to match by wiping over them some strong hot coffee, or other staining medium, previous to polishing. All repairs having been made good, the workman removes from the upper surface of them all a thin shaving, or shavings, till they look of a more uniform colour, and then re-polishing; and in the case of ivory and celluloid it is surprising the improvement this treatment makes to them and the whole instrument, though in the case of bone the improvement is so slight as to make it a doubtful question whether it is worth the trouble to do them or not.

To show to the readers of WORK how the majority of keys can be improved in the most simple and effective manner, with such tools and appliances as can be found or used in the domestic or home work-shop, is the object of this paper, from a careful perusal of which we trust many useful hints may be gleaned, and that none may meet with failure.

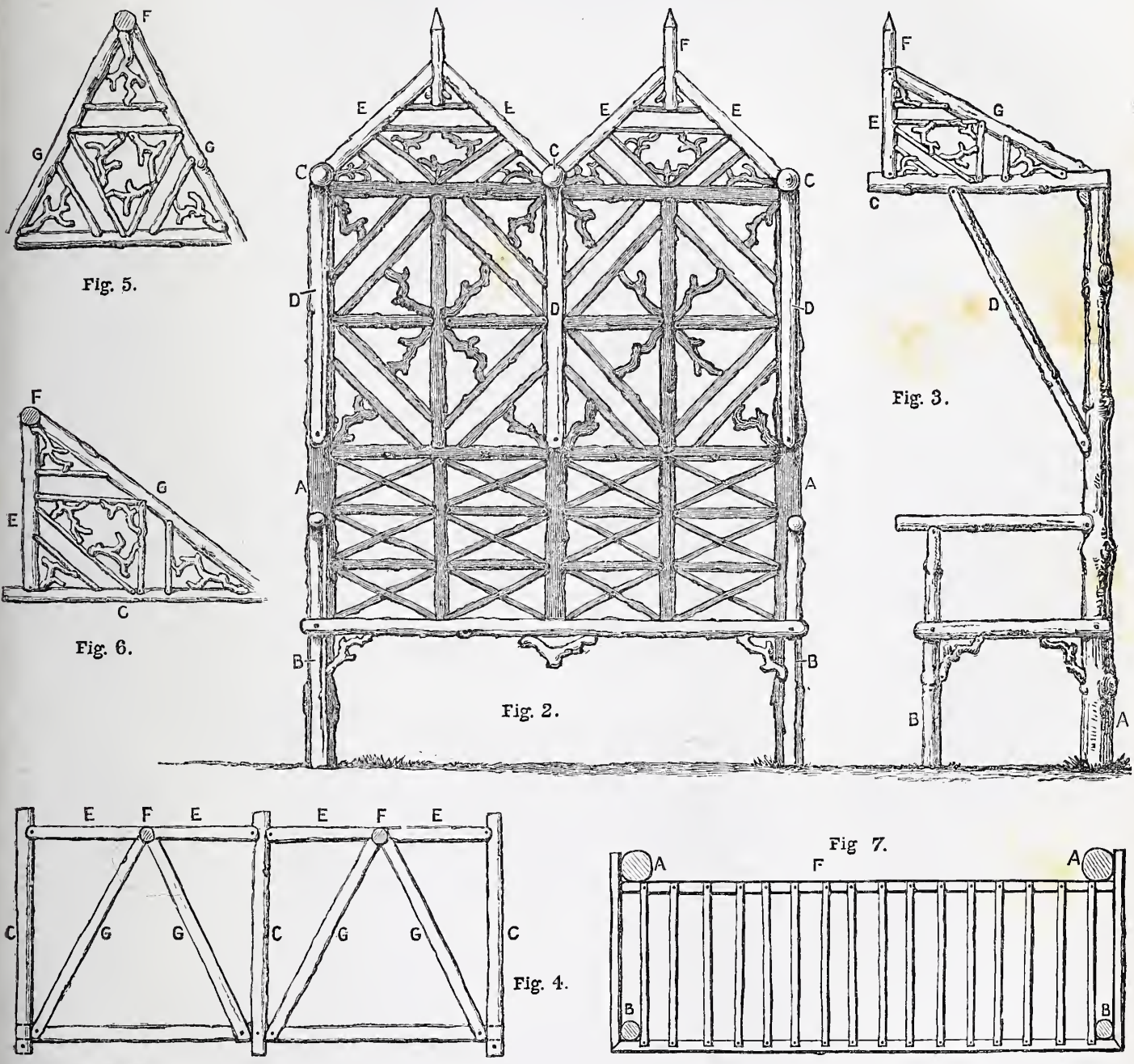
To Remove the Keys from Pianos.—It is a good plan to have at hand for these a board about 5 ft. long, 9 in. or 11 in. wide, and at least ½ in. thick. Set this on the top of the instrument, to be convenient for placing the keys on as they are taken out. If it is a cottage or upright piano it is a comparatively easy matter to do this, by first removing the top door, fall, and name-board; then place the white keys only on the board, starting at the right or treble end, taking care to keep them in proper rotation. If it is a square or grand piano, a little more care and observation may be

required. It may be necessary to remove the key-frame bodily. To do this, the front slip and screws may have to be removed. It is not always necessary to do this. I point it out because instruments vary so in their construction, some being more complicated than others. Should the key-frame have to be removed, take note of the presence of any bits of cardboard that may be placed under for packing purposes: to omit putting them back again might make a difference in the touch, etc. For this reason it is not advisable to remove the frames if it can be otherwise avoided. Should any difficulty arise in removing the piano or organ keys, it would be a wise plan to watch the tuner, and, if needful, ask him how they are removed.

To Remove Organ Keys.—In removing these, it will be found that, instead of a strip of wood being screwed on the top of the keys, as in harmoniums, a strip, 1 in. or so wide, is screwed to the *back* of the keys, they being grooved to receive it. Printed directions for taking apart the mechanism, to enable one to remove the stop-action, keys, etc., is generally posted up inside the better-class organs. If not, it will be noticed that there are at each end of the stop rail on the inner side a number of slips of wood, which will require to be uncoupled from the iron cranks, in addition to removing the screws or unfastening the hooks. In the cheaper class it may be only wire bent round, and secured by buttons; but with care it should not be a difficult task to remove the keys from any musical instrument.

To Remove Harmonium Keys.—First remove the stop-rail and shutter-swells (if any), then the narrow strip of wood that is screwed on the top of the keys at the back, watching closely the position and tightness of the long thin screws, as on the tightness or slackness of these depend to a great extent the evenness and springiness of the keys in front.

The flat board, as used for piano keys, is not suitable for harmonium or organ keys, owing to the presence underneath of regulating-screws or coupler-studs. To make this board useful, it will be necessary to nail or screw on two strips of wood lengthwise, at least 1 in. thick and 6 in. apart, or make a frame as will be shown in Fig. 3, particulars of which, with the necessary tools and how to use them, we must reserve for another paper.



A Rustic Garden Seat. Fig. 2.—Front Elevation. Fig. 3.—End Elevation. Fig. 4.—Plan of Canopy. Fig. 5.—Panel of Canopy: Back. Fig. 6.—Panel of Canopy: Side. Fig. 7.—Plan of Seat.

India-rubber collars should not be used in any place where they will be brought into contact with copper, as this metal acts deleteriously upon the substance. Iron, nickel, and tin have no action at all upon it, and lead very little.

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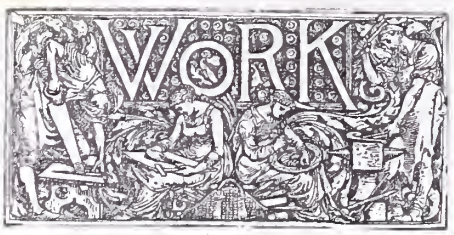

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CHICAGO EXHIBITION.—Although made a free space exhibition to intending English exhibitors at the cost of £60,000 charge on the British tax-payer, it does not stimulate the manufacturers generally to promise to send exhibits. At Leeds, after an effort, it seems to have fallen back to its starting-point of intention to avoid expense of transit, cost of attendance at Chicago, and having to pay heavy Customs charges if the goods shown are sold in the States. The United States Government have displayed an illiberal spirit in this particular; and British tradesmen, who could send some of the finest exhibits in the world, generally refuse to entertain the idea of exhibiting, and decline a lecture on the subject volunteered by the United States Consul's representative. England is paying dear in trying to teach Uncle Sam a lesson in international courtesy and amity, which will long remain a sore point. To have waived the import duty would not have been a loss to the States, as the people would have had the advantage of goods of the highest class to copy or improve upon.

JEWELLERS' EXAMINATIONS.—We have had submitted to us a copy of the examination questions set by the City and Guilds of London Institute in the ordinary—that is, the elementary—grade of goldsmiths' work, etc. The questions, as a whole, certainly convey one impression, and that is, that the subject is not being played with. The questions form but half of the examination, the other half being devoted to the production of a piece of mounted work, or a piece of chased or engraved work. We feel sure that there is a future before the classes held under the supervision of the Institute; and when the results of the examination are published we shall note the relative positions of the four places that held classes during the winter and sent up students for this examination.

BEAN-FEASTS.—Just now a few words about these "outings," of which perhaps the most generally conspicuous feature is that "beans" do not appear on the board, may be seasonable. The name remains from the days when broad-beans and bacon formed the staple dish, and Brockley Jack was dear to the hearts of London operatives. Improved means of locomotion take them further afield now, and in many cases the railway saloon-carriage displaces the "brake" or "waggonette." This annual meeting of employers, managers, and workmen has a greater significance than appears upon the surface: it implies a social *réunion* which rubs off any asperities that may have arisen amongst its members, and reduces the tendency to future friction. Those engaged in the earnest work of this world know that between managers and men there must necessarily arise some strained feeling. The former, in studying their employers' interests, must be strict with the men under their control; and the latter feel it, and sometimes think that they are not sufficiently considered. We are not now dealing with cases where there is obvious tyranny on one side or neglect of work on the other, but only with the ordinary run of business in which fair dealing prevails. When managers and men have met and spent together in common friendship a pleasant holiday they think better of one another. Each man's natural disposition shows itself—the restraint of duty is thrown off, and the workman finds that, after all, his foreman is a very pleasant fellow, and a kind one; and, on the other hand, the managers find their men generous in sentiment, and replete with good feeling one towards another and towards themselves. When the employers themselves join the gathering the men are naturally enough pleased; but, to keep to the particular use of these meetings, we must remember that the unpleasantnesses and jealousies are not, as a rule, between the employers and employés, but between the latter and their managers, with whom, in the ordinary course of affairs, they come in contact daily, and it is towards the removal of lingering discontent that annual holidays of the bean-feast type tend, besides affording healthful holidays and recreation to those who take part in them.

OBJECTS FOR THE MICROSCOPE.—There are many diverse opinions as to the best way of killing insects intended for microscopic mounts. The first object is to avoid giving any unnecessary pain, and also to avoid struggling, which, in the case of moths and butterflies, would lead to disarrangement of the feathery scales on the wings. It has been asserted that piercing an insect through the centre of the thorax with a needle dipped in nitric acid will cause instantaneous death, but there seems a strong likelihood of great pain being temporarily inflicted. The question of causing painless death is one that cannot be settled with absolute certainty, as there are no means of ascertaining the sensations that attend death, but, to all appearance, chloroform gives a satisfactory result. The insect to be killed may be put under a tumbler or bell glass with a piece of blotting-paper previously soaked in chloroform; when this method is adopted there are no disturbing struggles. Possibly among our large number of microscope workers there are some who may care to ventilate this question. Fresh specimens and examples must necessarily be forthcoming. It is desirable, however, where animal life is concerned, to be merciful in the highest degree.

HOW TO MODEL, BUILD, AND FIT A PORTABLE STAGE.

BY W. CORBOULD.

This stage is to fit a small or large room, for comedies, farces, and other amateur performances.

The first part of the work would be to lay the stage. This should be solid and strong. For this purpose the joists and all the supports must not be less than 4 in. by 3 in.

Take the stage at its smallest dimensions —say 12 ft. square. It would be a small room indeed where the stage would want to be less. My intention is to start at this figure, making it to extend to 24 ft. by 20 ft. —as large a size as would be required for any amateur performance.

The front elevation should be 3 ft. 6 in., and must rise ½ in. to the foot towards the back, so every row of supports must be 1½ in. longer than its front one. If the stage were extended to its full depth, it would be 10 in. higher at the back than the front. This gives the necessary slope. I have seen stages much higher, but ½ in. to the foot is quite enough.

Fig. 1 shows the under work, standing, as it would, at 12 ft. square. 1, the front of the stage, showing the first two trestle-like supports. These are 12 ft. long, having four supports, each 3 ft. 2 in. high, one at each end and one 3 ft. from each end. The middle strut is one of the supports of the centre beam, 3. When fixing the stage, this would be the first to put up. 1, 2, 3, 4, and 5 are placed over 3, standing 3 ft. apart, firmly bolted together by clamps and carriage-bolts, "about 4 in." (see A, B, Fig. 1A). All these trestles, it will be seen, are double. If one be drawn 3 ft. one way, and the other the

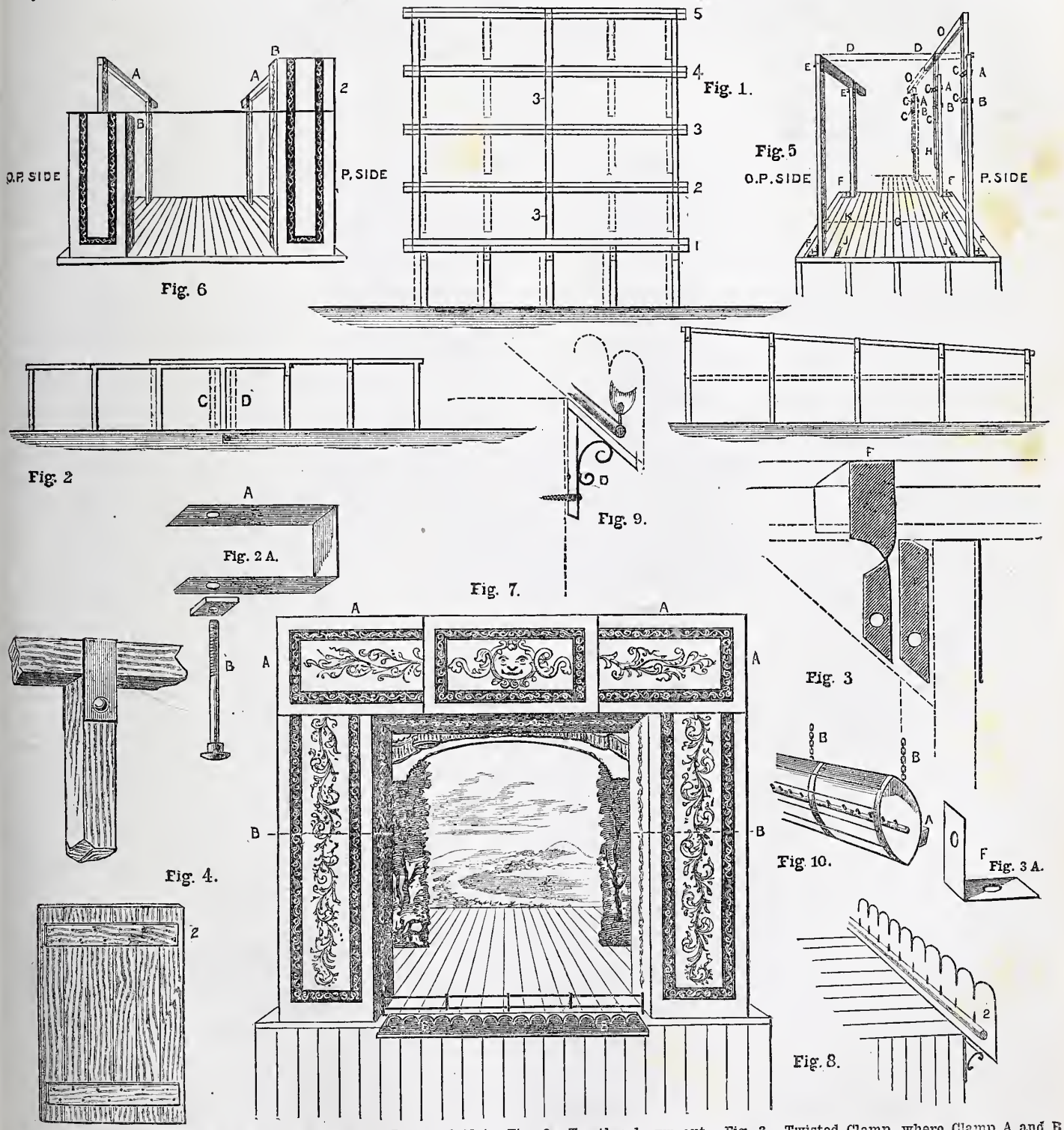


Fig. 1.—Position of Trestles. Fig. 1a.—A. Clamp; B. Bolt and Nut. Fig. 2.—Trestles drawn out. Fig. 3.—Twisted Clamp, where Clamp A and B would be useless. Fig. 3a.—Clamp or Knee Bracket for fixing Upright Timbers to Stage Floor. Fig. 4.—Section of Flooring. Fig. 5.—Method of shifting Framework. Fig. 6.—Proscenium Front attached to Framework. Fig. 7.—Stage Complete. Fig. 8.—Footlights: Side View. Fig. 9. —Footlights, supported by Bracket D. Fig. 10.—Gas Battens. Fig. 11.—Side Elevation of Trestles, showing the Fall from the Back to the Front of the Stage (Dotted Lines, a Piece of Stuff 3 by 1 in. screwed to Supports by small Bolt and Nut, to keep all steady).

same distance the other side, you would get a stage 18 ft. wide (see Fig. 2). This would bring supports C D close to centre. If you wanted to make the stage wider still, it is obvious that C and D supports would not pass the centre one, E; therefore, they would have to be taken off and shifted, and when the trestles were drawn out as far as required, would have to be put back again, dividing the spaces equally (see Fig. 2). The stage would now be 23 ft. wide. This would be ample for anything; but if the room was wider than that, a curtain hung on each side to close in the intervening space would have to be put up. We should want from ten to fourteen of these trestles when the stage was larger than 12 ft. square, but if the stage was only 12 ft. square, five trestles might do. One or two clamps, bolted through as shown at F, Fig. 3A would be needed. These clamps differ from Fig. 1A clamp in being only half the length one side, the other half being twisted, to bolt flat against the centre beam, 3 (see Fig. 1). Dotted lines indicate timbers.

Should the stage be opened to its fullest extent, the two back trestles would be 4 ft. apart, instead of 3 ft., as the others, thus adding 8 ft. on to the 12 ft., making the stage 20 ft. deep. This difference in the width of the trestles would not matter regarding strength, as the back of the stage is not used so much as the front and centre.

We ought now to be ready for the flooring; and this wants special care in the making. Inch floor-boards, which generally run about $\frac{5}{8}$in. or $\frac{7}{8}$in., must be used. Saw them into 6 ft. lengths; take six of them, lay them side by side (Fig. 4); place two cross-pieces (see 1 and 2) $3\frac{1}{2}$ in. from each end; screw this together with $1\frac{1}{2}$ in. screws, two for each board. The piece, when finished, would be 6 ft. by about 3 ft. If you now lay this piece on the trestles, it should fit so that the two cross-pieces, 1 and 2, are inside the trestles—that is, the edges of the boards should rest on the trestles, each piece of flooring butting each other closely. I am particular in explaining this, because on its fitting depends a firm stage to get about on, which is important. For a 12 ft. stage four of these pieces would fill the front half and four the back half—eight altogether. If you make the stage 3 ft. wider, you would require two more, and so on: fourteen such pieces for the full stage of 24 ft. The two back rows would only have to be 4 ft. lengths, made the same way as the others, so that the stage may be made 4 ft. or 8 ft. deeper.

Having our stage fixed, we now come to the fitting of the framework, to carry proscenium, scenery, etc. etc. The four principal uprights should be 3 in. square, and the two top beams 5 in. by 3 in. (see Fig. 5). The two uprights should be divided into two pieces, of about 10 ft. long each. These should work telescope fashion, by having two clamps with a bolt and nut through the both posts, holes being bored through the top piece about every foot or nine inches. This top piece will slide up or down, according to the height you wish to have the proscenium. A and B are the two clamps: C the bolt. The top beam, O O, is worked the same way. These ought to be 12 ft. each in length, to prevent bending or sagging when the weight of scenery, battens, etc., are on them.

This system of telescope working is applicable, and must be adopted in the sides and top of the proscenium in the way I will describe.

In the first place, make four pieces, 8 ft. high and 2 ft. 6 in. wide, made in frame-work (see "Stage Carpentry," WORK, No. 140). One piece will work behind the other, so that it may rise up. Should it be required to make the proscenium higher, you will see the back piece may rise 6 ft. or 7 ft., bringing the top of the proscenium nearly 20 ft. higher (see Fig. 6). A bolt on each side of the frame-work will keep all right.

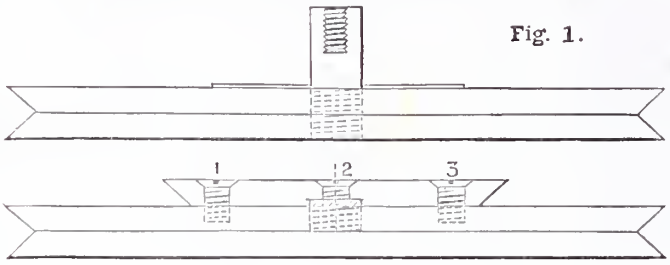


Fig. 1.

Fig. 2.

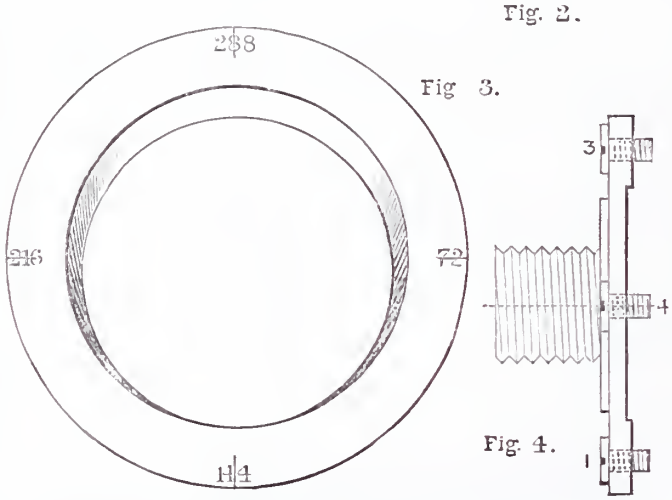


Fig 3.

Fig. 4.

Improved Arbor for Front Dividing Wheel of the Elliptic, Eccentric, Straight-Line, and Dome Chucks. Fig. 1.—Old-fashioned Arbor or Pin on which the Dividing Wheel is rotated. Fig. 2.—Improved Arbor. Fig. 3.—Dividing Wheel. Fig. 4.—Nose of Chuck.

We now make the top, which must be in three pieces—that is, the two end pieces must slide behind the centre piece, to be drawn out as required (see Fig. 7).

This frame-work may be fastened to the upright posts and cross-beam either by tying with cord or bolting.

In the painting of the proscenium the design must be as panels, so that when the back piece is moved up it will merely be making the panel longer (see 2, Fig. 6, A, A). Frame-work is all out of sight when the stage is finished (as Fig. 7).

The top centre-piece must be one panel, the two side pieces drawing out as required, forming two panels (see Fig. 7).

Sometimes return pieces are made to the proscenium, about 12 in. or 14 in. wide. These are made the same as the sides and top. The top pieces of the sides are made sloping downwards (see B, Fig. 6). The top piece thus, when fixed, slopes downward, the two side pieces standing obliquely about 4 in. or 5 in. (see B, Fig. 6). A piece of wood, about 1 ft. long and 2 in. by $1\frac{1}{2}$ in. square, screwed to the stage behind these side pieces as "cleats," the sides can be fastened to them (see J, Fig. 5). These return pieces may be painted as panels or columns.

This diagram (Fig. 5) shows the supporting frame-work of the whole of the scenery, proscenium, etc. You will see it is essential that it should be strong and well put together. The O P side shows only the two uprights and cross-beam, clamped and bolted together at E E, and fastened to the stage by a bracket similar to that shown at F; while on the P side the frame-work is raised up 3 ft., making the proscenium front higher, the clamps, A and B, keeping them as one solid piece, the bolt, C, being shifted according to the height required. The dotted lines show the position of upright H when shifted farther back to make the stage larger. It will now be seen that if the top beam is in two 12 ft. lengths, when fully drawn out to 20 ft. will give 4 ft. of double thickness in the middle. This would prevent them giving with the weight. Dotted line, D D, is a piece of stout quartering fixed across the front, carrying the top of proscenium. Dotted line, K K, shows the 6 ft. lengths of flooring: their division across the stage.

Fig. 7 shows the stage complete, B B dotted line showing the two parts—of course, decorated according to the taste of the artist; only, it will be seen at a glance, the running scroll-work is the best, because in lengthening out the design is not altered. The panels might be a pale blue or green, the styles a warm pink, the scroll-work in old gold. Now as to the manner of fixing the footlights, S, S. A board about 8 in. or 9 in. wide should be hinged on to the front of the stage, sloping downwards (as shown at Fig. 8); the gas-pipe lying in the bottom—bringing the lighted burner very little above the stage floor (see Fig. 9). D is an acute angle bracket, screwed to the front of the stage, as many being required as will carry the footlights—one about every 3 ft. The burners or gas-jets should be about 6 in. apart. The end of the end of the gas-pipe may be connected by indiarubber tubing; so, likewise, the gas battens in the flies. These should be guarded by a shield of sheet-iron over the back and four or five stout wires along the front, for safety (see Fig. 10). A is a stout batten which the whole is fixed to; B B are chains which the battens must always be hung with. The fixing of all the other parts in connection with the scenery, etc., has been explained in "Stage Carpentry," Nos. 140, 144, 149, and 154.

ARBOR FOR THE FRONT DIVIDING WHEEL OF THE ELLIPTIC, ECCENTRIC, STRAIGHT LINE, AND DOME CHUCKS.

BY NORMAN MACLEAN.

INTRODUCTION—OLD STYLE ARBOR—IMPROVED ARBOR—THE NOSE OF CHUCK—CONCLUSION.

Introduction.—It is generally acknowledged that the central pin shown in Fig. 1 is not strong enough for the work done nowadays by professional and amateur turners, and I propose to show, without taking up

too much space, how the improved arbor is in many ways superior to the old-fashioned central pin. It is well known that (for instance) the farther the slides of the eccentric chuck are from the central position, the greater the strain upon the central pin (Fig. 1), and if unfortunately the chuck meets with any obstacle, something has to give way, and this is generally the central pin. There is another device for providing for the proper rotating of the front dividing wheel—viz., the insertion of a tightening screw in the base of the front slide, which, I think most objectionable. Supposing the screw to be too tight, one is unable to turn round the wheel without great difficulty, and in the case of a click wheel, one dodges backwards and forwards in the vain endeavour to drop the click into the right notch; the other unpleasant alternative being that if the binding screw be too loose, the click "chatters" in its notch, and spoils good work, to say nothing of the inconvenience of taking the chuck to pieces to get at the binding screw in the base of the front or transverse slide.

Old Style Arbor.—Fig. 1 shows the old style of central pin, and needs no further description.

Improved Arbor.—This is illustrated by Fig. 2, and consists of a steel disc shaped like the sketch. My readers will note that there are traces of the old central pin, which has been cut off to within ⅛ in. of the surface of the front slide of the eccentric. This fits into a recess turned in the base of the steel disc, which is secured to the slide by three screws, 1, 2, and 3, and which are let in flush with the surface of the disc.

Fig. 3 shows the dividing plate. This is turned out to fit the angle of the cone of the steel disc, and is then placed on the slide of the eccentric chuck, the steel disc dropped into its position and screwed home, when it will be found, if the work is well done, that it can easily be turned in either direction.

The Nose of Chuck.—This, of course, necessitates the nose of the chuck being in a separate piece (Fig. 4), and which is fixed in position by means of four screws, 1, 2, 3, and 4, each screw having a small turned washer between the head of the screw and the plate of the nose. As the making and fitting of the nose dead true is a difficult matter, it would be perhaps better if the four holes in the plate of the nose were slightly slotted to allow for final adjustment before the screws are tightened up.

Conclusion.—I do not claim anything for this improved arbor. I regret being unacquainted with the name of the maker, as the chuck was bought some ten years ago second-hand, but during that time it has stood the test of some of the heaviest work I have ever executed, and whatever weakness it may have exhibited in other parts, it has certainly come out of the trial with credit to itself and with honour to its inventor.

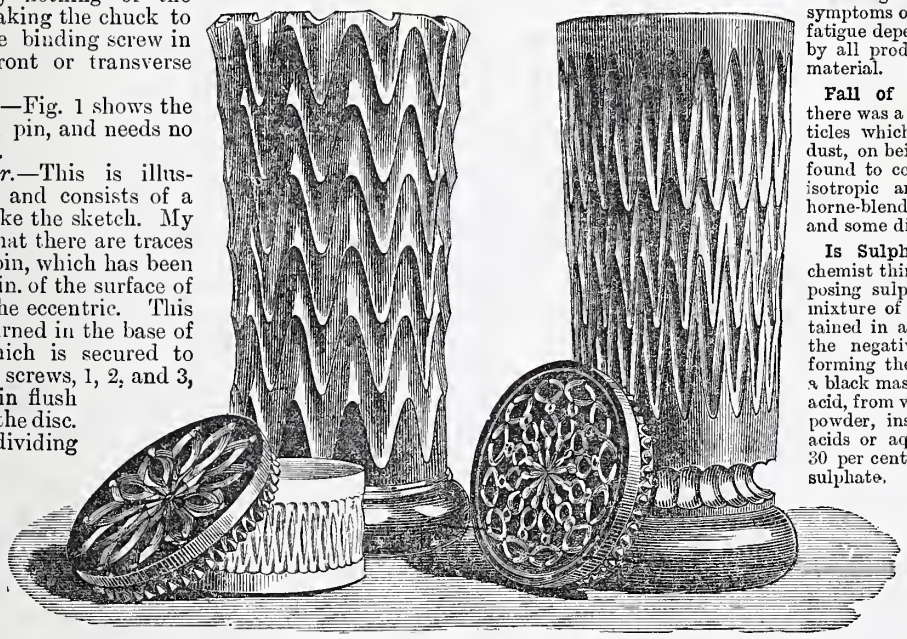
[Possibly, with this description, some among our numerous professional and amateur turners may recognise this arbor, and let us know. On the principle of "To every man his due," the maker's name ought to be made public.—Ed.]

SOME NOVEL TURNING.

BY F. A. M.

The spill-cups, napkin-ring, and box shown in the drawing were produced upon an ordinary 5 in. screw-cutting lathe, by a tolerably simple appliance. My lathe is not intended for ornamental turning, as, when setting up a workshop some years ago I found that lathes for ornamental turning were much more expensive than those made in quantities for the ordinary work of an engineer's shop; also that the ornamental lathe was not suitable for anything but the smallest metal work, whilst the engineer's slide-lathe furnished the means to make any kind of additional apparatus; and in making and contriving such apparatus is to be found far more exercise for ingenuity even than in using it.

Most ornamental turners buy a beautiful and expensive set of apparatus partly for the sake of the pleasure that comes from owning and handling beautifully-made and exquisitely-finished appliances. This may be a very innocent way of obtaining enjoyment and recreation for a rich man; but it does not often make a good workman. A far cheaper, and, as it seems to me, a better plan is to follow the line I have indicated. Begin with an honest slide-lathe at about £30, then buy no more finished apparatus but only the castings, planed; take one thing after another—say, the overhead motion, eccentric cutter, vertical cutter, universal cutter; make these by degrees, and you will not only become possessed of a capital set of apparatus, but will also become a good workman, competent to use them.



Some Novel Turning. Spill Cups, Napkin Ring, and Box.

The examples given above were made on the suggestion of a very clever American amateur, F. N. Massa, Esq., from whom I have obtained many good ideas; it has some advantage over the more ordinary kind of ornamental work in which the constant recurrence of the circle becomes rather wearisome. I hope the curiosity of my readers will be excited when I tell them the first work of this kind was done without any addition to my lathe beyond a piece of wire, some pullies, and a weight (the headstock). I had, however, overhead motion, driller, and a pin fixed as in one of the change wheels. This was, of course, a makeshift, yet it produced a nice-looking pattern, which would be thought to have required the pumping motion of the mandrel of a rose engine. The present examples were done by means of a home-made appliance, which may give as many as 96 waves in going round, and may make them 1½ in. long. The appliance is applicable to almost any slide lathe, and need not cost more than about £6. Instead of taking out a patent for it, I propose to describe it in Work by-and-by.

SCIENCE TO DATE.

Fatigue.—Professor Mosso, of Turin, has discovered that the blood of dogs fatigued by long racing acts as a poison, and when injected into other dogs causes the latter to exhibit all the symptoms of fatigue. Hence it seems that fatigue depends more on a specific poisoning by all products than upon a deficiency of material.

Fall of Dust.—In Stockholm recently there was a fall of hail mixed with dust particles which lasted for several hours. The dust, on being collected and examined, was found to consist of glassy material, both isotropic and anisotropic, together with horne-blende, magnetite, mica, metallic iron, and some diatoms.

Is Sulphur an Element?—A German chemist thinks he has succeeded in decomposing sulphur. By electrolysing a fused mixture of barium sulphate and nitre contained in a silver crucible which served as the negative electrode, a platinum wire forming the positive electrode, he obtained a black mass partly soluble in hydrochloric acid, from which he isolated a greyish-black powder, insoluble in nitric or hydrofluoric acids or aqua regia. It represented about 30 per cent. of the sulphur contained in the sulphate. He thinks that sulphur is, therefore, a hydrogen compound which by electrolysis loses hydrogen.

Curious Limestone.—In the valley of the Hirnant River, which flows into Lake Bala, there is a band of a black oolitic limestone. The blackness is due to a coating of carbon which the oolitic grains possess. Under the microscope they are seen to be made up of four layers: (1) a central nucleus; (2) a layer of carbon; (3) an outer cap of silica; and (4) another thin layer of dusty material. It is possible that the carbon in this rock, which is of Ordovician age, is due to vegetable agency.

NOTES FOR WORKERS.

The late Prince Louis Lucien Napoleon has left to the nation his valuable collection of metals, which have been placed in the Science Museum, South Kensington. The collection is rich in specimens of the rarer metals.

Rubber may be deodorised by dipping it into a solution of salicylic acid in alcohol. The solution is made by dissolving 20 grains of salicylic acid in half a pint of alcohol.

A French chemist has found that aluminium can be used instead of magnesium by photographers for producing an intense light.

The momentum, or amount of motion, of a body is found by multiplying the mass in grammes by the velocity of the mass in centimetres per second. Thus, a mass of 100 grammes, moving with a velocity of 5 centimetres per second, has a momentum of 500.

To preserve pencil drawings, paint them with a thin wash of isinglass, which will prevent the black lead being rubbed off.

Hops were introduced into America about 250 years ago. The greatest producing State is New York, which in 1889 had 36,670 acres devoted to this crop, the production being 20,063,029 lbs.

TRADE: PRESENT AND FUTURE.

**** Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

CUTLERY TRADE.—In the Sheffield cutlery trades there is very little change. The strike at Rodgers' continues.

COTTON TRADE.—The threatened crisis in the cotton-spinning industry is delayed for some days, owing to a want of unanimity on the part of the employers, some of whom favour a 5 per cent. reduction of wages and others 10 per cent.; all are agreed, however, that a reduction must occur before a trade revival can be expected. So far as Oldham is concerned, 85 per cent. of the employers are in favour of a 10 per cent. reduction; while in the Rochdale, Ashton, and Stalybridge district 40 per cent. favour this movement. In the Bolton district a reduction of 5 per cent. is considered sufficient to meet the requirements of the case, and as soon as 80 per cent. of the employers agree to this course being taken, notice of the proposed reduction will be sent to the operatives' associations. In North-east Lancashire the situation is critical, and short time is considered inevitable in this district. Many manufacturers are without orders, and machinery is being gradually stopped.

SILVER AND BRITANNIA METAL TRADES.—While the silver trades are dull, the Britannia metal trade is improving.

FILE TRADE.—The pressure of the Spanish and Portuguese duties has caused a lull. A few weeks ago the Peninsula was flooded with articles, good and bad, and some time must elapse before the altered conditions of trade can be measured with accuracy.

STEEL TRADE.—In the crucible steel trade prices are well maintained, and will probably advance as trade increases. The rolling mills are not so well employed.

BUILDING TRADE.—Our Rochdale correspondent writes:—The harmony in this trade has now been broken by the plasterers coming out on strike for an advance of ½d. per hour in wages, which are at present 8d. per hour. The men also demand walking time in all cases, instead of going for their wages in their own time, as at present. Both sides seem firm, and meanwhile all plastering is at a standstill.

ENGINEERING TRADE.—The improvement still continues, and the outlook is promising. Several orders have been secured by the leading machine tool makers, and stationary engine builders are better employed. In the locomotive building branch the prospects are generally regarded as being very slight. Boiler makers are better off for work than last month. The chief machine makers are fairly well employed. In the shipbuilding industry of the Mersey district no change is reported, while in the Barrow district the activity shows signs of slackening. Engineers in the district are also quieter. In the iron trade business is of the hand-to-mouth character. The belief in an immense reduction of prices, which is generally entertained, has the effect of causing consumers to buy only for immediate requirements.

CYCLE TRADE.—The cycle trade of 1892 is on the wane. The 1893 season may be said to have begun, in so far as booking fresh orders is concerned. Many of the cycle-making firms have already their representatives on the move, and good business in Scotland is reported for 1893. Several makers are preparing to put the new geared ordinary on the market, which machine may be expected to come largely to the front in 1893.

TIMBER TRADE.—There have been large sales, including 932 logs and 1,333 curls of mahogany, 396 logs cedar, 1,925 logs satinwood, 226 logs walnut, 1,889 boards maple, 545 planks teak, 28 tons lignum vitæ, 162 pieces Malabar ebony, 6 logs rosewood, 109 planks Bahia rosewood, and other lots. The imports, with some exceptions, have been fairly moderate; the stocks are increased, and, in some cases, are now excessive. Prices are mostly weaker; the attendance at the mahogany sales has been good, and satisfactory prices were obtained.

CHEMICAL TRADE.—The demand for bleaching powder is very great, and the price is from £7 10s. to £7 12s. 6d. Soda crystals, caustic soda, and sulphur are unaltered. South Durham salt is quiet at about 10s. per ton free on board.

TANNING TRADE.—The hide market is without any change, the business consisting of Santa Maria heavy ox at 5½d.; Gualaguaig, 5d.; and Rosario Matadeiro light, 3d. to 3½d. Tanners are very cautious, and complain of the limited demand.

SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

**** In consequence of the great pressure upon the "Shop" columns of* WORK, *contributors are requested to be brief and concise in all future questions and replies.*

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of WORK *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given.*

I.—LETTERS FROM CORRESPONDENTS.

Arithmetic.—STUDENT writes:—"Let A put down four figures in a line, and allow B, another person, to put a figure as a unit of the amount, as 2. He who adds the 2 may tell at once the exact total of a sum of five rows of figures, of which A puts two more rows and B two more rows, and adds them all together. Thus:—

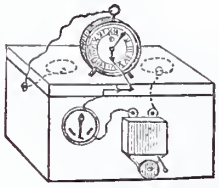
A....	99,992-B
B....	29,999
A....	70,000
B....	00,007
A....	99,992
Total	299,990

or,

A....	3,692-B
B....	1,000
A....	8,999
B....	0,101
A....	9,898
Total	23,690

B says the amount will be 23,690 as soon as he has added the figure 2 to the first line; the sum shows he was right. How is it done?"

Alarm.—H. F. G. (*Hammersmith*) writes:—"I send you the enclosed sketch of a reliable electric alarm, hoping that it will be of service to some of your readers. Since the last sketch on p. 699, No. 95, Vol. II., the alarm has worn, which they all do after some time, so I have abolished it and have taken the front glass out and bent the wire, A, from the switch so as to just clear the minute hand but come in contact with the hour hand. In sketch I have put it in front of the hour six, which is my time of rising. Of course, it can be fixed in front of any hour, and will keep ringing for an hour according to length of wire across the figures. If the battery box is nicely finished, it does not look amiss on a shelf over the bed within arm's reach for shutting off switch."



Electric Alarm.

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Books on Gas Engines.—H. S.—"On Gas Engines," by T. M. Goodeve, 2s. 6d., deals with the Otto engine. "The Gas Engine," by Dugald Clerk, 7s. 6d.: a very good book. "Gas Engines," by Wm. Macgregor, 8s. 6d. "Gas and Petroleum Engines," by Wm. Robinson, 14s.—F. A. M.

Pressure of Water.—J. J. (*Bromley*).—The pressure of a column of water in pounds per square inch at its base is found by multiplying its height in feet by 0·434. To put it as a formula, let H equal height of column of water in feet, and P equal pressure in pounds per square inch at base; then $P = 0{\cdot}434\ H$; and by transposition $H = \frac{P}{0{\cdot}434}$

Applying this to your case, we have:

$$H = \frac{P}{0{\cdot}434} = \frac{80}{0{\cdot}434} = 184{\cdot}33 \text{ ft.} = 184 \text{ ft. } 4 \text{ in.}$$

—F. C.

Pinion Wire.—J. J. (*London, E.C.*).—Messrs. Haswell & Sons, Spencer Street, or Messrs. Grimshaw & Co., Goswell Road, Clerkenwell; either of these will supply your wants in pinion wire, any number of leaves and any size. Prices run about 6d. per length of 12 in. about.—A. B. C.

Safety Bicycle.—H. W. (*No Address*).—I should be glad to make a machine for H. W. same as design given in WORK, but am not now in a position to do so, having entered upon an engagement with the North British Machine Company. If H. W. pleases to give me his address, I will be glad to forward him their catalogue, and can assure him he will be able to choose a machine of as fine design as anyone could wish for, and as good value as can be had anywhere; or, if he much desires it, I can have one made exactly from my own design, as shown in the pages of WORK, and under my own supervision in the works at Croshill.—A. S. P.

Automatic Door Fastener.—NOVICE.—The arrangement looks complicated, and would probably cost so much that it would scarcely compete with rim latches. It looks rather unsightly, and would demand more careful fixing than ordinary people give to such matters. The only way I should use it is in lieu of the private bolt used for bedrooms, which release with a cord led by pulleys to the bedside. As to the sash fastener, there is one almost identical, but superior, in the market, called the "Binder" sash fastener.—B. A. B.

Gold from Gilders' Rags.—A. B. (*Newry*).—First, burn them in a closed vessel—porcelain for choice; but if an iron vessel is used, then it should have a layer of thick paper placed in it for the rags to rest upon. The layer of paper will, even when burnt, help to prevent the metal attaching itself to the iron. If the burning is done carefully there should be no risk of this, for it is quite possible to completely burn the rags to a cinder without making the pan more than red-hot. Secondly, powder the burnt stuff up in a mortar, and mix one quarter of its weight of powdered pearlash with it; put it in a furnace, and run it down. If the flux does not come all of one consistency, a little more pearlash can be added until it does. If it shows signs of boiling over, add a little dry powdered salt. When the boiling mass of flux is regular in its composition (and you can test that by dipping the poker in and removing some on the end), the pot can be taken from the fire, left to cool; and when cool it can be broken, when there will be a button of gold at the bottom. So far I have tried to comply with the inquirer's wishes; but it is for him to consider if it is worth while to carry out this process; otherwise the quantity, if large, might be burnt and powdered, and sent to a refiner for an offer; if small, then they might go with the shop sweep, when that is sent.—H. S. G.

Galvanising Process.—The London Metallurgical Co., Ltd., Turnmill Street, E.C., work the process referred to in WORK, No. 162.—ED.

Regilding Metal Clock.—H. J. G. (*No Address*).—It is not worth considering, this idea of yours, to gild metal-work with gold leaf; it will not look nice, even if you do succeed in sticking the gold-leaf on. If you are in Clerkenwell, or in Soho, you might ask a gilder what his charge would be. Gilding is now done very cheap, and it might cost you but little more than your gold-leaf. If you cannot afford to gild it, why not clean it by well washing in hot soap and water? Soap the brush well that you use, and dust a little carbonate of soda on it; then well rub the article, rinse it well, and dry in warm boxwood sawdust. If the gilding is much tarnished, it can be partly restored by wiping it over quickly with a weak solution of cyanide of potassium, rinsing it quickly and thoroughly, and drying at once in boxwood dust.—H. S. G.

Automatic Expansion Gear.—A. B. (*Sheffield*).—I do not think you will get the information you require unless you apply to the patentee at Leeds. He sends a lithograph of the link gear with every governor supplied, and when desired, marks the cut-off and angular advance upon it. I should think a simple governor of the "Porter" type would be more suitable for your engine.—F. C.

Ship on Musical Box.—FLASHING DYNAMO.—Your sketch shows no means of rocking the ship on the lever H G. This lever should be carried on a short spindle fixed at its bend at the end G; the upper hole, which should be larger than the barrel axle to clear it, should be passed over the latter, and on the inner side of the wheel E a rim of spiral or wedge form should be fixed for the tail end of level, H G, to rest against. As the rising part of the rim passes behind the lever-tail, the rocking motion will be given, and if you desire to have several oscillations of the ship during one revolution of the barrel, you may attain this end by making the rim with a wavy or undulating edge. By carrying the spindle fixed at the bend in rocking bearings and fixing a small eccentric on the barrel shaft, F, to fit the hole in the lever, H G, transversely, you may obtain a rolling motion in addition to the rocking; in this case you must make the hole in the lever long enough vertically for the eccentric to revolve without touching the top or bottom thereof.—F. C.

Dulcimer.—JULES and S. W. (*Glasgow*).—Articles on the construction of a dulcimer appeared in WORK, Nos. 31, 38, and 41.

Canoe Building.—GARBOARD STRAKE.—Articles on "Canoe Building" appeared in WORK, Nos. 53, 58, and 62.

Boiler for ¼ h.-p. Engine.—J. B. (*Essex*).—I could not advise an amateur to attempt to make a boiler unless it were a coil boiler, and not many believe in these or will have anything to do with them; I believe they really answer with those who understand them, and I am promised some information on the coil boilers used on launches in America. Of course, they are very convenient in some ways, such as getting up steam in five or six minutes, and in not being liable to explode. In a list of boilers lying before me, I find the following proportions for ¾ h.-p., which would be amply large enough for the ¼ h.-p. engine: Shell, 3 ft. by 1 ft. 6 in. diameter, ⅛ in. thick; fire-box, 1 ft. 7 in. by 1 ft. 3 in. diameter, ⅛ in. thick; crown-plate, $\frac{1}{16}$ in. thick; approximate weight, 3½ cwt. There may be a cross-tube in the furnace, but it will make enough steam without.—F. A. M.

Electric Light.—S. J. (*Brandon Colliery*).—To light up the room you mention in your letter—viz., 15 ft. by 16 ft. by 9 ft.—you would want at least one 20 c.-p. lamp, two 10 c.-p. lamps, or four 5 c.-p. ones. Let us see what this means. To begin with, you will not get any satisfaction out of the E. C. dry cells, as they are not constructed to give steady

continuous currents. The only ones that would do would be either Bunsen's—which you cannot have in the room—or double carbon, single fluid chromic acid cells. Now, to light up a 20 c.-p. lamp, you will require at least 20 chromic acid cells, and more even if you use Bunsen's, as the least voltage you can light a 20 c.-p. lamp with is 40 volts. Now, if you use large cells and run this battery, say, six hours every evening, the most it would last is three evenings (perhaps not that), and then the whole will want recharging, cleaning, etc. From this you can see that it is impossible to compete even with paraffin lamps when primary batteries are used for small lights. Should you wish simply to rig up a small bracket with the electric light, only to be used on special occasions, this you can do by using 8 volt 5 c.-p. lamps, one of which can be lighted by a battery of four cells of the chromic acid type. Half-pint cells will last you one evening. Let me advise you to get WORK, Vol. II., Nos. 76, 82, and 89. In these numbers you will find more than can be stated in the limited space of "Shop." As to your second question, lamps cost about from 5s. to 6s. 6d. each. It takes just as much trouble to make a 1 c.-p. lamp as a 20 c.-p.—J. B.

Forth Bridge Caisson Work.—P. B. H. (*Southport*).—Your rather curious criticisms upon my article on "Caisson Work" are scarcely worth refuting, but, as you are so obviously wrong, I will mention the facts. The foundations were carried to more than 88 feet. The greatest depth reached, according to Mr. Phillips, C.E., was 90 ft., to which depth the caissons were sunk. Mr. A. Morrison, of Queensferry, says that "the lowest point in the foundations descend to 91 ft. below high water." Mr. Cooper, the engineer of the bridge, said in his paper, read in 1888, on the Forth Bridge: "The extreme depth of the foundations is 91 ft. below the level of high water." I consider that 88 ft. is a good average depth to quote. So much for No. 1. (2) As to Query 2, the height is 209 ft. Mr. Phillips, C.E., says, speaking of the cantilever piers, "The dimensions of the pier are at cutwater about 96 ft. by 45 ft. . . . rising to a total height of 209 ft. above high water." Your "criticism" is not very near this. No. 3 is not worth notice. (4) The caissons were sunk to a depth of from 71 ft. to 89 ft.; the Inchgarvie caissons to 72 ft. (See "Chambers' Cyclopædia," etc.). As regards the term "emitted," I need not dispute: the compressed air was, of course, equalised with the outer air from above. P. B. H. seems to differ from the engineers, and he can consult the authorities named and others.—H. F.

Invalid's Carriage.—NOVICE.—I am afraid there is no way in which you could work an invalid carriage, such as you mention in your letter, for a sick child, by primary batteries. The thing could be done with accumulators, but the cost of charging them, keeping them and the motor in working order, would be more than employing an able-bodied man to wheel the child about every day—to say nothing of the cost in the first instance of a rather complicated machine. If the poor little lad is still pretty lusty in his arms, the best thing you can do is to rig up his little carriage with a crank and lever, giving him all the power you can at the sacrifice of pace. Send a sketch of what you propose, and you shall have all the help that can be given you; but banish from your head all ideas of working such a thing by electricity.—J. B.

Wire-Wove Roofing.—GENEVA CROSS.—The roofing material that you inquire about is made by the New Wire-Wove Roofing Company, 164, Queen Victoria Street, London, E.C. It is a good substitute for glass, being durable, unbreakable, and translucent. The material consists of a fine iron wire netting, woven warp and weft, covered on both sides with a transparent material of the consistency and appearance of the finest glue. Called by the name of "Duroline," this substance is really a permanent varnish, of which linseed oil is the base. The colour is a slight amber or greenish yellow shade that, under exposure to the air, bleaches until it admits a nearly white light. It is soft enough to be cut with a pair of scissors, and yet requires extreme violence to tear it, while it is practically unbreakable. The price runs about 5½d. to 6½d. per square foot, which is slightly in advance of the price of glass, but this is compensated for by its greater durability. It is sold in sheets of various widths, or in cut size to order. As to the wood for the framework of your aviary, pitch-pine or redwood would be very suitable and easily worked, and would stand a long time under fair wear and tear. If you can procure teak easily, it would be better still, but is more expensive and difficult to work, as, being full of sand, it destroys the edges of the tools very rapidly.—G. LE B.

Crystals.—A. R. (*Stourminster Newton*).—Thiosinamine can be obtained from Messrs. Hopkin & Williams, 16, Cross Street, Hatton Garden, E.C.—W.

Overmantel.—J. G. (*Bala*).—I hope the accompanying design is what you require. The cut pieces are of ½ in., and the framing, uprights, and shelves of 1 in. stuff, while the brackets are 1½ in. thick. The bottom shelf can be 7 in. wide, supported on two brackets; with a framed panel between the latter resting on the architrave. The shelf is moulded and rounded at the ends. Above this is a small bevelled mirror resting on a plinth, and on each side a half round shelf, A, supported on wood brackets. You had better cut the hollow on these latter pretty deep, or else they will look heavy. Above this mirror is the pediment

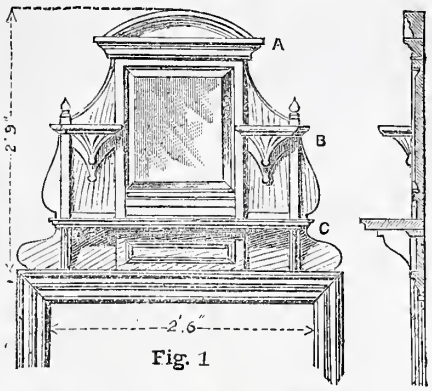


Fig. 1

Fig. 2

Overmantel. Fig. 1.—Elevation of Overmantel. Fig. 2.—Section.

and cornice, which give a good finish to the overmantel. The design would look well if executed in ash, but you will find that wood rather hard to work. The cheaper kinds of overmantels are generally made of deal, and the superior sort of walnut or oak.—F. J.

Window.—SECOND APPLICATION.—I consider that French, or casement windows, are easier for an amateur to make or understand than cased frames with double-hung sashes; so if you have thoroughly digested the articles on "Hung Sashes" that have appeared from time to time, you will have no difficulty in following the description of casements given here. The description must of necessity be very brief, on account of the great pressure on the columns of "Shop." Fig. 1 is an inside elevation of a pair of casements and frame, showing the architrave mouldings round the same. The glazed portion above the transom, A, is a separate sash; this is very often necessary, on account of the height of the room, etc., and is generally fixed, but can readily be hung if wanted. Figs. 2 and 3 are horizontal and vertical sections, showing the solid window frame, etc. You ask for thickness of material; but this is always regulated by the position, thickness of walls, etc. The sizes shown on these sections are:—head and sides of frame 4½ in. by 4½ in.; oak sill, 4½ in. by 3½ in.; transom, 4½ in. by 3 in.; sashes, 2 in. thick. The frames of casements are very often made out of 4½ in. by 3 in., and the stops nailed or planted on to form the rebates, but this is very seldom done in good work. The sashes should never be less than 2 in. thick—that is to say, out of 2 in. stuff—and should always be made to open outwards if possible, especially in exposed places, as then the wind pressing upon them from the outside only makes them close more tightly. They should be hung with either brass or wrought-iron butts, never with cast-iron butts, on account of their exposure to the weather. In making the same, the uprights are tenoned into the head and sill, and a return bead is sometimes stuck on the inside edge of the frame, as shown at B (Fig. 4); but this is not absolutely necessary. Sometimes the architrave is brought up quite close to this edge—in fact, there is no limit to the various methods of finishing the inside of solid frames; but this does not concern us; what I am describing is a *plain* casement frame. The frame is very similar to a solid door frame, with the exception that whereas the side edges of a door (that is very often exposed to quite as much weather as a window) are fitted into a square rebate, the side edges of a casement are generally shaped so as to fit into a circular recess made in the frame, as shown at C (Fig. 4). But this does not present any great difficulties; all that is wanted is a plough rebate plane, and a hollow and round plane to fit the circle required. Very often the plough iron is rounded to make the groove, but unless this joint is made very nicely it is very little better than the plain rebate. There are several other methods adopted for keeping the weather out, but the limited space at my command will not allow of my explaining them. Fig. 5 shows the joint between the two doors, known as a "hook joint"; there are special planes made for doing this, but unless there are a lot to do it is not worth while buying them, as it can readily be done with a rounded plough iron or hollows and rounds. Before bevelling the edges, try the sweep the doors will make in opening, by taking the width of one door as radius and describing an arc (Fig. 2): this will give the exact bevel, and by allowing a little, you can feel sure the door will unlock at the joint without wanting easing, and so spoil the joint after it is made. D (Fig. 5) is a fillet nailed on to the outside of the sash that opens first, to further protect the joint. From your letter, I take it that you only want one leaf or door to open; if this is so, I think I should dispense with the joint if it presents any difficulty in making, and depend on a good rebated joint protected with a fillet outside. The making of the casements are so similar to ordinary sashes that it is hardly worth while to describe them. It is very necessary to have a good fastening to casement windows to hold them tightly in their place. The best method is known as an "Espagnolette bolt"; it consists of a rod connecting a bolt on top and bottom of the door, and so arranged that a turn of the handle shuts both bolts simultaneously, and also secures both sashes together in the centre. If this description is not all that you require, write again, and I will put you right on any little matter you do not understand.—E. D.

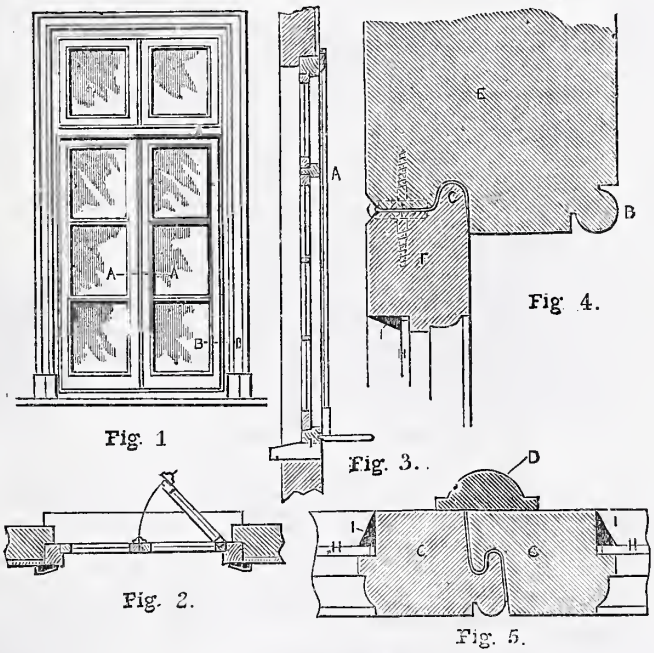


Fig. 1 Fig. 2 Fig. 3 Fig. 4 Fig. 5

Window. Fig. 1.—Elevation of Inside of Casement Window. Fig. 2.—Horizontal Section. Fig. 3.—Vertical Section. Figs. 4 and 5.—Details of Joints—A, Transom; B, Staff Bead; C, Weathered Joint; D, Fillet; E, Frame; F, Hanging Style of Doors; G, Shutting Style of Doors; H, Glass; Putties.

Removing Paint.—A. W. (*Glasgow*).—You will find the following recipe answer your purpose as well as anything you can try:—Take 1 lb. American pearlash and 3 lbs. quick stone lime; slack the lime in water, then add the pearlash, and make the whole about the consistence of paint. Cover well with the mixture, applying it with a sash-tool, and let it remain several hours. If necessary, give it a second coat.—W. E. D., JR.

China Drilling.—READER OF "WORK."—As the writer of the article in question, I am very pleased to know it has been of use to you. I do not know any place where you can buy half-round brass wire ready for using; but surely the trouble of making it ready for your purpose is not much. You can prepare sufficient wire for two or three dozen in about two minutes. A small coil of round brass wire can be bought at any ironmonger's. Take a length about two feet, and holding an old knife, as mentioned in the article, draw the wire against it two or three times, and it is done. If you have not tried to make it, do so; I am sure you will succeed, it is so simple; but if you would rather buy, if you will write me through the Editor, I would procure you what you want. I do not know of any manufacturers who would issue a book or pamphlet on moulding glass; it would hardly pay them to describe their own method for the benefit of other makers. For moulded articles of glass, apply to Messrs. J. Powell & Sons, Whitefriars Glass Works, Temple Street, London. Do you wish to buy the splints retail or wholesale? Write either to the address given in the article or to Messrs. Woods & Toussaint,

54, Spencer Street, Clerkenwell, London, E.C.—W. E. D., Jr.

Property in Chancery.—F. H. (*Bermondsey, S.E.*).—You had better advertise your assistance in our "Sale and Exchange" Column.

Model Boat Building.—J. E. (*Deptford*).—This is receiving much attention in Work. See Nos. 160 to 166 and subsequent ones.

Model Making.—W. H. D. (*Liverpool*).—Papers are constantly appearing in Work.

Cast Steel Name, etc., Marks for Iron and Steel.—B. R. P. (*Battersea*).—The steel stamps referred to in your letter of inquiry are charged for according to the number and size of letters, thus:—

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Under $\frac{3}{32}$ in., 2d. per letter.		$\frac{1}{16}$ and $\frac{3}{32}$ in., 6s. per set.	
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$\frac{1}{2}$ in.	,,	...	... 11s.

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Note.—The second and third price lists are of marks of "extra best quality," and are suitable for engineers and other heavy trades.—N. M.

Marking-Out for Twisted Candlestick.—Merthyr.—There are several ways, but a very simple way is by winding string round the wood. In a candlestick before me of corkscrew twist, there are two threads, and the twist becomes rather steeper as it rises, which looks well; the pitch is 3 in. If I wanted to mark for this, I would take an elastic ring and stretch it over the bottom part, where the diameter is largest, and slip two threads under the ring on each side, setting them about ⅜ in. apart, and on opposite sides of the wood; then have another elastic ring 3 in. higher up, and a third 6 in. Now you have only to wind the threads round so that they make one complete turn between each ring. You can move the threads about under the rings till you see the twists are regular and about the right thickness to be strong enough. In mine the candlestick is 10 in. high, and the cross section of the twist is ⅛ in. at the bottom and $\frac{7}{16}$ in. at the top. All that is easy to arrange by moving the threads under the bands. Now, when all looks right, take a pencil and draw a line under each thread. If you want 4 threads in the twist then you would use 8 threads; that is all. This is much easier than setting out the threads geometrically by measurement.—F. A. M.

Telegraph Instrument.—J. E. (*Braestairie*).—Your letter gives no particulars of what you wish to know.

Photographic Lenses.—Amateur.—Consult the advertisement pages of Work.

Modelling.—G. C. S. (*Inverness Gardens*).—My advice to anyone desirous of taking lessons in modelling, etc., would be that he should join the classes of the nearest Government School of Art at which modelling is professedly taught. Particulars of times and hours can be had at the respective schools. This will be found not only much more economical, but in almost every respect far better than taking private lessons.—M. M.

III.—Questions Submitted to Readers.

**** The attention and co-operation of readers of* Work *are invited for this section of "Shop."*

Stirrups.—London Saddler writes:—"This is a subject of much importance, and I shall be glad to hear brother readers' views and experiences with stirrups of old pattern or patents."

Concertina.—Youthful Reader writes:—"Will some kind reader give me a few hints as to making a concertina?"

Coins and Medals.—Numis writes:—"It would be a great help to me if some reader of Work could suggest some ideas for mounting them."

Birdlime.—A Young Reader writes:—"I shall feel obliged to be informed as to the way in which birdlime is made from the elder-tree."

Joiners' Work.—Reg writes:—"Can any brother reader recommend a good practical book respecting joiners' work for inside of churches, chapels, etc.—that is, pulpits, seats, etc. etc.?"

Horse-hair Weaving.—J. W. (*Dundee*) will thank any brother reader to give him some information as to the weaving of horse-hair as used for coverings of chairs and sofas.

Aphengoscope.—F. C. K. (*Mapleton*) writes:—"Will some reader kindly give me instructions, with diagrams and measurements, how to make an aphengoscope, suitable for use with a pair of Hugbes's large pamphengos lanterns, with 4-wick lamps?"

Water-Wheel.—Dynamo writes:—"Would any reader kindly inform me what power—*i.e.*, h.-p.—I could get from a 3 ft. by 1½ ft. undershot water-wheel placed over stream running at the rate of about three miles an hour? Also, what diameter of wheel would be required at other end of shaft of water-wheel to drive a 20 c.-p. Manchester dynamo, having a driving pulley 1½ in. in diameter, at the rate of 2,260 revolutions per minute?"

IV.—Questions Answered by Correspondents.

Tin.—Chemicus writes, in answer to Young Reader (see No. 168, page 190):—"I make scoops for ordinary shop use out of *empty* condensed milk, cocoa, and other tins. This is done by cutting the tin *diagonally* with an ordinary pair of strong scissors along the dotted line, thus:—

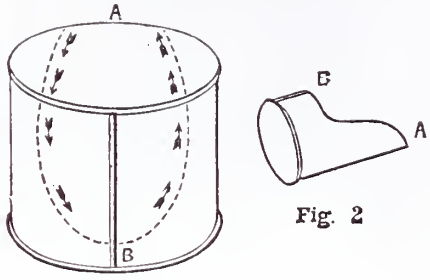
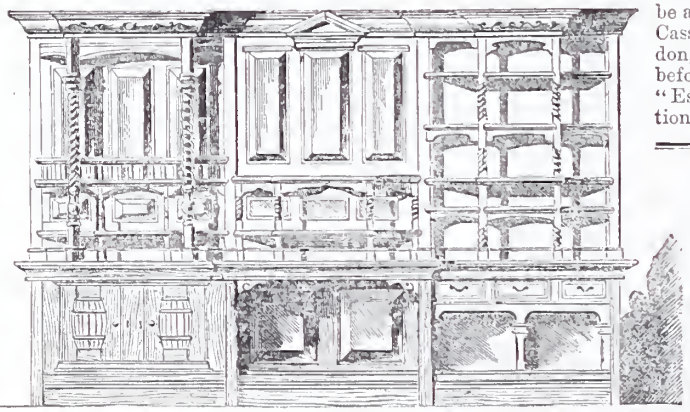


Fig. 1 Fig. 2

Fig. 1.—Mode of Cutting. Fig. 2.—Scoop.

Begin to cut at A in the direction of the arrows, as shown, finishing off at the point from which you began. Be careful to keep the seam of the tin where there will be least of it in the scoop, as at B. I have saved many a shilling in this way, besides always having a good supply of scoops in drawers, etc."

Stained Glass Designs.—M. (*Bishop Auckland*) writes to J. B. (*Moss Side*) (see No. 172, p. 254):—"You may get designs from one of the following books: 'Divers Works of Early Masters in Ecclesiastical Decoration,' £3 10s., by Owen Jones; 'A Book of Ornamental Glazing Quarries,' by A. W. Franks, £1 1s.; 'Westlake's History of Stained Glass,' Vol. I.—Fourteenth Century, 13s. 6d.; Vol. III.—Fifteenth Century, 18s., published by Batsford, 52, High Holborn."



Refreshment Room Sideboard.

Refreshment Room Sideboard.—F. J. (*Exeter*) writes, in answer to A. D. B. (*South Shields*) (see No. 171, page 238):—"Perhaps this design is the kind of thing you require. The drawing shows an alternative for one of the wings. The sketch is to ¼ in. scale. It is impossible to tell you what the cost would be; it all depends upon the kind of work you put in it; bevelled mirrors and expensive mouldings and ornament will double or treble the cost of a plain article."

V.—Letters Received.

Questions have been received from the following correspondents, and answers only await space in Shop, upon which there is great pressure:—R. B. T. (*Tyldesley*); F. A. W. (*Prowsley*); Doo; Precise; H. C. (*Norwich*); Anxious; H. T. (*St. Helens*). C. W. S. (*London, S.E.*); W. W. W. (*Wembley*); Constant Reader of "Work"; O. K. (*No Address*); W. J. H. (*Govan*); J. M. H. (*Glasgow*); H. W. (*Byfield*); G. H. (*Ashford*); Phœnix; E. C. J. (*Kyneaton, Victoria*); A. H. S. (*Kelvinside*); R. B. (*Galashiels*); A. B. D. (*South Shields*); C. O. (*Albany, West Australia*); R. D. T. (*Marylebone Road*); J. H. W. (*Halifax*); F. P. (*Camden Hill*); O. B. & Co. (*London*); F. McG. (*Dublin*); Desideratum; P. E. (*Birkenhead*); Anxious One; H. C. B. (*Ascot*); Workman; Music; H. B. (*Worcester*); C. R. & Co. (*Darlaston*); S. H. S. (*Barnsbury*); A. W. (*Stockport*); J. T. L. (*Ho Grace, Newfoundland*); Novice Electro; F. J. K. (*Tufnell Park*); C. A. I. (*Manchester*); J. W. (*Askham-in-Furness*); J. T. (*Glasgow*); M. & C., Limited (*Ardwick*); F. R. H. (*Stoke Newington*); Shaver; Would-be Driver; H. J. C. (*Hampstead*); Carver (*Bristol*); A Poor Man; Two Years' Subscriber; J. B. (*Fulbourn*); C. L. M. (*Glasgow*); A Lover of "Work"; F. B. (*Oldham*); Theory; R. M. C. (*Gravesend*); Model.

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Third Prize, £1.

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All Descriptions to bear the Work Prize Coupon, cut from one of the numbers of Work in which the Prize Scheme is announced.

Each Description to be signed with an original *nom de plume*, and to have the writer's real name and address securely attached to the manuscript in a sealed envelope.

Each Suggestion should be fully described in respect to its construction, conditional surroundings, and working, and, where possible, should be illustrated with a drawing of the device itself and its various parts to elucidate the description.

A Suggestion not illustrated will have an equal claim in the competition provided the description be sufficiently in detail to convey a full idea of the value of the device.

The Prize Devices and Drawings, and any others, to be published, if desired by the Editor, in Work, but the copyright thereof to remain with the authors.

Copies of MSS. and Drawings to be retained by the competitors, as in no case can the return of MSS. be undertaken.

The Editor of Work will supervise the judging of the Suggestions, and the selection as determined upon is to be final.

All manuscripts intended for the "Escape from Fire Device" Competition must be addressed to the Editor of Work, c/o Cassell & Co., Ltd., Ludgate Hill, London, E.C. They must reach him on or before Saturday, August 27, endorsed, "Escape from Fire Device" Competition.

NOTICE TO READERS.

Among the contents of next issue (No. 180) will be:—A Small Table in Enamel; Makeshift Combination Work-bench; Watch and Clock Cleaning and Repairing; Chemical Apparatus Making.

*** The Editor makes this intimation in the hope that readers, having friends interested in any of these subjects, will bring the same to their notice.

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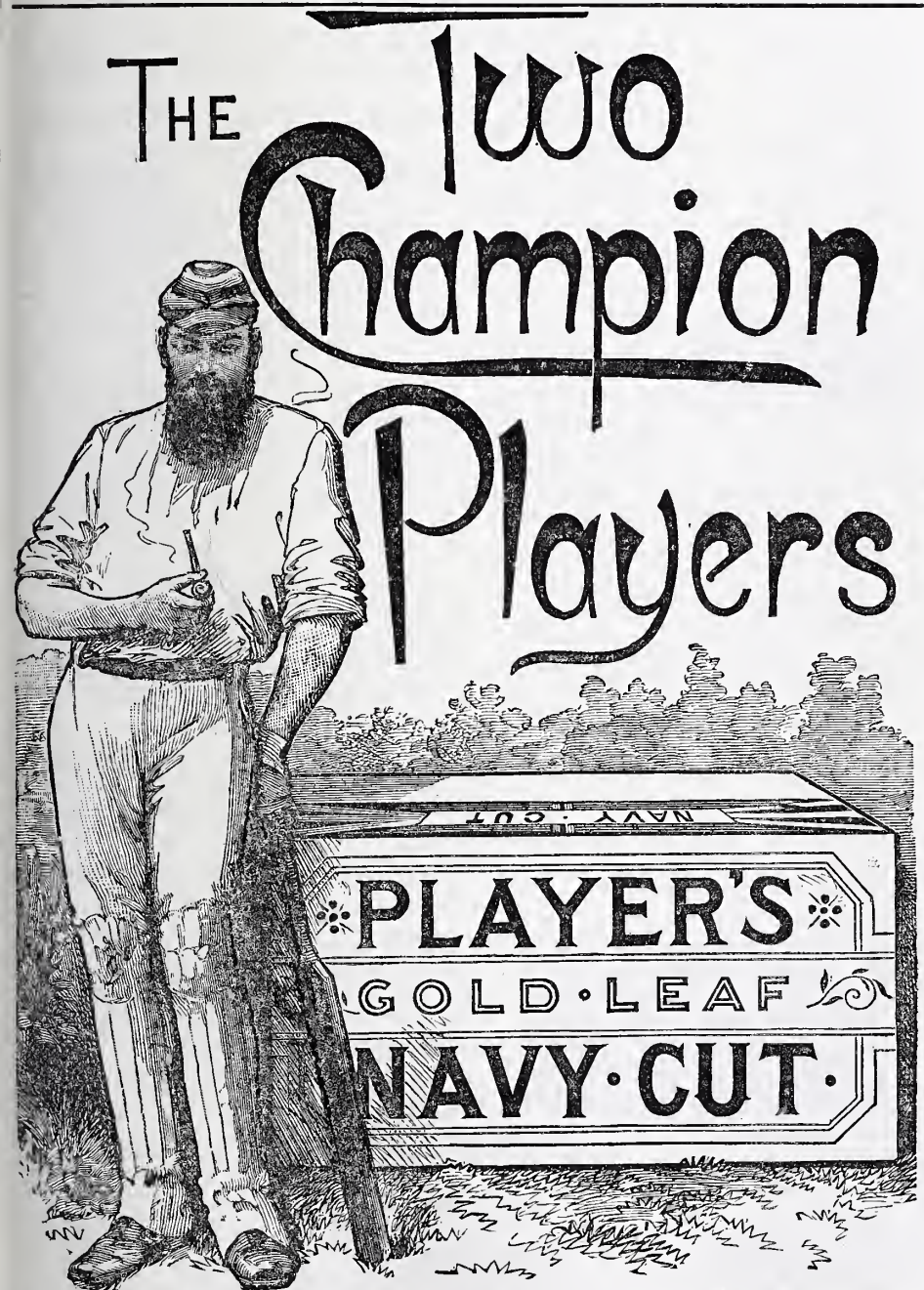

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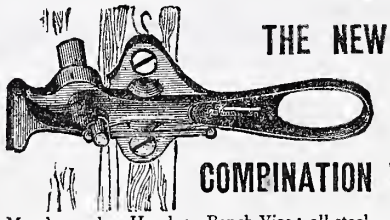

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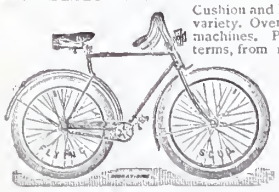

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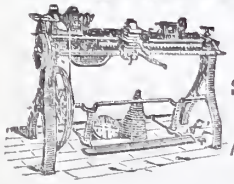

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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VOL. IV.—No. 180.] SATURDAY, AUGUST 27, 1892. [PRICE ONE PENNY.

WORK WORLD.

FARM labourers and domestic servants are the great want of the Canadian Dominion.

* *

A test has been made of Brown's 5 in. segmental wire gun. It withstood the powder pressure of 66,000 lb. per square inch.

* *

A Newcastle-on-Tyne firm have recently made, in one length of 10,670 yds., a tram cable, weighing thirty-six tons, for use in Australia.

* *

Experiments are being made for the manufacture of soap from used cotton waste. It remains to be seen whether the product will be worth the cost of extraction.

* *

The dynamo is replacing the battery to such an extent in telegraphy that its use will, it is thought, be universal in a few years. It is both cheaper and more efficient.

* *

English and Scotch iron-masters will find room in New South Wales. The Government have decided to call for tenders for 175,000 tons of steel rails to be manufactured within the colony from ores obtained there.

* *

Bricks are extensively manufactured in Japan for home consumption, but a small quantity have been exported as a venture to Vancouver, and should the demand justify further exportations, Japanese bricks could be shipped to British Columbia as ballast at nominal rates.

* *

A new American pavement consists of steel plates 3 ft. long and ¼ in. thick, flanged on the sides, and bedded in sand. These plates are laid from curb to curb across the street. The flanges are pinned together, and the plates perforated for drainage purposes.

* *

The use of natural gas as fuel in the rolling mills of America is declining on account of a shrinkage in the supply. In most of the works bituminous coal has been substituted, but in some places attempts to use gas-coal or petroleum have been made.

* *

Waterproof sheets of paper, united by a special paste, are being used for boot-soles, and the same material is to be tried for horse-shoes. Paper can hardly be regarded as a new material for boot-soles, although it is not openly specified in large contracts!

* *

Where cylinders exhaust into condensers, and in all cases where exhaust steam is used over again in the form of boiler feed-water, the boiler parts should be lubricated with the best cylinder oil and not with tallow. All tallow contains more or less acid, which is very injurious to boiler plates.

* *

Experiments recently made with liquid oxygen are of very great interest, and are to be extended. The comparative properties of oxygen and ozone can be further studied, and the question whether oxygen is an elementary or a compound substance ascertained. Come along, Royal Society!

* *

All interested in the "eight hours" question will watch its progress in America, as, if it is successful there, a great impetus will be given towards its adoption here, not only for miners, but for all labourers. President Harrison's signature, limiting eight hours for the work of the labourers and mechanics employed on public works in America, has gone forth. Room for the British Labour Party!

* *

The export of pig-iron from Swansea port last year was 646,000 tons less than in 1890. That of Bessemer steel had fallen to the extent of 46,666 tons, and "open-hearth" steel showed a decrease of 189,319 tons. This decline of exportation has unfortunately continued during the first six months of this year. Strikes have done this!

* *

When taking indicator diagrams from steam-engines, the atmospheric pressure should be considered. With regard to the economy of the engine, it is right to know how much the exhaust pressure is above zero. The atmospheric pressure is not always the same at sea-level, and at any altitude it is always less than 14·75 lb. per square inch. Many engineers neglect this important fact.

* *

Business is very brisk in Chatham Dockyard just now, and a large number of hands are daily working overtime. The ships absorbing the greatest number of hands are the first-class battleship, *Hood*, 14, 14,150 tons, 13,000 horse-power, one of the new Admiral type of vessels, and the twin-screw protected cruiser, *Hawke*, 12, 7,350 tons, 12,000 horse-power. What it costs for ironclads, and how little real use there is, or need be, for these weapons of offence and defence, the Peace enthusiasts will say!

* *

"Cutting it fine" is a known business experience. A French veneer-cutting firm have brought their machinery to such perfection that from a single tusk, 30 in. long, they can cut a sheet of ivory 150 in. long and 20 in. wide. Some of the sheets of rosewood and mahogany are only about one-fiftieth of an inch in thickness, and sheets of boxwood, maple, and other woods of this character are often so thin as to be translucent. The grain of many varieties of wood, however, is not sufficiently close to enable such fine work as this to be done.

* *

A new process for obtaining aluminium is the outcome of seven years' experimenting. The metal can be reduced from ordinary, fair quality clay, all iron and silicon being efficiently removed. It is hoped to produce 5,000 lb. of aluminium a day with plant driven by 5,000 horse-power motors, and this at one-quarter of the cost now incurred. When it is remembered that the specific gravity of aluminium is 2·5 compared with 8·9 for copper, it seems probable that the latter metal will, for many purposes, be superseded by the former, and as it is not so corrodible satisfactory results may be expected.

MAKESHIFT COMBINATION WORK-BENCH.

BY CLERICUS SECUNDUS.

Necessity is the mother of invention, saith the proverb. It is also the mother of many a makeshift which the proud amateur looks upon as a hardly inferior kind of invention.

Nor is it necessarily a disagreeable necessity. Of course, it might be more pleasant to have only to write to Messrs. Melhuish & Co. or Messrs. Syers & Co., and order a compact or complete bench (according to taste or circumstance), but many considerations may block the way to such a transaction and throw the luckless (?) amateur back on himself and such powers of getting out of a difficulty as Providence may have given him. In that case the best thing he can do is to practise the French proverb: "If you have not what you would like, you must like what you have," and there is a distinct pleasure, which the favourites of blind fortune never know, in having to pit one's brains against the difficulties of one's circumstances.

Being called to a somewhat distant field of labour, I found the cost of transit such that I must needs part with the humble but solid work-bench at which I had whiled away many a pleasant hour. What I should do at my journey's end, I knew not, but, Micawber-like, waited to see what would turn up.

Having reached my destination, the half-hoped-for second-hand bench did *not* turn up. Experience, expediency, and expense alike forbade the purchase of a new one, and yet a bench I must, would, and should have.

The outcome of the dilemma is now before the reader in the hope that—

> "Some forlorn and shipwrecked brother,
> Seeing may take heart again."

It is so unlikely that my exact conditions will be met with by any brother-amateur, that details of size, etc., would be practically useless, and are not given. Suffice it that my bench is 6 ft. long, 32½ in. broad, and stands 3 ft. high.

The idea, simple as it is, will be found capable of considerable adaptation to circumstances, and if carried out substantially as follows, the bench will thoroughly answer its several purposes.

A number of packing-cases, boxes, and trunks of various descriptions being (alas!) among my permanent belongings, it occurred to me that I might perhaps be able to utilise some of them for the end in view.

My first idea was to take a couple of boxes or packing-cases, stand them on end, and fix some kind of bench top on them. Some of my readers may prefer to simply carry out some arrangement of this kind, but, as will be seen, mine was a little more elaborate.

I had by me two stout, well-made boxes with hinged lids, and decided to use these as the bases of my construction. On laying them on their backs, however (in which position I wished them to remain), I found that the lids, which are flush with the outside of the boxes all round, were prevented from falling back, the contact with the floor allowing no room for the play of the lids. So I got two covers of other packing-cases, about the same size as my boxes and of the requisite thickness, and screwed them down to the floor where the boxes were to stand, and a couple of inches back of the front line of these latter (Fig. 1, A). This, of course, gave the lids of the boxes the necessary room to work and rendered the interiors get-at-able.

I now screwed the boxes down on to the covers, driving the screws right through from the inside and further fixed them to the floor, at both ends and back, by means of angle irons, or brackets, two of which are shown in Fig. 1, C.

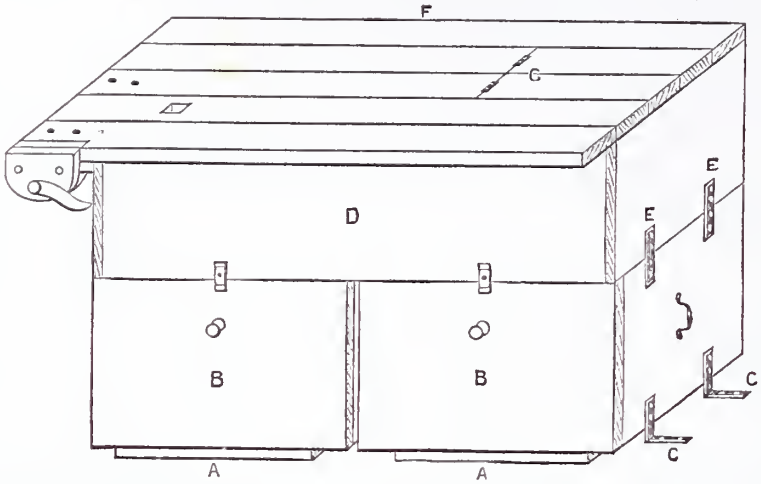


Fig. 1.—Bench complete — A, Covers of Packing-Cases fixed on Floor; B, Boxes fitted as Tool Chests; C, Angle Irons; D, Long Packing-Case fastened to Boxes; E, Strips to help fix ditto; F, Bench Top; G, Hinge Planks.

This was the more necessary because the workshop was right up under the roof, and that I had to fix the bench nearly in the middle of the floor to have standing-room. Of course, had I been able to fix it against a wall, the arrangement would have been somewhat easier and slightly different.

But my boxes, as they lay, were only 19½ in. high. As it was out of the question that the bench top should be so low, I proceeded to build on them. I had among my packing-cases a long one which had served to contain a baby's run and sundry lengthy etceteras, and this I now fixed on the top of my two boxes, its front being flush with the covers of the latter. A couple of buttons prevent the lids from suddenly falling back, and perhaps endangering the shins of the worker, whilst two small knobs facilitate the opening when required. The long case was firmly fixed by means of screws through the bottom and strips of iron all around (Fig. 1, E), the whole structure being thus made practically one, and as steady as could be reasonably desired.

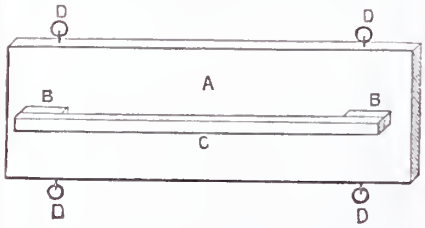


Fig. 2.—Tool Rack—A, Backboard; B, Blocks to carry Lath; C, Lath to carry Tools; D, Eyes for Screws.

My first idea had been simply to utilise the top of the case as the bench top, but unfortunately it was made of short ends of somewhat thin wood screwed on across the width of the case, and so was useless for the purpose.

I procured five planks of 1¼ in. deal. These, not including the tongues and grooves, were 6½ in. wide, and so gave a total width of 32½ in. As this was about 4 in. wider than my case, I arranged them so as to overlap in front, and supported the projecting part by screwing some angle irons underneath. Not wishing to lose all the space afforded by the long case, I hinged a couple of feet of the two middle planks (see Fig. 1, G). The space thus made available is most convenient for stowing away planes or other bulky objects—care being taken not to push them beyond reach—or the shavings may be swept into it instead of littering the floor.

The bench was now practically complete, except for the fittings. I decided to procure a patent instantaneous grip-vice and a patent bench-stop. Of course, I fixed the latter (easily enough) so as to be flush with the bench top when pushed down; but the vice presented an unlooked-for difficulty. It was meant for much thicker bench tops than mine, so that the jaws projected considerably above the level of the bench top.

To remedy this, I made the top the requisite thickness by screwing a plank-end across underneath its upper end where the vice was to be fixed. Four stout bolts right through the planks and vice, but with the heads sunk so as to be flush with the top, and an angle iron under the easting to take off the strain (the weight of the vice being considerable), completed this part of the job.

I also purchased a bench knife or back-stop, of the kind which are screwed to the edge of the bench top; but this is also meant for a top of average thickness, and the screw is not long enough to grip the edge of mine.

A strip of 1 in. wood along the underside of the front edge sufficed to make this all right. If, however, I were to begin again, I should get thicker wood, or (perhaps better) make the bench top of two thicknesses one across the other. This would obviate the inconveniences I have experienced, and effectually prevent the top from warping.

There now only remained the fitting up of the two boxes as tool chests. In this, of course, each reader will suit his taste or convenience.

In my case, as it is probable that sooner or later the boxes will be needed for their more legitimate purposes, it was best to have the whole interior arrangements easily removable. So the tools are fitted in racks similar to Fig. 2, which are fixed to the lids and sides of the boxes by small screws through the eyes. The remainder of the tools are arranged on movable shelves inside the boxes—an arrangement necessitated unfortunately by the dampness of my attic-workshop, which forbids any of the tools being left exposed.

The whole makes a useful and compact bench, and, for an amateur's makeshift, a neat and fairly workmanlike job. Some of the readers of Work wanting a makeshift for a Melhuish bench may value this.

SMALL TABLE IN ENAMEL.

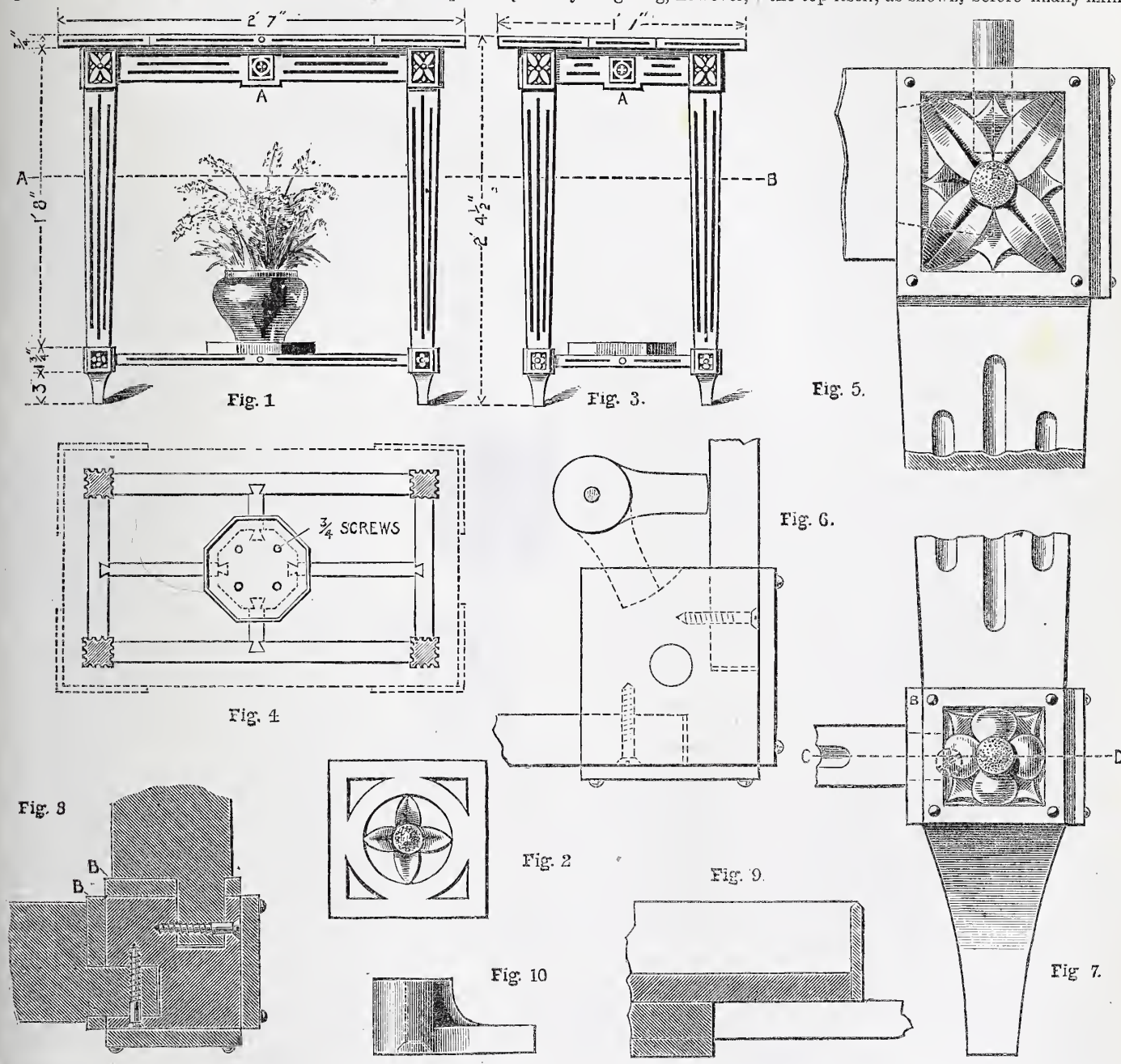
BY H. J. MARK.

INTRODUCTION—TOP—TOP RAILS—LEGS—BOTTOM RAILS — UNDER FRAME — TRAY — CARVED PIECES—ENAMELLING AND FINIS.

Introduction.—The subject is a little in advance of my original whatnot, but is designed *en suite*, having some carved work introduced, and the framing is a little more complicated. It forms also a good study for dovetailing, tenoning, etc., as well as squaring. The wood used is deal, excepting the carved pieces and the turn buttons, shown in Fig. 6, for securing to the table top; these are mahogany, as I thought it desirable that they should be of a stronger wood. The table is also designed to take to pieces for reasons before stated.

Top.—This is made of two pieces of 9 in. stuff, ¾ in. thick, tongued and grooved. A very good series of articles by Mr. David Adamson on jointing up generally appeared in the monthly numbers of WORK for August, September, and October, 1889, and which I recommend my readers to peruse if unacquainted with the precise method of working. They will find his remarks very useful and instructive. These two pieces are glued together, and when dry, faced and trued up. Preparatory to gluing, however, I made a cramp similar to the one explained by "H.H." in "Means, Modes, and Methods," p. 730, Jan. 24, 1891, and by which I secured the top after gluing. Remember to wash off any glue that squeezes out beyond the joint, or that has been dropped by mischance on the board, else in planing you will most likely notch your plane. When the top is ready, strengthen the underneath side of the joint by a strip of wood 3 in. by ⅜ in., and screwed at alternate intervals with ¾ in. screws, taking care, however, that it is not longer than is necessary to bring it up to the inside edges of the top side rails. The projecting angle pieces at each corner are strips of ½ in. stuff nailed and glued, so as to form a whole with the table top, and mitre-jointed as shown in Fig. 4, by the outside dotted lines. It will be found advantageous, after fitting them, to work the grooves in their face, sides, and likewise in the top itself, as shown, before finally fixing them. To work the grooves more neatly in the end-grained sides of the table top, I nailed two pieces of ½ in. stuff on to each side, and the angle piece over that again; by this means I had clean cut grooves all round. Punch all nails, used here and elsewhere, in a little way, and fill up the holes with shellac melted into them by the application of a hot iron. This is better than putty, and will completely hide them.

Top Rails.—These are 2½ in. by ⅝ in., and are dovetailed into the legs, as shown in Figs. 5 and 6. They are not glued, but



Small Table in Enamel. Fig. 1.—Front Elevation. Fig. 2.—Carved Piece of Top Rail. Fig. 3.—Side Elevation. Fig. 4.—Sectional Plan on Line A B; Outside Dotted Lines show Plan of Table Top. Fig. 5.—Top Portion of Leg, Dotted Lines showing Dovetail of Top Rail and Depth of Dowel. Fig. 6.—Plan of Top Portion of Leg with Turn Button for securing Top, Dotted Lines showing Slot for Turn Buttons. Fig. 7.—Bottom Portion of Leg, Dotted Lines showing Tenon of Bottom Rail. Fig. 8.—Section on Line C D. Fig. 9.—Section of Portion of Tray. Fig. 10.—Turn Button.

secured by $1\frac{1}{4}$ in. screws. The projecting piece, marked A in Figs. 1 and 3, is a strip $\frac{3}{8}$ in. by $\frac{5}{8}$ in., and is treated in the same way as those of the table top.

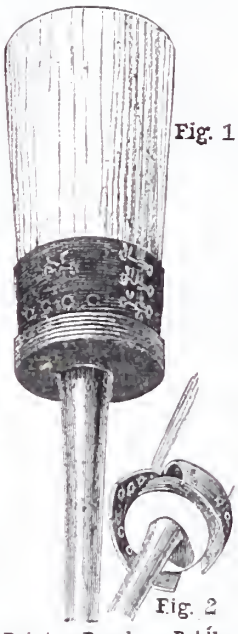
Legs.—These are $2\frac{1}{2}$ in. square at top, and taper to $1\frac{3}{4}$ in., as shown in full-size details. All dimensions given, it must be remembered, are finished sizes, and in getting out the stuff allowance must be made for sawing, planing, etc. After truing up, strike a centre line down two opposite sides, set off the taper, and work down the two sides to it; then do the same for the other sides. The best way to set about this is to cut down with the tenon saw at end of taper, clear away superfluous wood with the chisel, and finish with the smoothing plane; take care to leave flat and square the part that takes the bottom rails. The two square pieces marked B, in Figs. 7 and 8, are glued on and fixed by small brads; the mortises for the bottom rails have to be cut through these as shown. Now proceed with the mortises and dovetails, shape the feet, and leave the grooves till last. The grooves are on all four sides of legs. To cut the dovetail mortise use the dovetail of top rail as a template; take care, however, to hold it at right angles to the leg. The mortises for the bottom rails must be cut before the tenons, as the tenons have to fit them, not they the tenons. The mahogany turn buttons shown in Fig. 6 for securing table top are 1 in. thick, and are screwed to the top of the table as shown, the screw passing through a free hole. They fit into a slot in the legs, shown by dotted lines in Fig. 6. Whereas the dowel pins prevent any horizontal displacement, so these pieces prevent the prospect of lifting the table, and carrying off the top only. The dowels are let into the leg twice their height above it (see Fig. 5). They are secured by glue, but should not be made too tight a fit, else when glued and driven in they may swell and perhaps cause a crack. They should be a tight fit for the table top. They should also preferably be made of mahogany, or some other hard wood, and can be worked round with the plane, using the appliance shown in Fig. 21, p. 136, May 16th, 1891. With a little care and sand-paper, and using also a template hole, made by the bit you are going to use, they can be got fairly true. Of course, they are made in one length, and the four dowels are cut from it afterwards. The dowels may be left to the last, and to be as much as possible on the right side in getting their centres true, proceed as follows:—After marking their centres on the table top and legs, tap into the table top centres four shoemaker's brads, leaving their heads projecting about $\frac{3}{16}$ in. Now, these points should exactly correspond with the centres on the legs. If they do not, your framework must be somewhere out of square and must be seen to, as the edges of the top must be equidistant from legs and rails all round, though if carefully fitted together the centres will fall on each other without much deflection. A $\frac{1}{32}$ in. out would never be noticed, except by an extremely critical eye—at least, not in this case.

Bottom Rails.—These are $1\frac{1}{2}$ in. by $\frac{3}{4}$ in. The tenons are secured by $1\frac{1}{4}$ in. screws, as shown in Figs. 7 and 8. They must be a little less in length than the depth of the mortise, so as to allow the shoulders fitting up close.

Under Frame.—Having fitted the rails and legs together, proceed to make and fit together the under frame. The arms are $\frac{1}{2}$ in. by 1 in., and are dovetailed to bottom rails and to an octagonal piece of $\frac{3}{4}$ in. stuff, indicated by dotted lines in centre of plan (Fig. 4).

Tray.—This is octagonal in shape, with a raised edge made by mitre-jointed strips of $\frac{7}{8}$ in. by $\frac{3}{16}$ in. stuff, fitted round a $\frac{3}{8}$ in. bottom piece, and glued and fixed by brads. This tray is screwed to the octagonal piece, as shown, by $\frac{3}{4}$ in. screws.

Carved Pieces.—Having taken all to pieces, sand-papered, stopped, and put by to dry (by-the-bye, why not try the filling recommended by Mr. David Denning, p. 167, May 30th, 1891? I intend doing so on my next piece of work, and I do not see why it should not answer; and, besides, it saves the double sand-papering), start on the carved pieces. These are of $\frac{1}{4}$ in. mahogany, and are best carved and fretted all in one piece, shaping out and fitting afterwards. The centre bosses represent the middle portions of flowers and are in relief, but kept rather flat. The speckling means punching. The petals issuing from them are slightly hollowed and sunk as shown by shading. The little under leaves are below the petals, and are worked accordingly. The pieces belonging to the legs (Figs. 5 and 7) are secured by means of $\frac{1}{2}$ in. brass gimp pins, and are meant to be removed at any time for the purpose of screwing up or unscrewing the rails. The pieces for the centres of top rails are permanently fixed. These carved pieces should be stopped as well as the rest of the work.



Paint - Brush Bridle. Fig. 1. — Perspective View. Fig. 2.—Bridle turned for Cleaning.

Enamelling and Finis. — Enamel in two coats. The main colour used is Arabian brown. The middle grooves of legs, top rails, small round centres of bottom rails, and table top; the bosses of carved pieces, and surrounding square and circle of centre-piece of top rails are in gold. All other grooves are in turquoise blue. All the petals are pink, and the leaves in bronze green.

The table could have a drawer added to it, or it could have a lid hinged in the top, and the space enclosed by the rails converted into a lady's work-box. A further improvement, by those who can do it, would be to paint at the four corners and in the centre some devices in oils or enamels, such as flowers, etc.

The table itself would look far better, and more artistic still, if made in walnut or oak unpolished, but that would mean just treble the cost, so I hope that in its present form it may prove acceptable. It is by no meaus inartistic when nicely made.

PAINT-BRUSH BRIDLE.

The illustration shows an American patent designed for application to paint-brushes of all kinds, facilitating the working out of the colouring matter, and enabling the brush to be flattened as desired. Fig. 1 is a view in perspective, and Fig. 2 shows the bridle turned back in position for cleaning the brush. The bridle takes the place of the usual twine wound around the butt of the brush, and consists of two similar pieces or flaps, held at one end between the plug and the brush ferrule, the edges of the flaps having eyeleted perforations to be connected in pairs by cords. When the brush becomes worn, the outer ends of the flaps with the outer cords may be cut off to give further flexibility, as this may be desired. Near the centre of the flaps are other perforations to receive a cord extending transversely through the bristles and back again, portions of the cord lying at each side of the centre, and its ends being tied at one side. If the brush is to be round, the cord is left loose enough to permit the bristles to assume a cylindrical shape, but by tightening the cord the brush is flattened accordingly. Near the base of the flaps are perforations, through which the paint oozes when the brush is worked to and fro to free it of a certain colour, but when the brush is to be thoroughly cleaned, the flaps are turned back as shown in Fig. 2.

WATCH AND CLOCK CLEANING AND REPAIRING.

BY A PRACTICAL WATCHMAKER.

Cleaning a Geneva Watch.

First thoroughly clean and dust the board; then spread out a sheet of clean paper, foolscap size, immediately in front of you, on which to put the small parts; arrange the tools mentioned in the last paper upon the bench, and seat yourself at such a height that when the arms rest upon the bench objects held in the hand are in easy focus of the eyeglass without having to stoop over them.

The first proceeding is to take the movement (works) out of the case. There are several methods of doing this, according to the kind of watch in hand; so I refer the reader to Figs. 11 and 12, a short description of which will not be amiss.

There are two ways of arranging the wheel-work in Geneva watches. Fig. 11 shows a "$\frac{3}{4}$-plate" movement—that is to say, a brass plate, B, covers all the wheels, etc., except that part known as the "escapement," which will be referred to later on. In the other example (Fig. 12) the wheels are each held by a separate brass bar instead of a solid plate. This is termed a "bar movement." These two varieties, again, may be either "key winding" watches, as in Fig. 11, or "keyless," as in Fig. 12. The latter kind has the addition of various steel wheels and other mechanism, by which the watch is wound by means of the "stem," instead of placing a key directly upon the winding square.

Now, suppose we have in hand a key-winding watch. To get this out of its case, turn the turnscrew A (Fig. 11), or A (Fig. 12), and gently push the entire movement out of the *front* of the case. When this is out, several notches will be observed in the inner edge of the front of the case, and corresponding studs on the movement. In replacing it, these studs must first be placed in their respective notches, and the movement gently pressed in again till it is quite level, and the turnscrew A keeps it secure. It is just as well, before going any further, to take out the movement, replace it, and take out again, to familiarise yourself with the operation.

In the case of a keyless watch, the small screw, B (Fig. 12), must be withdrawn first, then the stem, C, boldly pulled out, after which the turnscrew, A, may be undone, and the movement taken out as before.

The movement being out of its case, the next thing to do is to carefully examine it with the eyeglass before removing anything. Note carefully the exact position of every part visible, the way each piece is screwed down, etc.; this will be a great help when the time comes to put all together again.

Next proceed to take off the hands. Lever them up carefully by means of a pair of cutting nippers or a pocket-knife blade. They are all merely pushed on friction-tight. This done, the dial must be removed. In some watches the dial "feet," which pass through the watch plate, are held by turnscrews, as at D, D, Figs. 11 and 12, and in others they are simply pinned through, in which case the pins must be withdrawn with the small blade of the pocket-knife. The dial will then lift off free. If it does not, something is wrong, and a careful search must be made. *Use no force* in any operation appertaining to the taking apart of a watch, or damage will surely result. If parts do not come away easily, there is a cause, and that cause must be searched for with the eyeglass. Patience goes a long way in watch work.

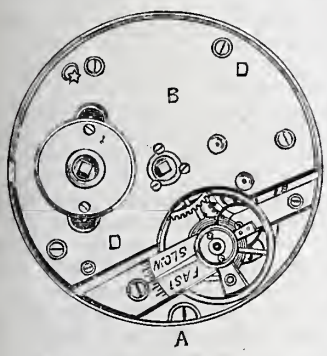


Fig. 11.—¾-Plate Movement.

When the dial is off, take off the two small wheels beneath it (called the motion wheels), turn the movement over, and see if there is any "power" on the watch—that is to say, is the mainspring wound up? If it is, and the watch will not go, it indicates that something is wrong, probably dirt in the wheel teeth or pinions. Under these circumstances it would not do to remove the balance wheel without first blocking the train wheels so that they cannot run. This is easily done by running a stout hair under the arms of the last brass wheel of the train, the fourth wheel, or that which drives the scape wheel—the one with peculiarly-shaped teeth. This done, unscrew the balance-cock or brass bar that holds the balance in position, and gently lift it by placing the point of the screwdriver under the notch cut in it for that purpose, and so levering it up. When this is free, the balance-cock, balance, and hair-spring should all come away together. If it appears to catch, shake it slightly; if this does not free it, turn the scape wheel the distance of half a tooth either way, which will most likely liberate it. Now replace the screw in its hole, and proceed to unscrew the scape wheel cock, lifting it in the same manner as before described, and remove the wheel. Take hold of the latter by *one of its arms* with the tweezers, and carefully deposit it in a place of safety.

The hair can now be removed and the train liberated. Let it run down slowly, using gentle pressure of the forefinger on the centre-wheel as a brake.

If the mainspring of the watch was not wound, or was broken, there would be no power upon the wheel-work, or tendency to run when the balance was removed. In this case the before-mentioned operations can be performed without first blocking the train.

The parts we have now removed—viz., the balance, hair-spring, and scape wheel—constitute what is known as the "escapement," which is by far the most delicate part of a watch. Great care should, therefore, be observed in handling it.

The rest of the watch, an inspection will show, is merely a train of wheels by which power is transmitted from a mainspring, in the first place, to the escapement. The escapement is, in fact, *the watch;* the rest is merely designed for the purpose of driving the escapement and recording its vibrations.

In a ¾-plate watch, the whole remaining wheel-work is contained between the two plates. In a bar watch, each wheel is held by its own particular bar. In either case, the removal of the screws of bars or plate will enable all the remaining wheels to be taken out. Before doing this, however, the centre spindle, or set-hand piece, as it is termed, must be taken out. This, it will be seen, has a steel pinion pushed tightly on to its under side. To remove this spindle, hold the movement in the hand, dial side up, and with the hammer give the projecting point (upon which the minute hand, the long one, was fixed) a smart tap. This will knock it through, and the steel pinion can be lifted off with the tweezers, and the centre arbor, or spindle, withdrawn from the back. It is also advisable, before removing the plate, to undo the small screws, and take off the brass or steel cap which surrounds the winding square and holds down the ratchet-wheel and clickwork. When this is off, the said ratchet and clickwork can be removed also.

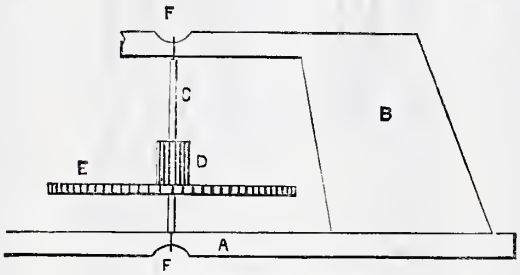


Fig. 13.—Wheel and Pinion.

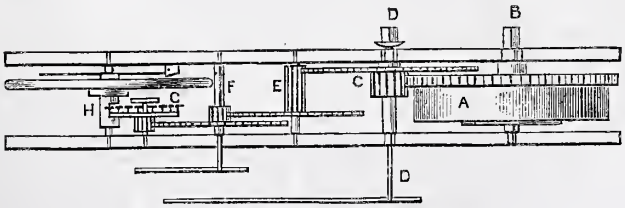


Fig. 14.—Arrangement of Wheel-work.

The watch will now lie on the paper in pieces, and the beginner will doubtless be surprised at the comparatively small number of wheels which it contains. We will now enumerate these, and describe their uses, and endeavour to give an insight into the working of the entire watch. A thorough appreciation of the use of each part will make the task of putting together correctly an easy one.

The watch, till we get to the escapement, may be summed up thus: mainspring, wheels, and pinions. Just here a little explanation of terms will not be out of place. Looking at Fig. 13. A is a "plate," B is a brass "cock" screwed to it, C is a spindle or, more correctly, "arbor," D is the "pinion" (a small steel wheel), E is the "wheel," F, F are the "pivots" upon which it runs in its "pivot-holes."

Thus the great wheel, or first wheel in a watch—the driving wheel, in fact—is formed hollow, like a box, and in a Geneva watch is called the "barrel." This contains the mainspring, designed so as to make the barrel perform four complete revolutions before its strength is spent. This wheel drives the *centre-wheel* pinion. The centre wheel makes thirty-two complete revolutions before the mainspring is spent. It revolves once in an hour, and its arbor (the set-hand piece referred to above) carries the minute hand, which therefore goes round once in an hour and marks minutes by divisions round the dial. This arbor, by means of the steel pinion (the *cannon pinion*) and the *motion wheels* under the dial, turns the hour hand, which marks hours. It is evident, therefore, that the watch if left alone will keep time for thirty-two hours, or eight hours more than should be required if it is wound regularly. This allows an ample margin for the somewhat irregular habits of some watch wearers.

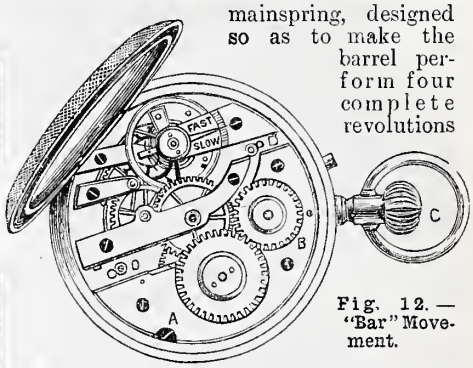


Fig. 12.—"Bar" Movement.

Proceeding with the train, the centre wheel drives the *third wheel*, which in its turn drives the *fourth wheel*. This latter carries the seconds hand, if the watch has one, and revolves once in a minute—that is, it makes sixty revolutions to one of the centre wheel. In a ¾-plate watch this wheel is the last held in position by the plate, and in a bar watch is the last provided with a large brass cock to keep it in position.

The fourth wheel drives the *scape wheel* in such a manner that the latter makes one revolution in six seconds. The scape wheel, by means of its peculiar teeth, drives the *balance*, making the latter perform two single vibrations for each tooth which passes. The rapidity with which the balance vibrates is determined by the strength and length of the *hair-spring*. This hair-spring is so selected that it makes the balance perform five vibrations, or make five "ticks," per second. The precise action of the escapement will be explained later on.

In a watch, to bring all these parts into as small a space as possible, they are arranged between plates, etc., of a circular form, and are necessarily cramped somewhat; but if they were all arranged in line between two plates, escapement as well, they would present an appearance something

like Fig. 14.—A, barrel, containing mainspring; B, barrel "arbor," or winding square; C, centre wheel and pinion; D, set-hand arbor, friction-tight in it, carrying minute hand; E, third wheel; F, fourth wheel, carrying seconds hand; G, scape wheel; H, cylinder, carrying balance, I. This figure will render the description more clear.

RAM OR PLUNGER-PUMPS.

BY PHILIP R. BJÖRLING.

History — Classification — Single-Acting Plunger-Pumps and Hollow Ram-Pumps.

The practical cause of failure of the solid, single-acting piston pump was its liability to jamb in the working-barrel by sand and gravel, and leakage of its leathers was apt to cause serious accidents to the costly pump-rods, and even to the steam engine.

Plunger-poles fitted to the case—the latter having longitudinal grooves for the passage of the water—were used at an early date in France. One of these pumps is described and illustrated in the "Dictionary of Mechanical Science," by Alexander Jamieson, LL.D., published in the year 1827. It is illustrated in Fig. 1, and consists of a wooden trunk, square or round, open at both ends, and having a valve at the bottom. N O is the surface of the water in the pit or well, and K the place of delivery. The pit must be as deep in water as from K to N O. A B C D is a wooden trunk, open at both ends, and having a valve, P, at the bottom. The top of this trunk must be in a level with K, and has a small cistern, E F. It also communicates laterally with a rising pipe, G J, furnished with a valve, H, opening upwards. M is a beam of timber, so fitted to the trunk as to fit it without sticking, and is of at least equal length. It is suspended by a chain from a working beam, and loaded on the top with weights exceeding that of the column of displaced water.

Sir Samuel Morland, Master of Mechanics to King Charles II., in the year 1674 invented and patented the plunger-pump made of cast iron. One of the most important features in plunger-pumps and dry-spear-pumps, as also in the steam engine, is the *gland* and *stuffing-box*, which was undoubtedly invented by Sir Samuel Morland, although it has been erroneously attributed to James Watt by some writers.

The arrangement used before the invention of the *gland* and *stuffing-box* was described in the following manner in the "English Encyclopædia," published in 1802:—

"The forcing-pump is sometimes of a very different form from that already described. Instead of a piston, which applies itself to the inside of the barrel, and slides up and down in it, there is a long cylinder, nicely turned and polished on the outside, and of a diameter less than the inside of the barrel. This cylinder is called a working barrel, and is constructed as follows:—The top of the barrel terminates in a flange, pierced with four holes for receiving screw-bolts. There are two rings of metal of the same diameter, and having holes corresponding to those in the flange; four rings of soft leather, of the same size and similarly pierced with holes, are well soaked in a mixture of oil, tallow, and a little resin. Two of these leather rings are laid on the pump flange, and one of the metal rings above them. The plunger is then thrust down through them, by which it turns their inner edges downwards. The other two rings are then slipped on at the top of the plunger, and the second metal ring is put over them, and then the whole is slid down to the metal ring. By this means the inner edges of the last leather rings are turned upwards. The three metal rings are now forced together by the screwed bolts, and thus the leather rings are strongly compressed between them, and made to grasp the plunger so closely that no pressure can force the water between them. The upper ring just allows the plunger to pass through it, but without any play, so that the turned-up edges of the leather rings do not come up between the plunger and the upper metal ring, but are lodged in a little conical taper, which is given to the inner edge of the upper plate, its hole being wider below than above. It is on this trifling circumstance that the great tightness of the collar depends. To prevent the leathers from shrinking by drought, there is usually a little cistern formed round the head of the pumps, and

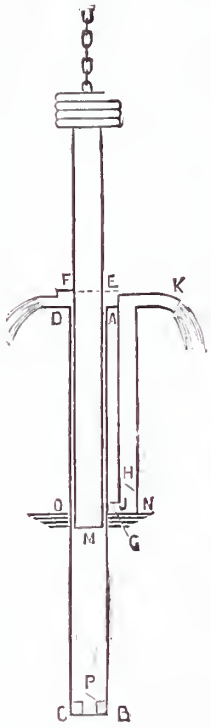


Fig. 1

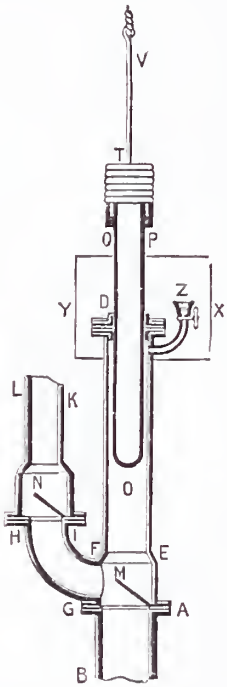


Fig. 2

Ram or Plunger-Pumps. Fig. 1.—Ancient Ram-Pump. Fig. 2.—Ram-Pump with Delivery Clack on the Side of the bottom of Working Barrel.

kept full of water. The plunger is either forced by a rod from a working beam or by a set of metal weights laid on it."

This pump is illustrated in Fig. 2, in which A B is the top part of the suction-pipe; D E F is the plunger-case; O P Q, the plunger or plunger-pole; V, the plunger-rod; T, the weights; M, the suction-clack; N, the delivery-clack; H I, the delivery clack-piece; K L, the delivery-pipe, or rising main; Z is a cock for discharging the air which accumulates in the top part of the plunger-case; and X Y is a cistern filled with water to prevent the packing leathers from getting dry.

Classification.

The writer will now proceed to describe each separate type of plunger-pump, dividing them into the following classes:—

1. Single-acting plunger-pumps.
2. Single-acting hollow ram or plunger-pumps.
3. Double-acting plunger-pumps.
4. Bucket and plunger-pumps.
5. Piston and plunger-pumps.
6. Plunger and plunger-pumps.

1. Single-Acting Plunger-Pumps.

Those which have the suction-valve in a line with the plunger, and the delivery-valve on the side at the bottom of the plunger-case.—A pump of this type is illustrated in Fig. 2, and has already been described.

Those which have the suction-valve in a line with the plunger, and the delivery-valve on the side at the top of the plunger-case.—This class of plunger-pump was invented—or, perhaps more correctly, designed—by the great Richard Trevithick, in the year 1797. It is illustrated in Figs. 3 and 4. The plunger-pole was made of cast iron, turned on the outside, and working in a cast-iron plunger-case or working-barrel, the sides of which were not touched by the pole. The pole-case was provided with a stuffing-box and gland and the necessary valves. Trevithick's pumping gear was quickly appreciated, and during the succeeding four or five years many of the principal mines in Cornwall had their old bucket-lifts removed to make room for the new plunger-sets. This form of pump is still largely used—almost as he designed it in 1797. Fig. 3 is a longitudinal section, and Fig. 4 a sectional plan. A is the plunger-rod of wood, fastened into the hollow cast-iron pole or plunger, B; C, the pole-case, allowing space for the passage of water round the pole; D is the stuffing-box; E, the bottom or suction-valve, allowing the water to ascend into the pole-case on the ascent of the plunger; F, the top or delivery-valve, through which the water is forced upward, through the pump-trees or rising main, on the descent of the plunger.

The plunger-set, made useful in the Cornish mines by Trevithick, met all the requirements: raising the water by the descending pump-rods, having greater simplicity of structure and freedom from breakage and liability of jambing.

Those which have the clack-pieces on the side of the plunger-case, so that the wind-bore, suction-clack, delivery-clack, and rising-main are all in one line.—An illustration of this pump is given in sectional elevation, Fig. 5. This arrangement is mostly used at the present day for convenience of fixing same in the shaft or well, and easy access to the valves. It consists of the plunger-case, A; the stuffing-box and gland, B, bolted to the top of the plunger-case; C is the plunger-pole, consisting of a cast-iron tube, turned on the outside, and forced on to a wooden spear. The plunger-case, A, is secured to the top of an H-piece, consisting of a short pipe, J, and the suction clack-piece, K, united by the water-way, or throat, L. The suction clack-piece is bored at E to receive the suction-clack; H is the wind-bore, or suction-pipe, bolted to the underneath flange of the H-piece; and the pipe, J, is secured to timber built into the sides of the shaft. On the top of the H-piece is secured the delivery clack-piece, which is bored at F to receive the delivery-clack. G is the pump-trees, so called because originally they were made from logs of trees, bored out and strengthened by wrought-iron hoops.

2. Single-Acting Hollow Plunger-Pumps.

A pump of this description is illustrated in Figs. 6, 7, and 8. Fig. 6 is a sectional elevation; Fig. 7 gives a view of the top of the plunger; and Fig. 8 shows the plan of the delivery-valve.

The plunger-case is similar to the ordinary one, and is fitted at the top with a stuffing-box and gland. To the top of the stuffing-box is secured a delivery clack-piece, furnished with a door for access to the delivery-clack; and to the top of this clack-piece is bolted a cover, provided with a gland and stuffing-box, for the pump-rod (not shown in the illustration). The plunger consists of a hollow pipe, A, without flanges, turned all over perfectly true and parallel; or, at least, it ought to be so. It is furnished at top and bottom in the inside with two lugs, B, through which pass two wrought-iron rods, C, provided at the bottom ends with double nuts, and at top secured to a cross-piece, D, forged on the main pump-rod, E, and secured by double nuts. The delivery-valve, F, in this example of hollow ram or plunger-pump, is simply a round disc sliding on the two rods, C, the disc being faced with leather; and a cross-piece, G, secured to the plunger-rods, C, by colters, is provided for determining the lift of the valve.

DETECTIVE, HAND, AND MAGAZINE CAMERAS IN TROPICAL COUNTRIES.

BY J. C. HANNYNGTON.

The variety of the above-named class of cameras, with which the market is now stocked, is so great as to cause selection to be difficult. I have, therefore, put together a few observations which may assist an intending user in deciding what kind of camera he will buy or make.

I will deal first with the exposing shutter with which all cameras of this class are provided. All are made to give very rapid and also time exposures.

If the shutter, when set for a time exposure, flies up with a jerk, remains open for such time as an elastic ball or a button be held pressed, and flies back with a jerk when the pressure is released, it will almost invariably shake the camera more or less, and the effect of the shake will be distinctly noticeable when a short exposure of less than two seconds is given. It is well, therefore, to have the power of exposing by hand—that is to say, by capping and uncapping the lens or aperture through which the lens looks.

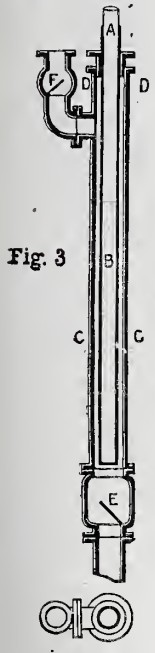


Fig. 3

Fig. 4

Ram or Plunger Pumps. Fig. 3. — Trevithick Ram Pump. Fig. 4. — Sectional Plan.

If the exposure has to be made by pressing a button or pulling a string, the action is very likely to cause shaking, whether the exposure be long or short, and whether the camera is held in the hand or attached to a stand. An exposure actuated by a pneumatic ball and tube is therefore preferable.

A hand camera may be of any size and any shape which it is possible for the operator to lift, point at the object, and fire off a shutter whilst so pointed, but it is likely to be an inconvenient companion of larger than half-plate size.

Any small camera with good light-tight slides or backs and a quick shutter will do as a hand camera. Some people like to have a finder, which can be easily attached; many prefer to work without any finder. I consider the finder exceedingly useful. Hand cameras may be divided into two classes—automatic and manual, both these classes including magazines. In the automatic class, a button or something is pulled or pushed, and a fresh plate from the magazine or reserve takes the place of the plate last exposed. In the manual class the plates may be carried in backs and inserted or fitted to the camera in the usual way, or the exposed plate may be raised by a lever grasped by the hand and placed at the back of the reserve of plates, or the back plate of the reserve may be raised and placed in front of the last exposed plate.

This latter plan is that adopted in Rouch's "Eureka," which has the following defects. Unless the magazine is fully charged with the dozen plates or dummies, it will not work at all; and if you want to expose only two plates you must carry the weight of ten extra ones, for if even one sheath is empty the apparatus will not work. Again, if you have twelve sensitive plates in the magazine, and having exposed only one, wish to develop it at once, you must remove eleven plates to get at the one you want.

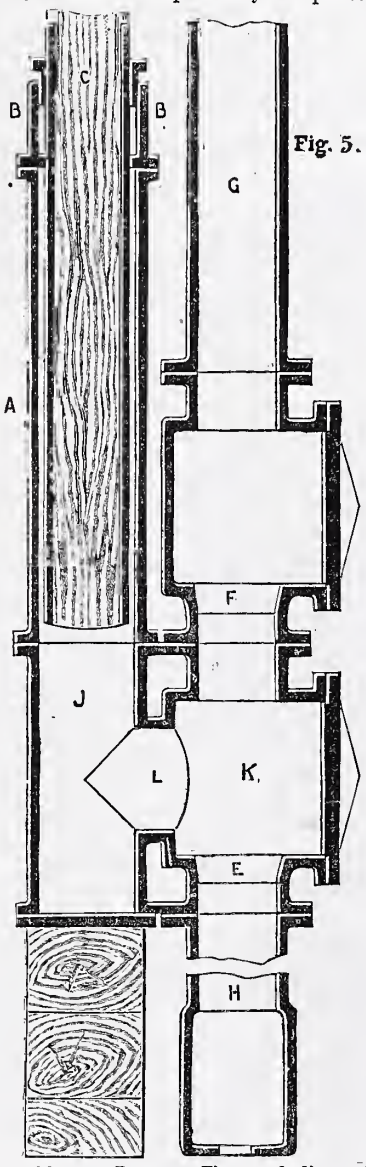


Fig. 5.

Ram or Plunger Pumps. Fig. 5.—Ordinary Ram Pump.

In another camera of this form this last defect does not exist, as it is the exposed plate which is removed and placed in rear of the unexposed lot.

In all cameras of this class, as well as in most of the automatic class, the plates are held in metal sheaths, and these sheaths, whether of zinc or iron, are liable to rust or oxidise, and the oxide comes off and makes spots on the plates. Varnishing the sheaths is fatal, but the metal sheaths may be dipped in boiling paraffin wax, the surplus wax rubbed off, and this will to a great extent prevent the evil.

A convenient kind of hand camera which may be made by the amateur (with the exception of the carriers or dark slides) is a box camera with an ever-set shutter (such as the automatique) fixed inside, opposite the hole of the lens mount. The lens should screw on outside, as in any ordinary camera, and should have a rack and pinion or a draw tube for focussing, for the camera being a mere box, no focussing can be done with it. The length of the camera should be arranged so that when the lens is racked or pushed right home the plate shall be in focus for distant objects; and for nearer objects the lens can be extended, the focussing being done on a focussing screen as usual, or preferably by marks on the lens tube previously arranged for various distances. The plates are carried in dark backs which slide or clamp into position. A leather handle on the top of the box facilitates carriage, and a screw-hole should be placed in the bottom and side of the box for use when it is desired to use a stand. The camera, if cunningly made, will carry a couple of extra dark backs inside, and can be fitted with finders inside or out. I consider this camera preferable to the kind in which an ordinary bellows camera is contained in a box with a hole in front for the lens to look out.

The best kind of dark back for a camera such as I have described is that in which the shutter of the back draws entirely out. Chadwick makes a very superior camera of this class. It has, however, a bellows body, and has to be "set up" each time it is required for use, so that it is not so constantly ready as the box I have described, but it has many qualities which render it superior to the box. It will take stereo pictures on a half-plate or on two quarter-plates, and it will take pictures the full size of the half-plate, and is, besides, a thoroughly good working camera for all sorts of work. The box form is superior only in solidity, simplicity, cheapness, and ever-readiness. Again, any camera may be fitted with a roll holder to carry a roll of sensitive film. No magazine camera yet devised can compare in convenience with this method, as the exposures can be made one after another with considerable rapidity, and the use of the film reduces the weight to a minimum.

Of this form of camera I have seen none to excel the Kodak. Of the automatic class I know of none better than the Ideal. Of the manual class I like Chadwick's and a magazine camera made by Stipn on the principle of the Eureka. The following are the points:—

Is the arrangement for changing plates (whether automatic or manual) simple and certain in action?

Are there means of altering the focus?

Are there means to alter the aperture of lens?

Can the camera be used for ordinary work, such as enlarging, reducing, etc.?

Can the apparatus be carried about without inconvenience and constantly ready for immediate use?

Is the instantaneous shutter of a type which is ever set ready for action, which will not shake the camera in discharge, and which will admit of time exposures being given without shake?

Can the lens be easily removed for cleaning?

Is the instantaneous shutter totally devoid of indiarubber blinds or bands which will not stand a tropical climate?—*Journal of the Photographic Society of India.*

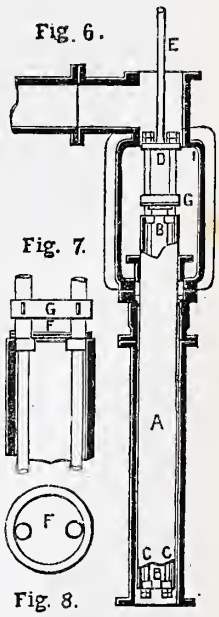


Fig. 6.

Fig. 7.

Fig. 8.

Ram or Plunger Pumps. Fig. 6.—Hollow Ram Pump. Fig. 7.—Top of Plunger. Fig. 8.—Plan of Delivery Valve.

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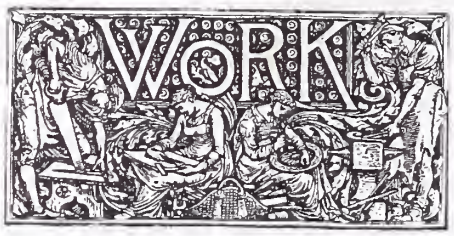

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NEW UNIONISM.—Some of the Derbyshire miners are beginning to find out certain disadvantages in the working of a rigid five days' week, and have applied to their council to be permitted to work also on Saturdays on certain occasions. This permission has been refused, and the council passed a resolution to the effect that Saturday must not be worked until the Miners' Federation gave permission. It is curious that the reduction of the working week to five days has not materially reduced the output of coal, so that the adoption of this curtailment of labour has not been attended with friction. The fact of the matter, however, is this: the miner is naturally fond of enjoyment when he is above ground, and delights in attending "feasts," races, and other sporting meetings. These cannot be enjoyed without having money to spend, hence he is anxious to be permitted to earn some extra money in the summer season. Should the agitation for compulsory shortening of the general hours of labour be in any measure successful, more of this class of complaint may be looked for, but even this one should have some effect on the minds of the workmen who think.

EDUCATION AND INVENTION.—If we run through the history of inventions, it is very notable that scarcely any important ones have come through educated men, and, great as is the advantage of a liberal education to the average man, it must be observed that it is in many respects inimical to originality. If an individual is taught how to compass all the ends he may desire to attain, he will, as a rule, be content to keep in the groove into which he has fallen, and although he may make some of those small alterations in machinery or methods which in our day are dignified by the title of invention, he does not strike out new and original ideas, as did the celebrated inventors of the first half of the present century. The very routine of laborious learning clogs the imagination, and restricts it to an arbitrary channel. Under the present high-pressure system of teaching, the object of learning is too often lost sight of in the anxiety to pass certain examinations. The student tells you he or she, as the case may be, is working up for such or such an examination; that examination past, the course of study is turned in another direction to meet the requirements of some other examination, and thus the memory is temporarily crowded with an amount of information which is very seldom retained, because it is, in the first place, too hurriedly acquired and subsequently neglected, and thus the legitimate end of education is defeated, while a severe course of over-study at the same time wearies and wastes the brain, and leaves it without the vigour essential to originality. Intervals of rest and relaxation, sufficient to allow of the mental digestion of facts and theories and their critical consideration, are absolutely necessary if we wish to progress as a nation. We wish those who are responsible for, at least, the elementary education results in this country would turn their attention to a "thinking" system of instruction, instead of the "parrot" and sing-song method adopted by the Board Schools.

EMPLOYMENT OF DISCHARGED SOLDIERS.—The War Office is at last making an effort in the right direction to facilitate the employment of time-expired men of the Army Reserve, which is recruited from the ranks of the discharged men of the regular army. By arrangements with other public departments, the Army Reserve men are to have the preference over other candidates for suitable situations. The War Office itself employs 1,600, and in the Metropolitan and City Police there are engaged upwards of 2,000 men. In the Post Office only some 1,500 are at present employed, but it is to be hoped that this number may ultimately be increased to 25,000 as the different posts fall vacant. The number of Army Reserve men thus employed by no means exhausts the ranks of those anxious to find situations, and it was in the hope of exciting favourable interest on behalf of those still unemployed that the heads of the War Office recently conferred with the managers of all the leading railway companies. While the managers expressed themselves in sympathy with the project, they pointed out that there were other claims to be met from the sons of old employés. The movement which has been so successfully started by the Government for dealing out something like justice to the Army Reserve men may not solve the great recruiting question, which at the present time more than usually troubles the army authorities; but the knowledge which will speedily gain ground that the time-expired man is not simply granted his pension and left unassisted to fight his way for work must inevitably make its influence felt. The great hiatus, however, is this: the men have been taught little else but to shoot down fellow-creatures. If the army scheme permitted some useful and profitable technical teaching and training for soldiers during peace time it might be possible for the soldier to turn to some useful and specific work in the labour market when his period of short service had expired. Why should there not be technical classes for soldiers? We have received and shall print correspondence which has reached us *à propos* of our leaderette in No. 178. The discharged soldier is heavily handicapped in the labour market, and some methods should be forthcoming to remedy this.

CHEMICAL APPARATUS: HOW TO MAKE AND USE IT.

BY H. B. STOCKS.

INTRODUCTORY — METHOD OF WORKING GLASS TUBES—MATERIALS REQUIRED AND PRICE—BENDING TUBES: PRECAUTIONS NECESSARY—OXYGEN APPARATUS: HOW TO MAKE—HYDROGEN APPARATUS: HOW TO MAKE—THISTLE FUNNEL—PRECAUTIONS NECESSARY IN THE PREPARATION OF HYDROGEN — PNEUMATIC TROUGH AND GAS JARS—METHOD OF COLLECTING GASES OVER WATER.

SINCE the time of Faraday very little has been done towards teaching students of chemistry how to manufacture their own apparatus. In the "Chemical Manipulation," written by Faraday, is given a great deal of information upon this point, and also how to successfully conduct experiments. More recent text-books generally take it for granted that the student has already learnt to fit up his own apparatus, or that he buys them ready fitted up. Now, this knowledge is hardly possible in the case of those who are not attending any class, or even in the case of a large proportion of those who are attending classes. I find they are very deficient in this particular. It is to such students as I have mentioned that I address the following notes, arising out of practical work in chemical laboratories, and which I hope may be followed by the very beginner himself.

Do not get the notion that a student may manufacture everything he requires from the raw materials; flasks, beakers, and such-like apparatus must be bought, as we have not sufficient skill, or the appliances, and nicely regulated heat used in the glass-house, to make them. I will point out as I go along what it will be necessary to buy, and the price. The advantage to be gained in fitting up the apparatus will be twofold—a saving of money, and a gain of experience in the deft fingering required in handling thin glass apparatus, and therefore a consequent decrease in the number of breakages.

I propose, then, at the outset to describe the method of working small glass tubes, as a number of useful exercises will thus have been performed. The materials required for this purpose are 1 lb. of glass tube, $\frac{3}{8}$ in. internal diameter, costing 1s.; triangular file, costing 4d.; the Bunsen burner, described at p. 167, or the blowpipe (p. 250); one length of thin glass tube, $\frac{1}{2}$ in. internal diameter, costing about 4d.; one piece of stout glass rod, costing about 2d.; and a piece of hard charcoal.

For the purpose of bending small tubes it is most convenient and satisfactory to use the flame of an ordinary gas jet. Fig. 1 may be taken as an example. Cut off a portion of the small glass tube, 20 in. long, in the following manner:—Make a scratch with the file at the place where it is required to break the tube, take the tube in both hands, hold the thumbs close one upon each side of the file-mark, and give a slight jerk. If the tube does not break, increase the file-mark until the object is effected.

Turn down the gas until you have a flame about $1\frac{1}{2}$ in. wide, hold the tube on each side of the flame at the tip of the bright portion (Fig. 2), turning it round all the time, so that it may be equally heated. When the glass commences to soften, apply a very gentle movement in one direction, so as to produce a curve like that at Fig. 1, A, and not as at Fig. 1, B, which is badly made and very liable to crack. During the heating up the tube will have become coated with a deposit of soot. Do not remove this: as it is a bad conductor of heat, it will allow the glass to cool down slowly. Place the tube resting against a block of wood, so that the bend may not come in contact with any cold surface. When cold, proceed to bend up the other end slightly. The end being heated in the flame, you will not be able to take hold of it. When the glass is soft enough, give it a touch with the piece of charcoal, which will bring it into the required position, allow to cool again, wipe off the soot, and proceed to round off the rough ends of the tube. For this purpose hold each end in the hot air issuing from the Bunsen burner (Fig. 3), and gradually bring it down into the hottest part of the flame. The ends will then fuse slightly, and be rendered stronger, neater, and much less liable to crack. Cool down each end by blackening it in the smoky flame produced by cutting off the air supply.

A great necessity in heating glass is to increase the heat very slowly, and to cool the object down very gradually; otherwise, fracture is almost sure to ensue. Thin glass does not require such great precaution as thick glass, owing to the heat penetrating better and more equally in the former.

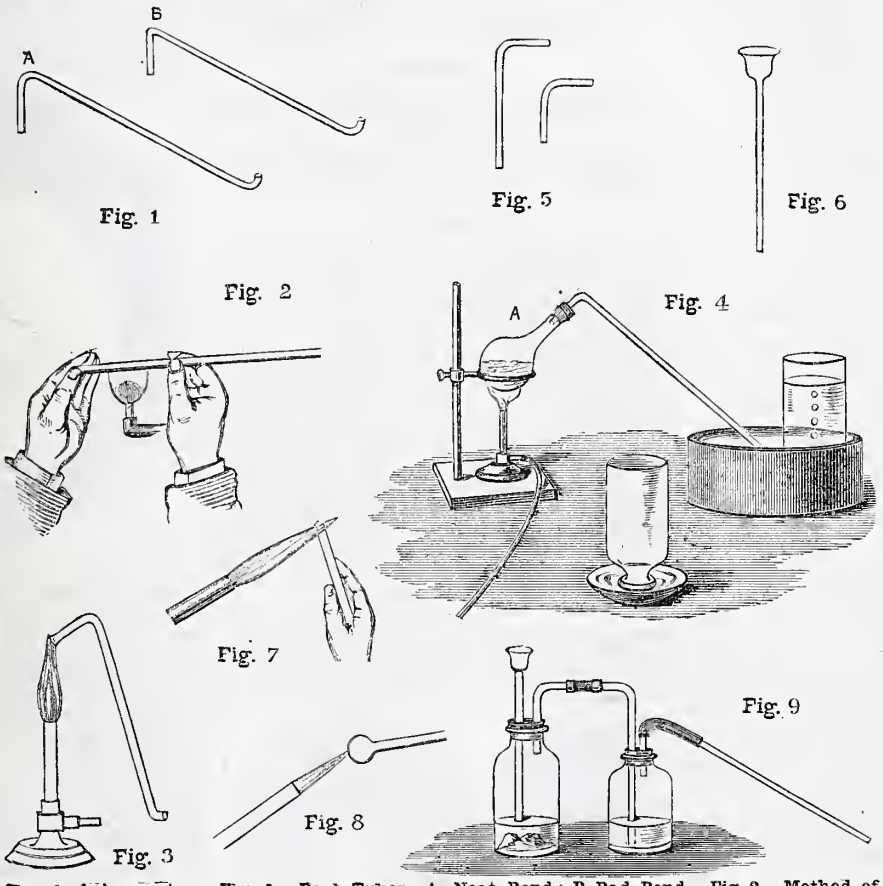
Having bent one tube satisfactorily—mind, I do not say you will be able to do this the first time, but by practice and patience you will be able to bend any tubes required—the rest will be easy.

The tube which I have given as an example is a portion of the apparatus shown at Fig. 4, which is used for the preparation of oxygen or of nitrous oxide (for which see text-books). It consists of a hard glass flask, A (a Florence oil flask will do if it can be procured), costing about 4d., and the tube you have made. The flask is supported upon a retort stand, or other support, to be hereafter described, and is heated by means of a Bunsen burner.

To fit up this apparatus, get a sound cork, fitting tight in the flask, wrap it in a piece of paper, and roll it under the ball of the foot—this will render the cork very pliable—then, by means of cork-borer (three sizes cost 1s.) or red-hot iron rod, bore a hole into which the tube fits very tightly. If by the above means a hole cannot be made as large as required, it may be enlarged by means of a coarse rat-tail file (cost, 6d.), which will be found a useful adjunct. Having made the hole, push the glass tube through until it just projects on the other side of the cork.

That the work of the student may be continuous, and not of a disjointed nature, I propose at this point to show in what way the oxygen may be collected.

Our apparatus for this purpose may be very simple and inexpensive. Any gas (such as oxygen) that is not appreciably soluble in water may be collected over water. The apparatus used is called a pneumatic trough, for which any flat-bottomed bowl or tin basin will do. The jars for collecting the gas may be ordinary wide-mouth pickle jars, which do excellently. To collect the gas, place a jar in the bowl, which should be full of water, and fill the jar perfectly full of water, then slide upon the mouth a ground glass plate which has been slightly greased, invert the jar, and withdraw the plate, keeping the mouth of the jar under the water. The jar will then remain full of water. Bring the exit tube of the apparatus under the mouth of the jar, and the gas, as it issues, will displace the water. When the jar is nearly full of gas, slide a saucer under the mouth of it,



Chemical Apparatus. Fig. 1.—Bent Tubes—A, Neat Bend; B, Bad Bend. Fig. 2.—Method of bending Glass Tubes. Fig. 3.—Rounding Ends of Glass Tube. Fig. 4.—Apparatus for preparation of Oxygen. Fig. 5.—Bent Tubes for Hydrogen Apparatus. Fig. 6.—Thistle Funnel. Figs. 7 and 8.—Method of making Thistle Funnel. Fig. 9.—Hydrogen Apparatus.

and withdraw the jar and saucer. The jar may then stand in the saucer of water until you have collected as many bottles of the gas as you require.

When you are preparing a gas requiring heat, as each jar is filled, lift the exit tube out of the water before taking away the source of heat; otherwise, as the flask cools water will ascend the tube, fall into the hot flask, and crack it.

We may now proceed to bend the tubes shown at Fig. 5. Cut one piece of tube 6 in. long, and two pieces 4 in. long, and bend each as shown, one piece having a longer limb than the other two. Having finished these off as already pointed out, proceed to make what is called a "thistle funnel" (Fig. 6). Cut off a piece of tube, 12 in. or 13 in. long (see that the glass is pretty thick), hold one end of it in the flame of the Bunsen burner, or blowpipe, in the position shown (Fig. 7), so that the glass, as it becomes pasty, may not fall from the tube. When the tube has melted up, and there is a knob of pasty glass on the end, remove it quickly from the flame, and, holding it vertical, blow into the open end, turning the tube round all the time, so as to blow a large bulb upon it which is as nearly spherical as you can get it. If you do not succeed the first time, melt it up again, and again blow out; but take care not to blow too hard, otherwise, your bulb will burst. If you have been successful, and your bulb is a fairly strong one, turn down the flame of the blowpipe very low, and commence blowing. Bring your tube with the bulb directly on to the point of the flame in the direction shown at Fig. 8. The bulb will quickly fuse at this point. Blow suddenly, and with force. The end will be blown out into a wonderfully thin balloon of glass, which will burst with a loud report. Crumble away all the fine glass from the bulb, and hold it in the Bunsen flame, turning it round quickly, so that only the edge is fused.

We may now fit up the hydrogen apparatus (Fig. 9). Procure a 4 oz. and a 2 oz. wide-mouth bottle, and corks to fit. Having bored two holes in each cork, place the thistle funnel and one short tube in the cork for the large bottle, and the other tubes in the cork for the small bottle. Allow the funnel to come nearly to the bottom of the bottle, and the same with the longer tube in the small bottle. Connect the bottles, as shown, by means of a small piece of indiarubber tube (4d. per foot), and the second bottle to a long piece of glass tube reaching to the pneumatic trough.

To prepare hydrogen, place your zinc in small pieces in the first flask, pour water through the funnel until the bottle is about a quarter full and the end of the funnel is covered, pour a little water into the second bottle sufficient to cover the end of the longer tube, cork it up, add a little acid through the thistle funnel. Gas will immediately begin to come off, and will be washed by passing through the water in the second bottle, finally escaping by the long tube to the gas jars in the pneumatic trough.

A word or two of caution is necessary in the preparation of hydrogen. Allow the gas to pass away a minute or two before collecting any, otherwise the air in the apparatus makes a very explosive mixture with the hydrogen. Two explosions due to this cause I have already seen. It is best to collect a small test-tube full, and apply a light to the mouth of the tube. If it burns quietly, you may collect, but if it makes a sharp crack, let a little more gas pass away before collecting.

Do not perform your experiments on the drawing-room table, as sulphuric acid has a powerful affinity for almost anything. A common bench, or a kitchen table, over which spread a piece of American cloth, is best; and note that drops of sulphuric acid rapidly eat a hole through clothes, carpets, etc. The best antidote is to sponge the cloth immediately with ammonia, which neutralises the corrosive effect. I should advise also that all chemicals be locked up to prevent accidents and mistakes, which are already rather frequent.

In my next article I propose to give another lesson in the working of glass tubes and fitting up of glass apparatus.

THE CYCLE: ITS WORTH TO THE NATION.

Being the Second Prize Essay by "ENDEAVOUR" (ALEXANDER STEPHENSON), 3, *Dixon Road, Swan Hill, Glasgow.*

In trying to estimate the worth of the cycle to the nation, one must take into consideration the fact that the cycle, whether considered as an article of commerce or an article of use, is comparatively a new thing.

Considered as a mechanical machine, its life is so young that it cannot yet be expected to have reached perfection, or even the highest state of improvement of which it is capable; and, considered as an article of use, its uses are being discovered and utilised every day, especially by public bodies, such as the military and civic authorities, as well as by numerous private bodies for business purposes. We can, therefore, only estimate approximately its *present* worth to the nation, and in doing so will endeavour shortly to note, first of all, what the cycle is.

The word "cycle" is used by us to denote every form of velocipede. The word "cycle," a circle, strictly means one wheel, thus—cycle, one wheel; bicycle, two wheels; tricycle, three wheels; quadricycle, four wheels; and so on. The

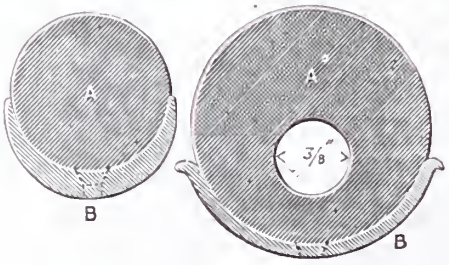


Fig. 1 Fig. 2

The Cycle. Fig. 1.—¾ in. Solid Tire. Fig. 2.—2¼ in. Cushion Tire.

word cycle, however, from usage, denotes very well every kind of machine, being a general term for all.

The cycle now so familiar to us, and that which is capable of being put to so many uses, is known as the Safety bicycle—the element of safety being but a comparative one, as it can only be said to be safer than any form of bicycle yet introduced.

In the beginning of the present century—1800 to 1820—a machine was introduced and used about the parks of London called the "Dandy-horse"; it had two equal wooden wheels about 30 in. diameter, the rider sat on a saddle placed on the centre of a horizontal backbone, and steered the front wheel with a cross handle-bar, exactly as in our Safety. The rider, when seated, could rest both feet on the ground, and the method of propulsion was by thrusting the toes into the ground backwards, thus giving forward motion to the machine and its rider. This must have been a fatiguing operation, and could only exist for a time as a novelty—since, indeed, it never reached any stage of usefulness.

The idea of two wheels running in line was indeed a novelty; but while the feet could reach the ground on either side anyone could perceive little difficulty in keeping the machine upright: but, when inventive genius conceived the idea of keeping the feet entirely clear of the ground, and propelling the machine by means of cranks on the axle, then the thing appeared to many minds an impossibility; for a man to balance himself on two wheels running in line seemed contrary to the law of equilibrium; yet it was only carrying out that law, as anyone may see by starting a wheel or hoop down-hill: the hoop will keep running upright so long as the conditions of the track are such as not to disturb the momentum.

In 1859 or 1860, the cycle known as the "Bone-shaker" was introduced as an article of trade, although I cannot find any patent in Philips' abridgments earlier than 1868. The Bone-shaker,

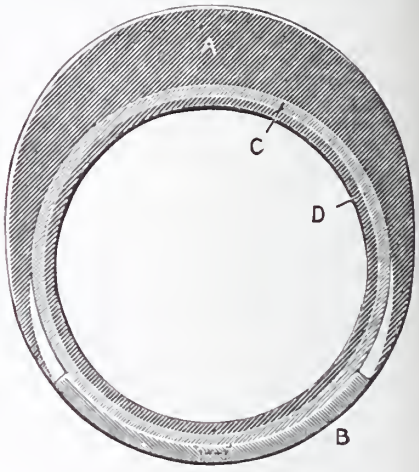


Fig. 3

The Cycle. Fig. 3.—2 in. Dunlop Pneumatic Tire.

like its parent, the Dandy-horse, had wooden wheels shod with iron, and was only the adaptation of cranks to the front wheel of that machine, with slight alteration of the frame.

Long prior to that date, however, many attempts (some of them successful) to apply cranks to the Dandy-horse had been made by private persons. The writer saw, in 1856, a machine made and ridden by a young man at Kilwinning, in Ayrshire. The front wheel of this machine was both driver and steerer, as in the Bone-shaker invented later on. Twenty years before this time—or about 1836—a blacksmith named McMillan, in Dumfriesshire, applied cranks to the rear-wheel of a Dandy-horse, thus constituting a rear-driving Safety. He became an expert in the use of this machine, and could ride it down-hill standing on the saddle; he made long trips on it—some of them to Glasgow, where on one occasion the crowd was so dense around him that, having run down a child, he was taken before the magistrates.

Coventry is understood to be the home of the Bone-shaker as put upon the market. The machine held its own till a better was introduced by the Coventry makers. Now began the period of tension spokes and rubber tires, and with their advent the Bone-shaker became dead stock. The general form of the machine now changed entirely; the front wheel grew larger, while the rear became proportionally small. A 6 ft. man got mounted on a 5 ft. wheel, and the element of danger was greatly increased, yet a speed of over twenty miles has been done on the Ordinary.

For about ten years the Ordinary was the popular machine, and in its best examples is a beautiful piece of mechanism. The danger of headers from being seated vertically over the pedals on the high machine was at once apparent. Many, and some fatal, accidents occurred; and makers sought to introduce a safer machine

Greater safety was claimed for the "Facile," "Xtraordinary," "Sun and Planet," and some others, including several types of the "Kangaroo" pattern: all to give place in a great measure to the rear-driven Safety as we now have it, and to which we will now confine our remarks.

The Safety, now so popular, was introduced about ten years ago: the "Pioneer," "Rover," and "Bicyclette" being among the first types of what is certainly the safest and handiest cycle yet known to us. Since its introduction the production has more than quadrupled the output of the best days of any former type, and many thousands of persons are now using the Safety who never would have ventured on an Ordinary; and for every one maker of the Ordinary there are now perhaps fifty makers of the Safety

The Safety of to-day resembles more nearly the original Dandy-horse or Bone-shaker than any type introduced in the interim, in having two small equal wheels; it steers in the same way; the essential difference is in the rear-driving wheel. Of course, there is a vast improvement in material, general detail, and in the mechanism itself. All movable parts are fitted with steel balls in the bearings, thus reducing friction to a minimum. The frames, constructed of thin steel tubing, are light and strong. The rubber tire has supplanted the iron ring. The saddles, constructed on tension springs, can be used for an indefinite time without chafing.

In nothing appertaining to the Safety has there been so great a revolution as in the tires; for a long time the solid rubber, about ¾ in. diameter, was the only tire for Safeties. Two or three years ago the cushion and pneumatic tires were introduced; the latter is a decided benefit in the reduction of vibration and increase of speed, while the former is considerably better than the solid in this respect.

The previous figures show sections of the three forms of tires:—Fig. 1, the solid; Fig. 2, the cushion; and Fig. 3, the Dunlop pneumatic, all full size; the latter is filled with compressed air. In Fig. 3 the inner ring, C, is rubber; the ring surrounding it, D, is canvas, which allows the inner ring or tube to expand equally round the wheel; the outer crescent-shaped rubber, A, is the tread proper, the thickest part coming in contact with the road; B is the steel rim to which the tire is fastened by cementing the edges of the outer rubber to it.

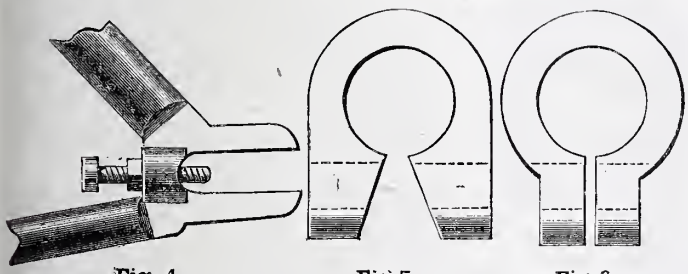


Fig. 4 Fig. 5 Fig. 6

The Cycle. Fig. 4.—Rear Wheel Adjustment Screw (half full size). Figs. 5, 6.—Handle-Bar Clutch (half full size).

The driving mechanism commonly in use on the Safety is an open link chain running on two cog-wheels, one on the rear hub and the other on a short axle situated a few inches in front of the driving wheel, and about 12 in. from the ground; on this shaft are fitted the cranks, and on them the pedals. An essential feature in the Safety is the gearing-up by means of the relative difference in size of the two cog-wheels, which gearing-up compensates for the small driving-wheel, as it may be geared to equal, or more, the largest Ordinary, some racers being geared as high as 70 in. or 80 in. Such is a brief outline of the Safety bicycle. Now for its worth commercially to the nation.

It would be difficult to name a branch of trade that has grown so rapidly as the cycle trade. Within the last seven or eight years hundreds of persons have embarked in the trade, either as makers or dealers. Millions of capital are now sunk in buildings and machinery for their production, while many thousands of persons are employed in the trade. It is estimated that nearly 200,000 Safety bicycles were made in 1891 in this country, and the present year has seen even a greater development of the trade, as many makers have had to extend their premises and employ additional workmen to cope with increased business.

Cycle production carries a number of other trades in its train. First of all, the makers of steel tubes, steel stampings and castings, steel wire, and other materials, saddlery, bell-making, lamp-making, enamelling, electro-plating, transfer printing, and very largely rubber tire-making and other rubber fittings, oils, varnishes, lacquers, cements, and solutions. The press also has its share of work in sending out numerous publications entirely devoted to cycles and the trade. Again, engineers and machinists do a large trade in making machines and tools for the cycle maker. The gas companies even benefit by it, as a large amount of gas is used for enamelling, stoves, blowpipes, and lighting purposes.

The benefits or worth of the cycle to the nation could not well be summarised in a short paper like this. Suffice it to say that the trade has developed and gone up with astonishing rapidity—the present year more so than any former year—and there is every assurance that the trade will go on increasing.

As to the worth of the cycle to the nation derived from its use, it is estimated that in this country some 800,000 persons use the Safety bicycle, to say nothing of a large number of tricycles and a good many Ordinaries.

As a vehicle for pleasure it is used for touring, holidaying, for racing on path and road. It is used by the military, the police, the post-office, the tradesman, the doctor, the clergy, the sportsman, the photographer, the mechanic, the labourer, and the collier.

It is used in almost every country on the globe, and in most out-of-the-way places, such as Malta and the Isle of Man. It is used by all classes of persons, from kings and emperors down to the collier, and of all ages, from seventy-five down to the latest disciple of the wheel, the infant King of Spain. It is used by thousands who do not possess a machine, but hire one at 9d. or 1s. per hour in the evening, when work is done, and by this class, it may be said, it is considerably ill-used.

As a practical repairer of the Safety bicycle, the writer has daily opportunity of noting certain details in the construction of even high-class machines that might be improved; and he would here respectfully throw out the following hints to makers:—All set-screws, such as are used to fix handle-bars and seat-pins, should have square heads, each of the four sides being not less than ⅜ in. A six-sided pin or nut that comes often under the wrench is an abomination. All rear wheel axles should be screwed ½ in. Whitworth; all front wheel axles should be screwed ⅜ in. Whitworth. Mud-guards should be attached to the frame by bolts and nuts, or studs and nuts. Front mud-guard should be fixed to fork crown with a bolt and nut. The best chain adjustment yet invented is that shown at Fig. 4, and is used by some makers; it is always effective, never gets out of order, and never gets lost; the screw should have a square head and lock-nut.

Machines made on the socket steering principle should have the column plugged solid, or with heavy tube, for at least 3 in. from the crown upwards.

When a clutch or gland is used to bind the seat-pin or handle-bar stem, it should be made as in Fig. 5, and not as in Fig. 6. Handle-bars made of ordinary ¾ in. steel tube should have 5 in. or 6 in. of their centre plugged with a bit of ⅝ in. tube to strengthen them at the T attachment. The stem should not be attached to handle-bar by lapping round, but by a T-piece stamping, and the tenon on the T-piece to receive the stem should not be less than 1 in. long.

In making plunger-brake work, the tube carrying the spoon should not be less than ½ in., with a ⅜ in. rod to brake lever; the tube should be plugged solid, 3 in. long from the spoon upwards.

The handle-bar of a racing machine should not be more than 18 in. or 19 in. across the tips of the handles, as racers seldom use the handles, but grip the bar nearer the head. The long handle-bar is a frequent cause of locking and spills.

Direct spokes for wheels, unless they are butted, should not be less than No. 11 gauge, and should be of the best steel wire.

Hubs should always have gun-metal flanges to receive the spokes, as there is in the softer metal a certain amount of give when the strain of driving is on, and the spokes do not snap off so readily as with steel hubs.

In concluding this paper, it may be mentioned that the present season has witnessed a new form of cycle, which bids fair to rival the Safety; it is called the Geared Ordinary. It resembles the old Ordinary in that the front wheel drives as well as steers. It has a gearing-up mechanism secreted in the hub, by which a small wheel can be geared up to any desired extent. It has been tested as to speed alongside the Safety, and quite equals that machine; but whether it or some yet uninvented cycle will drive the handy little Safety to the wall remains to be seen.

SCIENCE TO DATE.

Electricity.—The United States Government have supplied one of their iron war vessels with four electric fans for the purpose of blowing away the smoke from the guns when in action.

Analysis of Organic Compounds.—A more rapid process of analysing organic compounds than the usual method of combustion with cuprie oxide has been worked out by M. Berthelot. It consists in burning the compound to be analysed in oxygen gas compressed to 25 atmospheres. The operation is carried out in a calorimetric "bomb," and the products of combustion are then sucked out and drawn through the usual absorbing tubes. The combustion is total and instantaneous, and gives accurate results.

Ammonia in the Air.—M. Muntz has come to the conclusion that the rain water of tropical regions is always more highly charged with ammonia than the rain of temperate zones. In arriving at this result he insists upon the fact that observations made in the neighbourhood of large towns are unsatisfactory, for the atmosphere above a large town is always highly charged with ammonia and other impurities.

Acetic Acid.—The specific gravity of a solution of acetic acid in water at 15° C. rises gradually with the strength of the solution till it reaches 1·7048, which is the specific gravity of a solution containing about 80 per cent. of acetic acid. From this point as the amount of acetic acid increases the specific gravity falls until it reaches 1·0553; this, the specific gravity of the anhydrous acid, being the same as that of a solution containing only 43 per cent. If, then, a sample of acid has a specific gravity above 1·0553—say, *e.g.*, 1·0674—it may be of two strengths, in this case either 94 or 58 per cent. To decide which, water must be added and the specific gravity again determined. If a rise is found, then the acid was of the higher percentage; a fall would indicate a weaker solution.

New Artificial Musk.—A short time ago tri-nitro isobutyltoluol was introduced by Baur as an artificial musk. Para-isobutylxylol sulphonate is now recommended by Valentiner as possessing the advantage of being soluble in water instead of being an oil like tri-nitro isobutyltoluol. It is prepared as follows: A mixture of isobutylic alcohol and aceto-xylol is mixed in molecular proportions. The mixture is then treated with concentrated sulphuric acid, and the whole is thrown into four times its weight of water. A red watery solution is obtained with an oil floating on it. The solution is separated, and on saturating it with common salt the para-isobutylxylol sulphonate is precipitated in white crystals.

TRADE: PRESENT AND FUTURE.

**** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

JEWELLERY TRADE.—The London jewellery trade is almost at a standstill, except, perhaps, a small demand for turquoise work.

CUTLERY TRADE.—The Sheffield pen- and pocket-knife trades are in a poor way.

SILVER TRADE.—The silver trade of Sheffield shows a slight improvement. Messrs. Walker & Hall have completed extensive alterations, and Messrs. Mappin & Webb have opened their new show-room.

EDGE TOOL TRADE.—Most makers are busy. In shipbuilding and kindred tools there is not a good demand. A better market is being opened up in South America.

FILE TRADE.—The Sheffield file trade is not brisk, but a good trade is being done by some houses.

BOOT AND SHOE TRADE.—The production in the great manufacturing centres is not up to the average for August. The London bespoke trade is good.

GOLD THREAD TRADE.—With a fall in the value of the rupee to 1s. $2\frac{1}{16}$d., no improvement can be expected in the Indian branch of this trade. The home trade has not yet recovered from the effects of the General Election and the summer holidays. A slight improvement is shown in spangled and frosted thread orders.

WATCH TRADE.—A severe time of depression is being felt at Coventry and Birmingham. For the last two months the larger firms have been running short time, and further reductions are likely.

GENERAL PRODUCE.—Our Liverpool correspondent writes:—There has been some business done in New Para rubber at 2s. $9\frac{1}{2}$d. per lb., but the market is quiet. African rubber has brought very steady prices, but in Sierra Leone, Gambia, and South Coast kinds comparatively little has been done. The sales, which amount to about 30 tons, include Addah niggers at 1s. $7\frac{1}{4}$d., Acera and Cape Coast biscuits at 1s. 7d. to 1s. 9d.; Sierra Leone twists at 1s. 6d. to 1s. 9d.; ordinary Cape Coast, 1s. 2d. to 1s. $2\frac{1}{4}$d.; small tongue at 1s. 1d.; Grand Bassam, Axim, and Assinnee at 1s. 2d. to 1s. $4\frac{1}{2}$d.; gum Arabic, Turkey, 150s. to 200s. per cwt.; East India, 15s. to 80s.; Barbary, 42s. 6d. to 45s.; Gedda and Talca, 40s. to 45s.; Glazirah, 50s.; beeswax, Chilian, £5 5s. to £7 5s. per cwt.; African, £4 15s. to £6 15s.; American, £6 to £6 15s.; West India, £5 10s. to £7.

COTTON TRADE.—The depression in the cotton trade and the remedies proposed continue to occupy the attention, not only of the employers, but also of the operatives. The latter appear to fully anticipate a severe struggle before very long.

CYCLE TRADE.—There is a lull, and large stocks are offered at great reductions. Trade for 1893 is making a move, the Whitworth firm having booked for next season about half their estimated output. With regard to the new geared ordinary, the trade will be quite safe for another season with the safety, especially the pneumatic safety.

IRON AND COAL TRADES.—The iron and coal trades of Sheffield show most decided signs of improvement. It is highly improbable, even in the face of the resolution of the Miners' Federation respecting the discontinuance of the "stop-day" movement, that coal values will be reduced during the next month. The hematite market is so firm that prices must go up with any large increase of orders. An advance of 1s. 6d. per ton has already taken place, making the price in this district from 58s. to 60s. per ton. The demand for Bessemer material is increasing in firmness, and stocks of hematites are very low. Taken altogether, the prospects point to a renewal of prosperity in the iron trade. House coal is quoted at the pits at from 9s. 6d. to 11s. 6d., steam coal 9s. to 9s. 9d., and manufacturing coal is in steady demand. Slacks are quoted at from 5s. to 6s. per ton, and smudge and other small coal are firm.

SHIPBUILDING TRADE. — Shipbuilding in the Mersey district shows no signs of returning activity, while in the Barrow district no new orders have been booked lately, either in the shipbuilding or marine engineering branches.

ENGINEERING TRADE.—The improvement in the Manchester district continues, and in more than one instance some good orders have lately been secured. Some machine tool makers are fairly busy, also the larger makers of stationary engines. The locomotive building trade is worse. Machinists are only in exceptional instances well employed, and boiler makers are still far from busy. In the Tyne and North-east Coast districts trade is fair. Engineers have met the employers half-way in the proposed reduction of 10 per cent. Engineering work is very brisk in Aberdeen, but the pay is poor. Boiler makers have a fair share of work.

STONE TRADE.—The master masons and granite workers of Aberdeen have refused $\frac{1}{2}$d. per hour asked by the men. The standard rate of wages is: stonecutters, $6\frac{1}{2}$d., and masons, 7d., per hour.

BUILDING TRADES.—Our Rochdale correspondent writes:—The strike of plasterers continues. The masters have offered the extra $\frac{1}{2}$d. per hour on condition that the men walk home in their own time on Saturdays. This they decline to accept, as also the masters' offer to submit to arbitration.

FLANNEL TRADE.—The quantity of flannel manufactured during the last twelve months is much less than in the preceding twelve months, and there seems little prospect of pulling up.

SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

I.—LETTER FROM A CORRESPONDENT.

Norwegian Carving.—R. B. P. (*Dartmouth Park Road*) writes:—"A friend has just sent me an old Norwegian carved box (exact age uncertain) which offers a good design for wood-carving. I send rubbings of the top and side, which show the ornament, and which, though rude in execution, is very effective. The box opens by a sliding lid, indicated on the rubbing."—[We are obliged for these carving rubbings, which are spirited and interesting. We wish more of our readers, scattered as

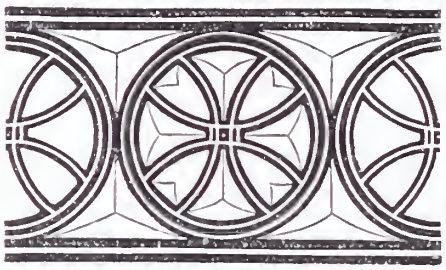


Fig. 1.—Side of Box.

Fig. 2.—Top, showing Sliding Lid.

they are far and wide, would go to the pains of sending us a sketch, rubbing, or small photograph of any quaint piece of wood, stone, or ironwork having architectural, legendary, or antiquarian interest. There must be thousands of quaint bits of this character stowed away in remote corners which would be none the worse for seeing the light of modern days. Should sufficient reach us we might be justified in issuing it in a supplement form instead of in "Shop."—ED.]

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Fixing Crayon Drawings.—W. E. R. (*East Grinstead*).—If the drawings are in the ordinary black and white crayons, which are comparatively hard, the fixing may be accomplished by any of the methods below without much detriment to the artistic effect of the drawing; but if it be a highly-finished work in the soft velvety crayons which are used for the best class of such work, there is a very great danger of reducing the effect of the picture in fixing it. The tints will be degraded, and the relation between light and shade to some extent disturbed. All the methods consist in fixing the chalk to the paper by the application of weak gums. The drawings would be destroyed if the liquid were applied, like varnish, by means of a brush on the front of the picture, so, in the first process, the picture is placed on a table with the crayoned side downwards, and the liquid applied at the back, and allowed to penetrate through the paper to the colours. Several coats may be necessary, with an interval for drying after each application. The liquid used consists of $1\frac{1}{2}$ oz. of best isinglass dissolved in 5 oz. of distilled vinegar, and then added to a quart of hot water. A portion of this liquid, after being filtered, must be mixed with an equal quantity of spirits of wine, and is then ready for use. A weak solution of isinglass with alum added is also recommended for fixing the drawing by immersion—that is, by dipping the drawing into a flat dish filled with the solution. This can be repeated until the colours are found to be secure, and the picture can then be varnished. A third method is to distribute the fixing solution in a fine spray over the surface of the picture by means of one of the common glass scent-sprays; while a fourth method, described in a well-known handbook on the subject, is by steaming the back of the drawing through a perforated rose like that of a watering-can. The directions given are to put 2 oz. of spirits of wine with 2 drs. of powdered sugar-candy into the vessel, and on heating this, to direct the steam over the back of the drawing. For myself, I should feel doubtful about the effect of heating spirits of wine in this way. I have not thought it worth while to give more recipes for the preparation of the solutions, for I have no doubt that if DRAUGHTSMAN went to a good oil and colour shop and stated his requirements, he could buy a transparent paper varnish better and cheaper than he could make it.—A. B.

Bedstead.—JOAN.—The iron is chilled in casting, and you cannot soften it. Better leave it alone or buy a new bedstead.—J.

Suggestion for Cowl.—W. H. M. (*Leeds*).—Your idea of running a cowl upon balls is impracticable, and your tinsmith friend could have told you as much if you had referred the matter to him. I will, as briefly as I can, give some reasons for my decision. In the first place, the cost would be much greater. The extra work in making and fixing the three annular rings or webs, as you term them, would, I am certain, be more than the cost of the ironwork for the cowl. We then have the cost of the balls to deal with. By your plan you only provide for four balls in each space, four for the cowl to run on, and four to keep it away from the side. This is not nearly enough. It would be if your idea of partitions to keep them in their places were admissible; but it is not, for the balls would grind against these, and stop the cowl, especially when it got a little dirty. So, you see, it would require two rows of balls not less than $\frac{3}{4}$ in. diameter. Now, I imagine (and if I am wrong in this, I trust some authority will correct me) that $\frac{3}{4}$ in. steel balls, perfectly true and hardened, could not be bought under 6d. each at the very lowest, and the quantity required to nearly touch all round the outside of a 9 in. chimney would be over thirty, and as twice that number would be required, that would mean 30s. Then, again, the noise it would make running round would be very great, and cause annoyance; smoke and soot would gain access to the balls, and rust and clog them up. You have made no provision for taking to pieces, nor have you shown clearly how you propose to put it together. It is very easy to draw a plan and section on paper, but quite another thing to make an article like it; and I can see difficulties in construction that it is scarcely necessary to enlarge upon here. Revolving cowls have always been, and, I fear, still will be (even the very best of them), a trouble and a nuisance.—R. A.

Covers and Binding for WORK.—J. G. (*No Address*).—The covers are 1s. 3d. each, the cost to bind 1s. 9d., or, including case, 3s.; carriage to and from London additional.

Three-Manual Organ.—F. A. (*London, W.*).—I am afraid that the organ of three manuals and thirty-four stops which you propose to build would prove a costly failure. Reeds cannot be combined with organ-pipes so as to give satisfactory results. It is much more than a question of more frequent tuning, which will not get over the difficulty, as you appear to think. The body and quality of tone derived from reeds are so different from the sounds given by pipes that the two will not balance or sound well together. Before giving credence to all the statements of makers of American instruments, it would be well for you to examine the instruments, and in most cases you would find that, where reeds are stated to be combined with pipes, the so-called pipes are merely very short tubes placed in connection with the reeds, and are in no sense organ-pipes. It stands to reason that if reeds could be efficiently substituted for pipes, the plan would long ago have become pretty general. It has been tried thousands of times, but has been abandoned. The firm you mention has, I believe, combined pipes with reeds on one of their instruments, but I have always understood that they do not stand in tune. I am open to correction if this is wrong. I would urge you not to divide your stops in the centre: it is a most unsatisfactory arrangement on any instrument, and would long ago have been abandoned were it not that so many people think the number of stop-knobs the chief indication of the value of the instrument. If you are so very anxious to use reeds, I would advise you to place them on one manual only, so that you could use them separately when not available with the pipes. You would thus have an organ and harmonium combined in one case, but

the occasions on which they could be used together would be few and far between. If, as appears from your letter, the cost of pipes puts it out of your power to acquire them, I would remind you that very satisfactory pipes can be cheaply and easily made of paper. You do not say how large your room is; but I note that the space in which the organ is to stand is only 9 ft. 6 in. high. In these circumstances, it would be absurd to think of having stops of 32 ft. tone, as it may be taken as an axiom that if there is not room for pipes of the requisite size, there is not room for stops of the tone they would give. In conclusion, I would strongly advise you to make yourself better acquainted with the subject of organ building, and then re-cast your scheme in the light of the knowledge thus attained. The task you have set yourself is of much greater magnitude than you think it.—M. W.

Combined Chest of Drawers and Bookcase.—S. P. (*Sunderland*).—If you procure the index of each volume of WORK, you will then be in a position to note the numerous designs for bookcases and drawer chests which have from time to time been placed in "Shop" and elsewhere. It will need nothing more to fulfil your desires, as I interpret them, than to select the upper portion of one of the bookcases, and materialise it as a separate carcase placed upon a rather shallow chest of drawers.—J. S.

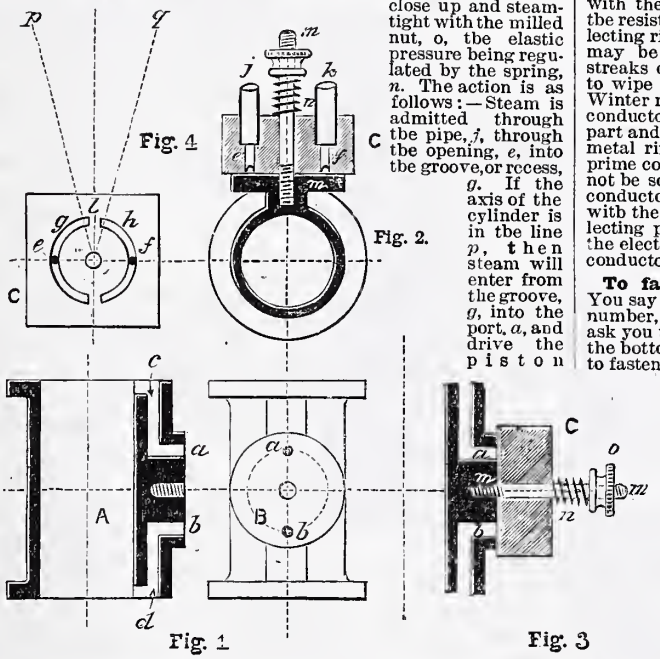
Electric Bells.—R. M.—(1) Arrangement of bells as shown in your diagram is named arranging in series. As trembling bells can rarely be got to beat in unison, the result of this arrangement would be unsatisfactory. If arranged in parallel to all ring at once, the No. 2 Leclanché cell will not furnish enough current. (2) If the bells are arranged as directed below, a battery of four No. 2 Leclanché cells will be sufficient. (3) Three of the ordinary trembling bells will do without any alteration except that of adjusting the contact screws to get best effects. (4) It does not matter in the least which way the current goes from battery to bell, providing all are connected on the same system to one battery. I think you will find the following arrangement suitable for your requirements. Have a bell on each floor, and a separate pressel in the office for each bell: No. 1 bell on top floor; run a wire from battery to bell, then back from bell to push, and wire from this to battery. No. 2 bell on next floor; run a branch from main wire into bell, then a separate wire back to a separate push, and connect this to wire from push No. 1. No. 3 bell on lower floor; connect by branch to main as No. 2, then wire back to office to separate push, and from this to wire of No. 1 push. By this arrangement you can signal the foreman on each floor by pressing appropriate button, and your bells will keep in order a longer time than by any other arrangement.—G. E. B.

Electric Gas-lighter.—GAS-LIGHTER.—Your gas-lighter is a modification of the ordinary electric gas-lighter with two cylinders, and is constructed on similar lines to that of a frictional electric machine. The revolving disc of hard rubber or vulcanite is an adaptation of the same principles of construction as those employed in the plate electrical machines, the brass quadrant taking the place of the brass or tinfoil sectors on one of those machines. The little brass knobs or rivet-beads in the upper fixed disc are probably knobs or knots of wire cord, which must touch the brass quadrants of the disc below, and thus perform the part of collectors. If you fasten on the little triangular pieces of brass to the disc again as they were before, I think you will find the machine work all right, for all the other parts appear, from your letter, to be properly connected. The brass quadrants are not to be connected by tinfoil.—G. E. B.

Motor or Engine to drive Two Lathes.—F. S. (*Pimlico*).—You ask for instructions for making an engine to drive two lathes. The ¼ horse-power engine described in Nos. 106, 110, 121, 125, 131, 136, 145, 149, would drive them if they are not more than about 5 in. centres, and if you used a pressure of not less than 50 lb. or 60 lb. per square inch. But as you still ask for instructions, and can hardly expect eight more articles to be written on a larger engine, could you not use the directions given for the ¼ horse-power engine, enlarging them by one-half so as to make the cylinder 3 in. in diameter instead of 2 in.? Thus you would have an engine of ample power.—F. A. M.

Observatory Hive.—F. E. (*Kerry*).—I conclude you want to see as much as possible of the working of the bees in the observatory hive you propose to construct. You must remember that an observatory hive is a very bad domicile for a stock of bees, and the better it is for observation the worse it is for the bees. You might make a box of glass something like an aquarium, 14½ in. long, 15 in. wide, 8 in. deep, inner measurement, without top or bottom, and it would accommodate the ten frames you require, but the work carried on between the combs would be quite beyond your vision. The best plan would be to confine your attention to a hive capable of holding only three or six frames, and make them to hang one deep, so that you could see both sides of the combs. I cannot refer you to the exact number, but in a former number of this magazine I described the construction of such a hive in "Shop." If you look through the index of the last volume you will find it easily. My back numbers are inaccessible at present.—APIS.

Double-Action Cylinder.—W. W. (*Gravesend*).—Figs. 1 to 4 illustrate the method of making steam and exhaust ways in cylinder and steam block. Fig. 1 illustrates the cylinder in longitudinal section, A, and in plan view, taken upon the port face, B. Port openings *a* and *b* are drilled in the face, B, to meet the steam ways, c, *d*, drilled through the passage block cast upon the cylinder body. Fig. 4 shows the steam block, C, in face view. It is also seen in its relation to the cylinder in Figs. 2 and 3, with which it must be compared in the following description. The block is pierced with two holes, *e*, *f*, in communication with the steam inlet pipe, *g*, and the exhaust pipe, *k*, respectively. There are two grooves, *g*, *h*, nearly, but not quite, semicircular in the face of C, the grooves stopping short of the centre line to leave a little bridge of metal, *l*, *l*. The face, B, of the cylinder is held against the face of the steam block, C, with a pin, *m*, tapped into B, and passing freely through a hole drilled in C, and kept close up and steam-tight with the milled nut, o, the elastic pressure being regulated by the spring, *n*. The action is as follows:—Steam is admitted through the pipe, *j*, through the opening, *e*, into the groove, or recess, *g*. If the axis of the cylinder is in the line *p*, then steam will enter from the groove, *g*, into the port, *a*, and drive the piston downwards. The axis of the cylinder will move round towards the line *g*, and the steam will be cut off at the upper bridge, *l*. At the same time, whatever steam was in the bottom of the cylinder will be exhausting into *h*, out at *f*, and away through the pipe, *k*. As the axis of the cylinder goes on towards the line *g*, the port, *b*, will be coming over the recess, *g*, and steam will enter at the bottom of the cylinder, driving the piston *upwards*, and the steam above the piston will exhaust into *h*, and so out at *f*. This is the cycle of operations in such an engine—if we may dignify a toy by such a term. A correct model of a slide-valve engine would, however, be more worthy of the attention of the readers of WORK.—J.



Double-Action Cylinder. Fig. 1.—A, Section of Cylinder; B, Plan of Port Face. Fig. 2.—Cross Section through Centre of Cylinder and Steam Block. Fig. 3.—Longitudinal Section through Cylinder Ports and Steam Block. Fig. 4.—Face of Steam Block.

Armstrong Glass.—JERSEY.—The only address I can find is Armstrong Glass Co., Albion, Birmingham; but I should think this will find them.—L. W. F.

Poster Painting.—S. J. H. (*Leicester*).—Articles on this subject will be taken in hand at once, and will shortly appear.—H. L. B.

Printing Transfers for Pottery.—A. E. S. (*Glasgow*).—The inks used for printing these are, I believe, made in the same manner as ordinary china-painting colours, and thinned to the proper consistency with boiled linseed oil. The common blue is stated to be made with oxide of cobalt, ground flint, and sulphate of baryta, fused together, reduced to powder, and mixed with a flux of ground flint and thick glass powder. I am not aware that the paper used is anything more than a thin, unglazed, yellowish paper, and imagine that A. E. S. will find preparing these inks a thing which no amateur can hope to do successfully.—S. W.

Fixing Cloth on Iron.—LUDLOW.—The property of doing this is claimed for Le Page's carriage glue. Try it.—M. M.

Upholstery.—J. A. S. (*Nottingham*).—Much on Upholstery has already appeared in WORK. Consult indices to Vols. I., II., and III. When a thoroughly competent man presents himself, the subject shall be treated in every branch.

Frictional Electricity.—J. W. T. (*Huntingdon*).—It is difficult to say what causes the escape of electricity you complain of. See that you have a good earth contact by means of a suitable length of brass chain or spirals of wire attached to the gas-pipe of the room in which the machine is worked. If you darken the room you will most probably be able to detect the weakest part of the machine. See that the rubbers do not press too hard against the plate, and bear in mind that a high rate of speed develops only a small amount of electricity, a large machine requiring to be turned slower than a small one on account of the greater surface area. The amount of electricity developed depends largely upon the state of the atmosphere, as a damp or wet day will be found to exert a marked influence on the quantity developed. Are you sure that the machine is entirely free from dust? Electricity is continually attracting dust from the air, and these dust particles act like so many points or vehicles for the escape of the fluid. Use fresh clean amalgam of good quality, and not too hard, with as little grease as possible: only just sufficient to cause the amalgam to adhere to the rubber—ordinary raw suet will answer the purpose very well. When too much grease is used with the amalgam, it will be liable to cause the electricity to be carried round with the plate, as it will be unable to overcome the resistance by leaping on to the pins of the collecting rings. The presence of an excess of grease may be known by the appearance of metallic streaks or rings on the plate; it is, therefore, wise to wipe these away as soon as they appear. The Winter ring is merely an enlargement of the prime conductor, and, to all intents and purposes, forms part and parcel of the latter; consequently, the large metal ring must be in metallic contact with the prime conductor and its collecting rings, but it need not be soldered. All the brass work of the prime conductor should be lacquered with good lacquer, with the exception of the extreme points of the collecting pins; these should be left bare, otherwise the electricity will not pass, as the lacquer is a non-conductor.—C. A. P.

To fasten Soles, etc.—T. M. A. (*London*).—You say you are a reader of WORK from the first number, therefore it will not be troubling you to ask you to turn up No. 137, Vol. III., and there, at the bottom of the first column, page 516, "The way to fasten the felt in" is explained. Your next question, "How to fasten the sole to the welt without showing any traces of it when the boot is finished," I will briefly answer, for it is very simple. When you place the sole on the boot, it should be mellow (damp), and by pressing with the thumb and finger of both hands all round the edge, it can be made a little concave; this, when it is pressed down tight in the centre, will cause it to fit to the welt all round. The edge of the sole can be put just flush with the welt at the toe, and then a tack driven in at the other end (the heel). The boot is then held (heel to the left, toe to the right) on the knees with the left hand, and with the right cut the channel for about ½ in. at the centre of the toe, as shown in the above-named article. Open it, as there shown, and, instead of putting your nail in at A (Fig. 5), put it in these sections of the channel, and, if you like, when you have pared up the edge, you can put another in each side. As to the question whether soles sewn right through are as strong as those sewn in a channel—whichever is adopted, they should be stitched, not sewn. But to answer you will tell a great many readers what they ought to know: and that is, that those stitched through are the strongest, for these reasons—it is the wax and the thread that lay through the sole that give the strength, not, as is often supposed, the stapled end on either side; and also because the channelling reduces the substance that these cross strands have to lie in.—W. G.

Desk Hinges.—EUCLID.—I have inquired of a great many ironmongers and travellers I know, but I have not been able to discover the makers of the hinges you want. Most scholastic furniture makers have their own special hinges, which are made solely for them, and very likely your particular hinge is one of these. One way to treat blackboards is to (1) prime them with a good coat of oil paint in the ordinary way, and then (2) colour them lead colour, rubbing down between each coat; next a (3) coat of drop black, mixed with japan, gold size, and turps, in the proportion of three of gold size to one of turps. After rubbing this coat down, give the boards another coat of the same black, with about one-third of its weight of finest powdered emery mixed with it. I should strongly advise you to keep your back numbers. You would find them very handy at times; in fact, it would pay you to get them.—E. D.

Magnetic Belt.—J. G. (*Edinburgh*).—The magnetic lines of force are always the same from the small magnets in your belt, whether you sweat or do not sweat. It does not need acid nor sweat to make magnets work. This you may find out for yourself if you bring the belt near a small compass, for the needle of this will be deflected by the magnets in the belt at all times, whether the belt be damp or dry. That your feelings may vary at different times I am prepared to admit, but these variations prove nothing in favour of or against the use of the belt. The variations of feelings may be

due to dozens of causes apart from the belt. The best steel for the magnets of these belts is stiff crinoline steel of hard temper. It is not necessary to have a horseshoe magnet to magnetise these strips of steel. They may be magnetised by stroking them over a bar magnet, and this may be made by enveloping the bar of steel in several convolutions of insulated wire, and sending an interrupted current through the wire. The current from your Leclanché battery will do, and the wire may be of any size from 20 to 30. The north poles, or the north-seeking poles, should point downward.—G. E. B.

Magnetising Steel.—F. J. (*Oldham*).—Steel may be magnetised by three different methods, named respectively single touch, double touch, and electric induction. Magnetising by single touch is effected by stroking the steel with a permanent magnet. The north end of the magnet is placed on the middle of the steel bar, and drawn slowly to one end, then lifted, and again placed on the middle. This motion is repeated several times—say, a dozen or more. The opposite end of the bar is then stroked in a similar manner with the south pole of the magnet. Magnetising by double touch is effected in a similar manner, using two magnets at the same time, placing both on the middle of the steel bar, and drawing them simultaneously to the ends. This method is not only more expeditious, but also makes a stronger magnet. Magnetising by electric induction is effected by winding over the bar several coils of insulated copper wire, and sending a frequently interrupted current of electricity through the coil for several minutes. Steel bars may be easily magnetised by stroking with them the field-magnets of a dynamo electric machine.—G. E. B.

Cleaning Electric Bell Battery. — H. B. (*London, N.*).—You have done quite right in washing the cells in warm water and scrubbing the zinc rods to free them from loose dirt. The ends of the wires should be cleaned by rubbing them with emery-cloth, and the parts of the screws to which these wires are fastened must be cleaned in a similar manner, so as to have clean metal touching in every part. The outer jars are not to be charged with acid, but with sal-ammoniac dissolved in water until the water will not take up any more of this substance. Probably the jars will take 3 oz. of sal-ammoniac to each jar. It is a whitish salt in large crystals, obtainable at any Italian warehouse. No solution is required for the inner cell, as the sides of this are porous, and the outer solution soaks into the pores. If the battery will not ring the bell after being thus cleaned and re-charged, the inner cells may be worn out, and must be renewed.—G. E. B.

Petroleum in Boiler. — "Through." — The boiler described by our correspondent is far too small to be heated by petroleum, otherwise than by a lamp or burner, which will give a local concentrated heat. We should feel inclined to use coke, and turn the exhaust from the engine into the chimney—which is full small for the size of the fire-box—and see what that would do, breaking the coke into pieces of the size of a nut. We believe it might be adapted to burn benzoline with a suitable apparatus, which would generate an intense heat in the box; but this stuff is so highly inflammable and dangerous, that it would require to be in the hands of a manipulator well skilled in its use, to avoid the chance of accident. If our correspondent will try coke with the exhaust into the chimney, and let us know the result, we will then see what is best to be done. Possibly it will be found necessary to use a larger chimney—say, 2½ in.—to obtain the desired result; but the exhaust from the engine with coke should produce better results. At any rate, it is worth trying, and will not make matters worse.—C. E.

III.—Questions Submitted to Readers.

**** The attention and co-operation of readers of* Work *are invited for this section of "Shop."*

Roller Skates.—J. B. (*Glasgow*) writes:—"Will any kind reader of Work inform me how to make a pair of roller skates?"

Musical Glasses.—Musical writes:—"Would any reader of Work kindly inform me what sort of glasses are used for making a set of 'Musical Glasses,' and if they are tuned by putting water in them; and what is the stuff to put on the fingers to make them play by rubbing round the top?"

Razor Setting. — Village Shaver writes:—"Will any reader please give me information on the art of razor setting and stropping correctly? Also, where could I procure the necessary materials for above, and the proper method of using the cavalry strop?"—[You should consult Work, No. 105, page 7.]

Gold and Silver Braid.—Admirer of "Work" writes:—"Will someone who has had experience kindly advise what is the best thing to clean the silver ornaments and braid on officer's uniform, to give them that beautiful *dead white* appearance; also gold ones; how to apply it, and where it can be obtained?"

Horse-hoof Parings.—M. (*Holloway*) writes:—"Can any reader kindly inform me how to dissolve these, and, if there are different ways, the quickest and the best?"

Canvas Canoe. — W. F. (*Glasgow*) writes:—"Will any reader kindly inform me through 'Shop' how to make a canvas canoe?"

Printing, Paper, Stationery, etc.—G. L. (*Poplar*) writes:—"Will any reader kindly give particulars of a book or books on the above subjects, containing technical terms used in printing, and signs used for alterations of proofs, etc.; and hints how to tell different kinds of paper?"

Wind Wheel Driver.—Young Smith writes:—"Will some kind reader inform me whether there has been any invention brought out in the way of a wind wheel for the purpose of driving small machinery, such as a small lathe or chaff-cutter, etc.? Plans of same, or the address of makers, would oblige."

IV.—Questions Answered by Correspondents.

Sash Beads.—Nil Desperandum writes, in answer to H. F. (*Ramsbury*) (see No. 171, page 238):—"I send the following instructions and sketch, the latter not being drawn to any scale:—To determine the necessary bevel at the head for the casement to open, draw a line from the centre of pivot to X, or back of rebate. Then make X Y square to this line; this will give the splay required for the casement to clear when opened. To cut the beads, draw the casement when open with bead

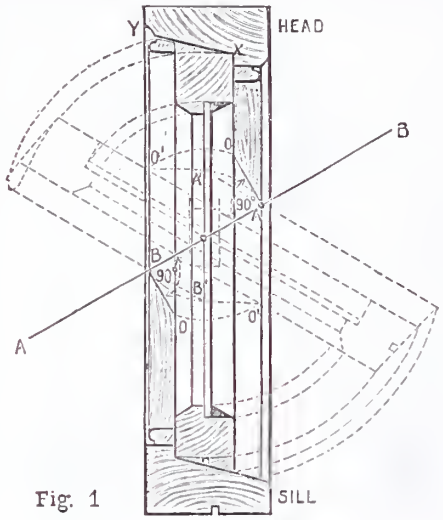


Fig. 1

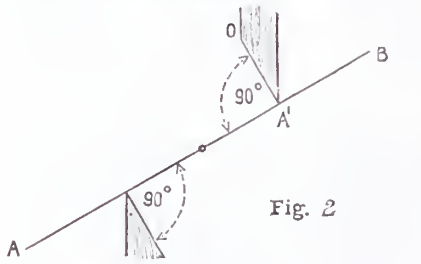


Fig. 2

Window Sash Plan.

lines on; then from the centre to A draw a line, and make this line, and the line, A O, at right angles—viz., square; B O is the same, and A' O' and B' O' show the points when the sash is open. The portions of the beads shown by the grain of the wood are fixed to sash frame, as also are the outside bead at head, and inside bead on sill. The remaining portions, including inside bead at head (and outside bead at sill, if there were one fixed), would require to be nailed on to the sash itself and to open with it."

H. E. B. Monogram.—W. J. B. (*Londonderry*) writes:—"The monogram H. E. B. (see Work, No. 165, page 142) was sent for Win by me, and not by F. J. K. (*Tufnell Park*), as stated."

Drawing.—D. B. Y. (*East Grinstead*) writes, in reply to Reader (*Clonmel*), to say he may be able to assist him if he gives more particulars.

Paint.—G. P. (*London, S.E.*) writes to C. J. (*Chester*) (see No. 172, page 253):—"Balmain's luminous paint is on sale at the Crystal Palace. An agency has long been established there."

V.—Letters Received.

Questions have been received from the following correspondents, and answers only await space in Shop, upon which there is great pressure:—Spirits; E. D. (*West Kensington Park*); Phono; W. W. (*Gravesend*); J. H. (*Bradford*); W. McS. (*Glasgow*); Leo; A. L. C. (*Camberwell*); A. W. R. (*Kilburn, N.W.*); V. W. (*Dewsbury*); R. T. (*Barnsbury*); C. E. F. (*Clapham, S.W.*); W. S. L. (*Canning Town*); J. S. Q. (*Paris*); H. G. C. (*Axbridge*); J. W. M. (*Birmingham*); H. S.; J. P. (*Newcastle*); Porzee; C. R. (*Acton, W.*); W. A. (*Nactan*); T. P. (*Bray*); A. D. S. (*New Brighton*); A. T. (*London, N.*); A. S. A. (*Aberdeen*); W. N. (*No Address*); H. S. A. (*Crewe*); W. M. (*Saltley*); W. B. (*Northam*); P. K. (*Gateshead*); Painter; E. L. (*Wakefield*); Young Sportsman; Fish; Joiner; J. W. B. (*Castleford*); Oxy; Try Again; J. B. (*Widnes*); W. J. D. (*Manchester*); F. P. (*Bristol*); High Press; J. B. (*Ashton-under-Lyne*); Zetetic; A. M. R. (*Golden Square*); M. A. & Co. (*Nottingham*).

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NOTICE TO READERS.

Next Week's issue (No. 181) will contain, among other interesting articles—

Jewellers' Enamel and Enamelling.
How to Make a Check Cash Till.
Stage Draping and Draperies.
Dividing Flower Tub.
Bachelor's Bookcase.
Cleading Vertical Boilers.

*** The Editor makes this intimation in the hope that readers, having friends interested in any of these subjects, will bring the same to their notice.

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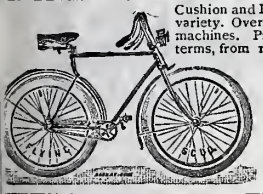

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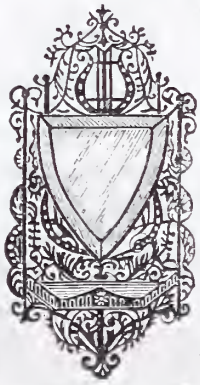

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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VOL. IV.—No. 181.] SATURDAY, SEPTEMBER 3, 1892. [PRICE ONE PENNY.

WORK WORLD.

A VALUABLE bed of coal has just been traced at Ashton-under-Lyne, which is estimated to yield over 230,000,000 tons.

* *

In one day the human body generates enough heat to melt forty pounds of ice and raise it to boiling heat. A marvellous machine this human frame!

* *

A scheme for amalgamating all the building trades in Philadelphia makes progress. The idea is to avoid strikes, and more agreement between employers and employed.

* *

Wood properly treated may be moulded in blocks in the shape of bricks. A hotel built in Hamburg, entirely of compressed wood is as hard as iron, and rendered absolutely proof against fire and the attack of insects by chemical processes.

* *

Krupp, of Germany, will exhibit at the World's Fair the biggest cannon ever constructed. It will weigh 122 tons. The special car on which the cannon will be shipped will itself weigh nearly 20 tons, so that almost 142 tons will be comprised in a single load.

* *

At last the dry collodion process plates are on the market. The advantages which they possess cannot be disputed:—a clear glass in the shadows, suitableness for lantern slides, fine results in copying, freedom from halation, and rapidity in the developing and washing processes.

* *

An idea is on foot for a trial of speed of English and American locomotives between New York and Chicago during the Columbian Exposition. The plan is to bring over an English engine of the latest pattern, with fuel and crew included, so that the test may be fair. Given equal conditions, we believe the English would win on all points—easily.

* *

"Sand Cement," made by mixing hydraulic cement with sand, gravel, or ballast, has been patented. The idea of "hydraulic" cement is novel. We know of cements that resist the action of water—all limes that burn buff colour do this; the best is the barrow lime of Leicester—but water-pipes made of cement would be new to us. Where was the inventor's adviser?

* *

Diving dresses in the pearl fisheries of Tahiti are to be abolished, as being injurious to the interests of the natives who depend upon that industry for their living. It is also considered unadvisable to fish at greater depths than ten fathoms, as beyond that the shells are mostly important for reproduction, and to destroy them will be to ruin the fisheries.

* *

In an electric arc the positive pole is hotter than the negative, the positive showing a temperature of about 4,000° C., the negative showing a temperature of 3,000° to 3,500° C. This difference of temperature produces a counter electromotive force which acts like ohmic resistance. The cause of the positive pole wearing away twice as fast as the negative is due to this difference in temperature.

* *

Some trials of anti-fouling paints upon English warships show that a French composition introduced by our Naval Attaché at Paris is likely to be largely adopted. It was applied to the hull of the *Camperdown*, which vessel, when recently docked at Portsmouth, after a ten months' cruise as flagship of the Channel Fleet, presented an exceptionally clean and satisfactory appearance. The composition is to be again applied to the vessel.

* *

In a new pneumatic tool for caulking the joints of steam boilers, a chisel edge is given a rapid reciprocating motion by the action of a small piston driven by compressed air. Held in one hand, the instrument requires little pressure to keep it to its work. Some hundreds of blows are struck per minute. One feature of the appliance is that it can be used in awkward places where it is difficult to use the ordinary hammer and caulking tool.

* *

The lifting of a railway station has been accomplished at Frodsham, in Cheshire. The station being too small for the joint lines running into it, and in order to obtain increased platform accommodation, it was decided to remove the station-master's house, booking-office, and general waiting-rooms about 6 ft. back. With the aid of eleven powerful jacks, the whole erection, weighing about 400 tons, was moved *en bloc* into its new position. A cracked chimney stack only marred the operation.

* *

Engineers, when letting eccentric straps together, should have a trammel gauge or piece of ¼ in. wire turned down at each end and sharpened at the points. When the engine is in good order a centre mark should be made on the stuffing-box, and another on the slide-rod or eccentric-rod, then make the trammel gauge to suit this distance when the engine is on one of its dead centres. This will save time; the slide-valve can be lined up, without breaking the joint of the steam-chest cover, by placing liners at the foot of the eccentric-rod.

* *

An instrument for testing the magnetic properties of iron and steel has been invented. An aluminium wire, 30 in. long, suspended vertically by a wire, carries at the top a magnet fixed at right angles thereto. The lower end carries a light fork, across which a fibre is stretched to carry a mirror at right angles to itself. The specimen of iron is placed in a magnetising coil near the mirror, and the current also passes through a coil placed near the upper magnet. The motion of the mirror is observed by the aid of a spot of light which, as the current is varied, traces out curves of magnetic variation.

* *

Temperatures in deep borings in America are interesting. One boring, 5 in. in diameter and 4,500 ft. deep, lined with iron pipe, was dry except where water had accumulated at the bottom. It was found that the temperature became higher by about 1° Fahr. for every 82 ft. increase of depth. As the boring was continued, the increase of temperature became somewhat higher; at a depth of 4,462 ft. it was 110·15° Fahr., that at the surface being 51°. No law can be formulated on the subject, because the crust of the earth is not homogeneous. In the instance cited the fact of the bore-hole being lined with iron may have rendered the thermometer readings inaccurate.

JEWELLERS' ENAMEL AND ENAMELLING.

BY H. S. GOLDSMITH.

EXTRACT FROM SYLLABUS OF THE CITY AND GUILDS OF LONDON INSTITUTE FOR THE ADVANCEMENT OF TECHNICAL EDUCATION—DEFINITION OF AN ENAMEL: ITS QUALITIES AND USES—CLASSES OF ORNAMENTAL ENAMEL—CHAMP-LEVÉ, CLOISONNÉ, AND ENAMEL PAINTING, ILLUSTRATED BY DIAGRAMS AND EXAMPLES OF HOLBEIN WORK—JEYPORE ENAMELS—FRENCH CLOISONNÉ.

THESE short papers were written as an attempt at giving such information to the students of the ordinary grade of goldsmiths' work as would be useful to them in the course of their business, as well as in their examination for prizes and certificates next May, and to deal with matters not spoken of in their text-books.

In the syllabus issued by the "City and Guilds of London Institute for the Advancement of Technical Education" the subject is mentioned in these words:—"Enamelling. — Difference between champ-levé, cloisonné, and enamel painting, with some account of their principles and practice."

The writer asks leave to state that the following remarks will not be strictly and rigorously held within such bounds as may seem to be defined in the above quotation; for liberty has been taken to refer to other—but, it is hoped, not irrelevant—matters.

Definition of an Enamel.—Enamelling—at any rate, for jewellers—can be defined as an opaque or transparent *vitreous glaze* fused to a *metallic* surface. It is used by goldsmiths to embellish jewellery, by giving variety of colour and surface to the different ornaments; and it is used by other trades for other purposes: from enamelling a street-sign or the number of a cab to lining a saucepan. With us it is employed mainly for its artistic qualities, on account of the many beautiful colours it can give us; with others, its more prosaic, but not the less valuable, qualities of permanence and non-corrosiveness are more valued, as the readers of WORK well know.

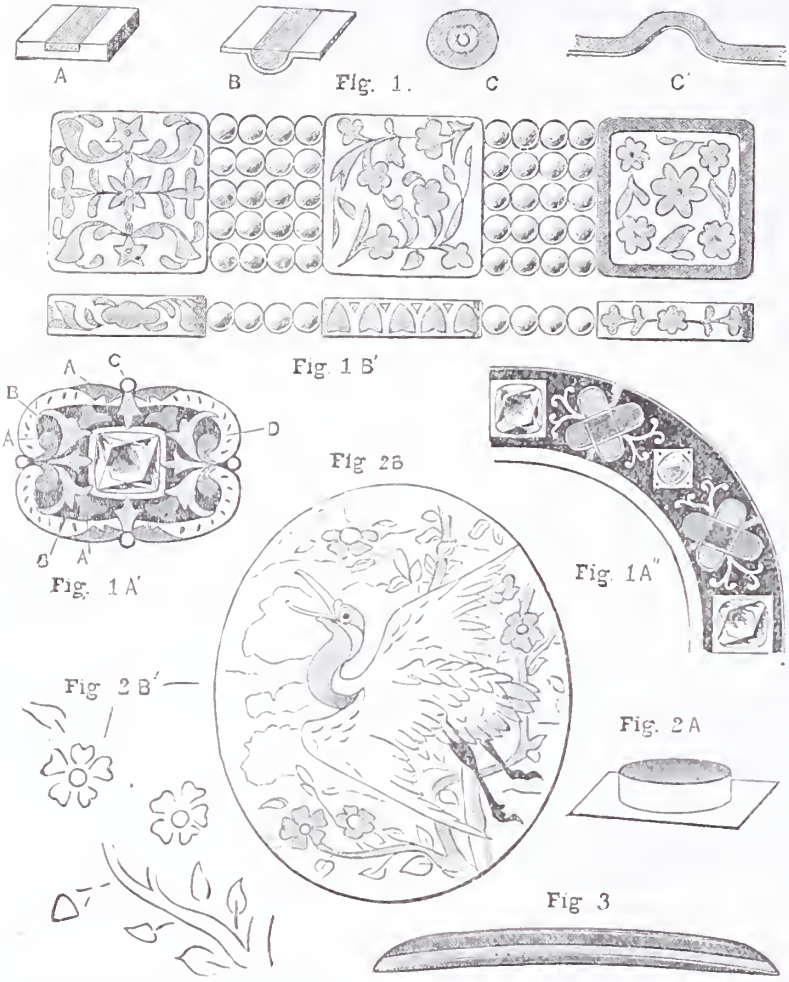
Classes of Enamel Work.—The first two terms made use of in the extract from the "City and Guilds' Syllabus" are *champ-levé* and *cloisonné*. These are the names of two classes into which enamels are divided, but they refer entirely to the way in which the work *is prepared for the reception of the enamel* (Fig. 1, A, B, and C C′, and Fig. 2, A, show them in their simplest form), while enamel painting deals *with the surface only* of an already prepared enamel plaque (shown diagramatically in Fig. 3).

Enamel Painting is a process in itself very much like water-colour painting: the colours are laid on in a powdered condition with a volatile oil, just as water-colours may be laid on paper with water as a vehicle. The difference is that enamel colours are fixed, and to a great extent *developed*, by fire, while water-colours undergo no further development. More will be said on this subject later on.

It being understood that enamel painting has to do with the surface of a piece of enamel, and that the two terms champ-levé and cloisonné have to do only with the form of the supporting material, it follows that an enamel painting may be a cloisonné or a champ-levé enamel as well as an enamel painting: not that enamel paintings are, as a rule, done on plates prepared *à la cloisonné*, but on a plaque of gold or copper, encrusted with two qualities of enamel under certain defined conditions.

The two French terms *champ-levé* and *cloisonné* seem to ask for an explanation of their meaning. Champ-levé means that the ground or field which is to support the enamel is either chased into hollows, if the metal is thin (Fig. 1, B), or has hollows dug out if the metal is stout enough (Fig. 1, A); the hollows or grooves being, of course, made of the desired pattern that the enamel is to take.

Champ-levé enamels, then, will be those where the surface of the article is altered to a suitable condition to receive the enamel, either by the formation of grooves, hollows, or shelves; and the same name is given to enamel work even when the article is quite, or only partially, enclosed in enamel (Fig. 1, C, etc.), this last mentioned being more often called the Cinque-cento or Cellini style when applied to boldly-modelled ornament. It is well shown in several enamel articles in the South Kensington Museum, but particularly in a book-cover or case for a missal said to have belonged to Henrietta Maria, Queen of Charles I. (No. 736.64). It is at present in the Prince Consort's Gallery, where also is the small cup we shall shortly refer to.



Jewellers' Enamel and Enamelling. Fig. 1.—A, Simplest Form of Champ-leve Enamel—*i.e.*, with hollow cut out; A′, as applied in an Enamel Brooch of Holbein; A″, as applied in the Modern Holbein Work; B, Another Form of Champ-levé, where the Metal is chased into Hollows of the desired Shape; B′, as applied in Indian Work: the sketch is taken from part of a Necklace; C, C′, a Third Form of Champ-levé, the Enamel encrusting or enclosing the Metal, either partly or entirely. Fig. 2.—A, Simplest Type of Cloisonné Enamel—a Cloison filled with Enamel; B, Drawing of a French Cloisonné Plaque; B′, Lowest Branch of same, showing how Wires or Ribbons are shaped to form Cloisons and the Number of Pieces (Thirty-three). Fig. 3.—Section of an Enamel Painted Plaque—1st Top thin dark Layer represents Enamel Paint; 2nd Layer is the Enamel Ground; 3rd, Metal; 4th, Enamel for strengthening purposes.

All the parts of Fig. 1 are mere diagrams, to illustrate the variations in their simplest possible forms.

Holbein Style of Enamel.—Of the two more ordinary varieties of champ-levé three examples can be shown. Fig. 1, A′, is a copy from some genuine designs of Holbein; and if it were made up in what we call the Holbein style, the varied pattern would be brought out in many different colours of enamel: such as green, red, white, black, and blue.

A genuine sketch has been preferred for evident reasons, but it would hardly be fair to pass over the modern Holbein work, in which stones in raised settings are alternated with a severe and ugly form (as shown in Fig. 1, A″.)

This shape is more or less toned down by varying the colours of the enamels in the five partitions, and would probably have a few scrolls running from it. The scrolls might be gold and the ground black; but there is nothing fixed with regard to this class of work, except that a good contrast of enamel colours and of gold was to be attained.

The plate to form the article would be either flat or in some simple raised form; the enamels would be run into hollows that were engraved out, and the whole of the enamel polished off quite smooth, this being in complete contrast to the raised or Cinque-cento style, shown in its simplest form in Fig. 1, C.

Indian (Jeypore) Enamel.—For an example of champ-levé, where the ground is chased into hollows, the best example is Indian work.

The sketch, Fig. 1, B′, is the back view of part of a necklace, two squares out of sixteen, with pearls connecting them. The colours would most probably be crimson for the flowers and green for the leaves. There are dozens of examples of this sort of work in the Indian section of the South Kensington Museum, and they are to be met with in nearly all art collections.

The gold used is very nearly pure, and is extremely thin. The purity, combined with

its tenuity, of course greatly facilitates the formation of the different-shaped hollows, and also brings out the enamel colours in their highest degree; but being too weak for wear, it is always filled in with a pitch-like substance before the stones are set in.

Cloisonné (or in cells).—This term comes from the French word, "cloison" (a partition wall); and, as one would expect, for this class of work the surface is divided into separate parts by soldering properly shaped partitions or ribbons at right angles to the surface, so that different enclosures are formed. This is sometimes called filigree enamel, or Byzantine style. Into these enclosures, or "cloisons," the enamel is fused.

The best examples of modern cloisonné are produced by the Japanese and the French, the latter using it for jewellery to a great extent, and the former for many other articles, vases included; and on some of the vases the work is even finer than the French put on their jewellery, fine as that is.

The finished example given here (Fig. 2, B) is sketched from a series of four stages, showing (1) the design, (2) the gold plate with cloisons soldered on, (3) first stage of enamelling, (4) the finished article. These were presented to the South Kensington Museum by Monsieur A. Falaize, aîné, and are numbered 1772 to 1772c.—69. They are at present in the Western Galleries, where most of the modern jewellery is.

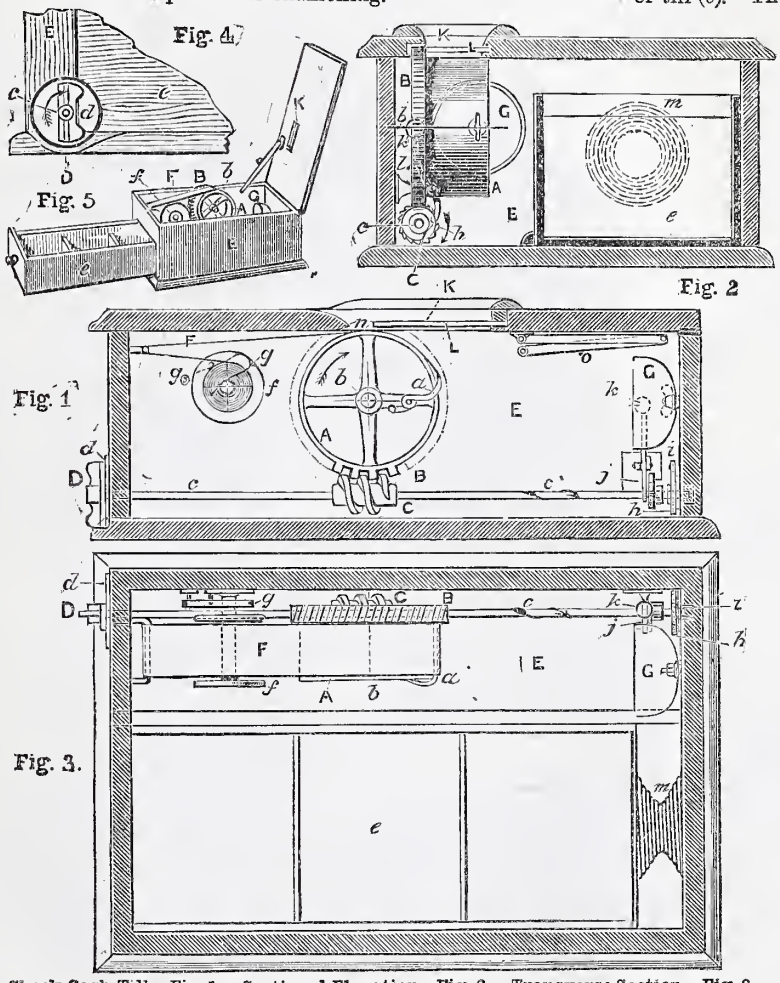
To give a clear idea of the number of pieces that go to make up a cloisonné enamel, the lowest branch is here shown (Fig. 2, B′) separated, and thirty-three pieces are in that portion alone. The full number can be counted by anybody curious in the matter, and possessed of sufficient patience to make a pilgrimage for that purpose to the Museum.

The finest examples of Japanese cloisonné are now seen in the shop window of Messrs. Halstaff & Hannaford, Regent Street, W. The jars are decorated with a minuteness and refinement almost incredible.

These two classes of enamel work—champ-levé and cloisonné—have both the same practical object in view, which is the formation of cells to keep the colours separated and to protect the enamel, by giving depth to obtain a firm hold, as well as to guard it from risk of danger by blows on its thin edges. Depth is also required to obtain richness of colour in many cases. Less depth is required than would be thought necessary by most people; but slight as it is, it does away with the extremely thin and weak edge that an enamel would naturally have if left in the condition that it would take after being fused.

Cloisons.—The partitions (Fig. 2) which give the name to the cloisonné enamel are not always made of *flat* pieces soldered at right angles to the work. The cloisons are still cloisons even if round or twisted wire is used to form the partitions; and so that the enclosed spaces, the cells, or the compartments for the reception of the enamel are placed *on* and fixed *to* the work, it will belong to the "cloisonné" style; while if the base *itself* be prepared by cutting a portion out, or by being chased into hollows, or is enclosed in enamel, then the title "champ-levé" will belong to it.

The next paper will deal with the more uncommon varieties—with false enamels and niello; the third with the preparation of work for enamel; the fourth with the process of enamelling.



Check Cash Till. Fig. 1.—Sectional Elevation. Fig. 2.—Transverse Section. Fig. 3.—Plan, Lid removed. Fig. 4.—Front View, showing Handle for working Mechanism. Fig. 5.—Perspective View, showing Till and Top open.

TRADESMAN'S CHECK CASH TILL.

BY P. B. H.

There are several kinds of tills in use to prevent robbery by assistants. The principle is, however, somewhat the same in all: so I will, with the above drawings, describe the interior arrangements of one of the many. I may here say that most of these machines are patented, but I have no doubt one could alter the mechanism and arrangement to overcome the difficulty. The drawings herewith respectively numbered 1 to 5 will give a clear idea of the mechanism by which check tills are worked. A is a turned metal hollow roller about 5½ in. diameter, round which the paper for the accounts is gradually wrapped, and to which it is first held by means of a small spring clip (*a*) fastened to one of the arms. This roller, the width of which depends on the width of paper required—which latter should be first settled by the quantity of figures and writing required in one line—turns on a shaft (*b*), to which is also fixed a worm wheel (B), driven by means of a worm (C) fastened to a longitudinal shaft (*c*), which latter projects through the front end of the till, and is carried therein by a suitable bearing. On this projecting end is fixed the brass polished handle (D), the shape of which can be best seen in Fig. 4, as well as the brass circular segment plate (*d*) against which it works, and which is fixed, part on the box (E) and part on the drawer or till (*e*). The worm (C) should be single-threaded, and the pitch should, in this case, where the worm wheel and cylinder are almost of the same diameter, equal the space between two lines of figures, so that with each revolution of the shaft (*c*) the worm wheel, together with the cylinder (A), will have turned through a space equal to the space between two lines of accounts. The paper (F) is carried rolled on a wooden bobbin (*f*), which latter is prevented from unwinding too quickly by the spring (*g*) bearing on the lengthened end, and this spring should be carefully adjusted, so that the tension on the paper should be neither too great nor too little. I may here remark that the shaft (*c*) must not be turned backwards, therefore on this shaft, at the back of the box, I have fixed a ratchet wheel (*h*) and ratchet (*i*), kept in position by a small spring.

The bell (G) is rung by means of a cam (*j*) on shaft (*c*); this cam (*j*) gradually moves the hammer (*k*) of the bell till the shaft (*c*) has revolved a quarter of a circle to the right from its present position, when the hammer (*k*) is driven against the bell by means of the spring (*l*). The drawing, I think, without more explanation, shows the mechanism clearly. The handle (D) for working the internal mechanism is of the shape shown in Fig. 4—that is, there are two ears on the right-hand side; this only allows the till (*e*) to be opened in one position for each revolution of the shaft (*c*), and that is when the handle (D) has performed one-half of a revolution from its present position, or until the straight side comes next the till (*e*), when, by means of a coiled spring (*m*) fixed to the back of the casing, the till (*e*) is forced out, and when the change has been taken out the till is replaced, and the handle (D) made to complete its revolution.

An opening (K) is cut in the top of the box, and glass (L) inserted, a small slot (*n*) being left the full width of the paper, so that the figures can be entered on the paper. The small rods (*o*) are to prevent the lid opening too far. The methods of carrying the various parts I have left to your own taste, and even the mechanism could be altered to suit anything you might have at hand. In order,

however, to leave it more to your judgment, I will give you a few directions to assist you when using the till.

A strip of paper (F), ruled to whatever design you require, and long enough to register the transactions occurring in a day, is placed on the reel (*f*), and the end secured by *a*; the lid is then closed and locked. Just before business commences you enter on the paper through the opening (*n*) the amount of change to commence with. You then turn D until the till springs out, so that you are enabled to insert the change. I may say that during this half turn the bell has rung. The till is now closed, and the handle turned into position, as shown on drawing. During this one revolution of the handle the figures written on the paper have been carried under the glass, and though they can be plainly seen, they cannot be altered.

Suppose an article worth 6s. is bought, for which the customer tenders 10s., you first record the amount through the opening (*n*), then turn the handle to the right for a quarter of a revolution, when the bell rings, warning assistants that someone is at the till; another quarter of a revolution, and the till opens, thus enabling you to place the 10s. in and take out the change. You then close the till and turn the handle to position shown, when the figures will have been carried forward, and the paper left ready for another transaction. Suppose the customer had tendered 6s., and an assistant wished to steal it, he must first omit to register it and also to open the till, when the suspicions of some of the people about will be aroused at not hearing the bell sound.

He is a fortunate tradesman whose experience has given him no concern respecting his till. Many an ingenious man ought now to be able to make his own check cash till. Any difficulty could always be remedied in "Shop."

BACHELOR'S BOOKCASE.

BY H. J. MARK.

INTRODUCTION—SIDES—SHELVES—BACK-RAILS—BACK-BOARDING—UPRIGHTS—CUPBOARD-DOOR FRAMES—PANELS—BRACKETS—ENAMELLING AND FINIS.

Introduction.—I have chosen the above title on account of this particular bookcase being especially suitable to the requirements of bachelordom, being neat in appearance and compact, easily and cheaply made, and, above all, being so designed that it can be readily taken to pieces, packed up for transit, and as readily put together again. It will hold between thirty and forty volumes, quite as many as most bachelors care to carry about with them; and now that winter is coming, and a pipe and cheerful fire are two great factors of a bachelor's (or a married man's) comfort, what can be more pleasant than to take some favourite book or periodical from a bookcase, made more enticing by the fact of its being of one's own construction? To my thinking, the book seems to have an additional flavour added to it coming from such a repository than it does from the landlady's rickety shelves, chiffonier, or whatever receptacle it is she provides. It stands, when finished, 4 ft. 1 in. high, 2 ft. 6 in. long, and 1 ft. $3\frac{1}{4}$ in. deep over all. It is made of deal and mahogany, and is finished in enamel colours and gold—say, Pavitt's Ardenbrite.

Fig. 1

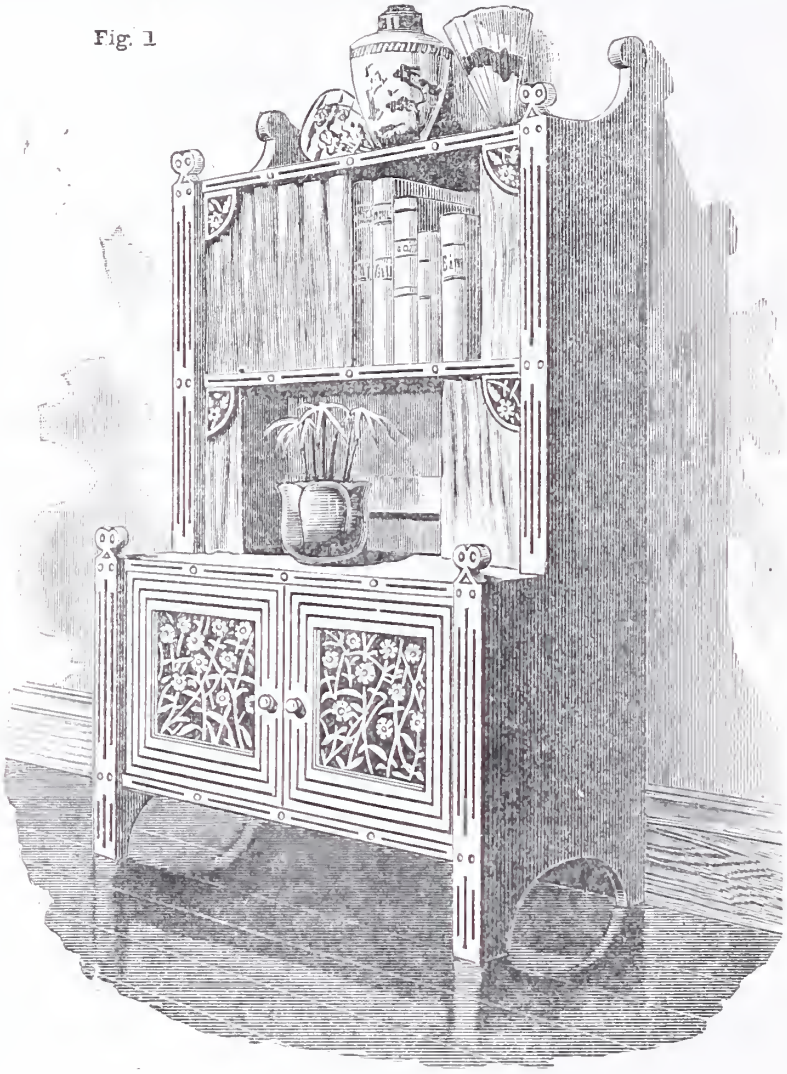


Fig. 1.—Bachelor's Bookcase Complete.

Sides.—The sides are 4 ft. 1 in. high, 1 ft. $2\frac{1}{2}$ in. wide, and 1 in. thick, and preferably are shaped out of one piece of stuff. They are rebated $\frac{1}{4}$ in. deep for the shelves and $\frac{1}{2}$ in. deep between the two lower shelves, to take the back-boarding of cupboard.

Shelves.—These are 2 ft. $4\frac{1}{2}$ in. long and $\frac{3}{4}$ in. thick, the top ones being $10\frac{3}{8}$ in. wide, and the two bottom 1 ft. $2\frac{7}{8}$ in. wide. They are housed into sides, and secured by three round-headed brass screws at each end. They project beyond the sides $\frac{3}{8}$ in., and have grooves and sinkings along their fronts, as shown in Fig. 1. The two lower shelves are rebated along their inside edges at back $\frac{1}{2}$ in., to take back-boarding.

Back-rails.—These are 2 ft. 5 in. long, 2 in. wide, and $\frac{1}{5}$ in. thick, and are secured, as shown in Fig. 3, by $\frac{3}{4}$ in. screws, two at each end, to sides.

Back-boarding.—The back-boarding of cupboard is of $\frac{1}{2}$ in. match-boarding, tongued and grooved, and fitted into the rebates of shelves and sides, and secured by $\frac{3}{4}$ in. screws. If desired, the back-rails could be done away with, and the back-boarding carried up to top shelf.

Uprights.—These are fashioned in the same manner as in a "Whatnot for Amateurs" (No. 128, Aug. 29th, 1891), the projecting $\frac{3}{8}$ in. of the shelves being housed into them, as shown in Fig. 7, isometrical detail. They are likewise secured by the same kind of fancy brass-headed nails.

Cupboard-door Frames.—These are 2 in. wide, $\frac{3}{4}$ in. thick, and 1 ft. by 1 ft. 1 in. over all, and are mitre butt-jointed, as shown in isometrical detail (Fig. 4). The joints are glued and secured by 1 in. screws, care being taken to put in the screws so as they shall enter the thickness of the wood and not penetrate through the grooves; the screws, of course, are screwed in from the inside of door frame. They are rebated $\frac{1}{2}$ in. by $\frac{1}{5}$ in., to take fretwork panels, to secure which and keep in place, a fillet 1 in. by $\frac{1}{4}$ in., mitre-jointed, is put around, as shown in section (Fig. 2). They are hung with one pair of brass hinges each to two pieces of $\frac{3}{4}$ in. by 1 in. stuff, and 12 in. long, fitted inside cupboard, and secured to uprights. They are also fitted with two small ornamental handles, a cupboard lock, and one small brass flush bolt. Two small pieces of wood, $\frac{1}{4}$ in. by $\frac{3}{8}$ in., should also be placed inside, top and bottom, for them to stop against.

Panels.—These are of $\frac{1}{5}$ in. mahogany. The *motif* of the design is that of marguerites, $\frac{3}{4}$ in. border (see Fig. 6). The panel would look still better if finished by a little relief carving.

Brackets.—These are of $\frac{1}{4}$ in. mahogany (Fig. 5), drawn half-size, and are secured by $\frac{1}{2}$ in. screws to uprights, the dotted line in the figure being the line of upright. Two are wanted for the right hand and two for the left.

Enamelling.—The wood is stoped in the same way as for the previous articles in WORK, and the main colour is Arabian brown. The uprights are treated as before described. On the edges of the shelves the grooves are blue and the sinkings gold. On the cupboard-door frames the two outer grooves are gold, the middle one blue. The panels—the flowers are white with gold centres; the leaves, various shades of green, according to taste; and the stems bronze-green or olive, with touches of a little brown in more shadowy parts; the brackets, ditto. Behind the panels is placed, tastefully arranged, pea-green pongee silk or other material. The curtains are hung to a small brass rod with what my wife tells me is a "roosh" at the top; they are also

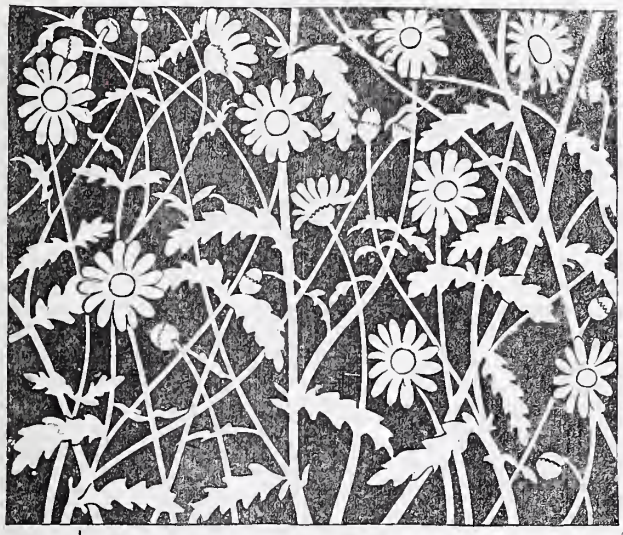
pea-green, and are for protecting the books from dust, etc.

THE WORSHIPFUL COMPANY OF PLUMBERS.

BY A WORKING PLUMBER.

This Company, one of the most active of the City Guilds, was founded in the sixteenth century, and its objects at that time were probably somewhat similar to what they are at the present day—viz., the protection and preservation of the trade or craft of the plumber. It is well known, no doubt, to our readers that these old City Companies have from time to time been held up to ridicule and scorn, as having ceased to fulfil the ends for which they were designed; and no doubt, in some cases, this has not been without reason. The giving of an occasional dinner, the presentation of its freedom to some titled nobody, and such similar proceedings, certainly do not evince much vitality or energy; and that this is all that some Companies do to advance the interests of the trades they are supposed to represent is too true. The Plumbers' Company, however, is a worthy exception, and has done much within the last ten years to advance the interests of plumbing and sanitary science, especially under the mastership of Mr. George Shaw. Under its auspices a great many reforms have been inaugurated and many benefits conferred not only upon plumbers and the plumbing trade, but on the public at large. Amongst these is the Registration scheme for Plumbers. This was introduced in 1886, and was designed to protect the public from the ignorance and incompetence of workmen who, whilst professing to be plumbers, and taking in hand plumbing work, had only the most shadowy claim to a capacity to undertake any such work. That much illness, disease, and even death, has been occasioned by such incapacity is beyond all question. This Registration scheme was, undoubtedly, a step in the right direction. Briefly stated, it is as follows:—

A register is kept of qualified plumbers, the requirements being that all registered plumbers shall pass an examination in the theory and practice of the trade before a Board of Examiners, consisting of thoroughly practical men. The only exception to this examination is in the case of plumbers engaged in the trade before 1886. These are admitted to the register on furnishing satisfactory proof of their efficiency. Why these persons should have this privilege it is hard to say. It is a weak place in the scheme, and that all who desire registration should show their capability in a practical manner should be imperative. Testimonials are not difficult to get, and this little loophole accounts for a good many R.P's. being not so capable as they might be. Nevertheless, the fact of a man being a R.P. does not thoroughly ensure the public against scamped work—work that may be in accordance with sanitary principles as regards the fixing and general arrangement, yet faulty as regards workmanship and material used — this through the plumber being employed by an unscrupulous builder. What is wanted is that inspectors of sanitary work should be appointed in each town of any size, who should be empowered to inspect all new buildings, and to report to the local sanitary authority if the sanitary arrangements be not properly carried out. They should also be empowered to periodically inspect all dwellings in their district for any nuisances or defects in sanitary arrangements. Most plumbers will bear me out that if such an arrangement were carried out there would be a revival in the plumbing and kindred trades such as has never been heard of. How many pan-closets, for instance, are there yet in London and its suburbs alone? Thousands! These would have to be condemned or altered. It may be argued that it would press hardly on property owners. This consideration, however, can scarcely be allowed to stand in the way of such reforms if in the interests of the public health it is necessary. A man has no right to allow a nuisance on his premises, and to plead that it must remain because he cannot afford to have it removed. For this an Act of Parliament—a species of Public Health Amendment Bill—would be wanted; and members wanting something to do should look to this. This is a matter that the Plumbers' Company might well take up when they have succeeded in passing the Plumbers' Registration Bill. The inspectors under such an Act should not be kid-gloved gentlemen, with a smattering of sanitary science crammed into them, but hard-handed, practical plumbers from the workshop—men who know something about the work they are to inspect. Inspectors such as these would be a terror to jerry-builders and their fraternity; for they would not be able to gull them. With regard to schools and classes for plumbing and sanitary engineering, the Company probably is prepared to render every assistance in its power to towns or localities with a desire to start classes, such assistance taking the form of grants of money or prizes; but something further might be done for the provincial towns. The London technical schools are well provided with teachers, and they have the chance of seeing and hearing the best men and leading lights of the trade. It is different in country towns. Often there is not a first-class plumber in the neighbourhood, and where he exists, he is often not able to teach. If the Plumbers' Company could see their way to retain a staff of teachers, whom they could send, at nominal charges, occasionally to teach classes and inspect work in distant localities, it would be a great boon. Another step that the Company might take would be to communicate with the Technical Education Committees of County Councils and Municipal Authorities, stating their willingness to assist in forming classes for plumbing. Lectures could be given by qualified lecturers, which would serve a double purpose—in educating the public, as well as those in the trade, in the all-important bearing of sanitary surroundings upon the general health. The Company could also do a good work amongst the public by preparing and circulating leaflets bearing upon house sanitation in general, pointing out dangers to health, how to remedy them, and so on. Some controversy has been going on as to the rights of ironmongers to do plumbing work. It is certainly difficult to define what a plumber is. From his name, he is a lead-worker; and



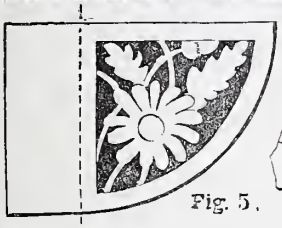
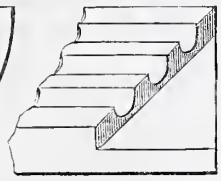


Fig. 5.



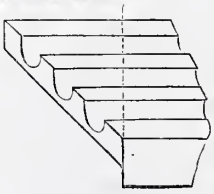


Fig. 4.

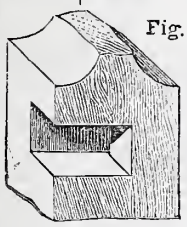


Fig. 7.

Fig. 3.

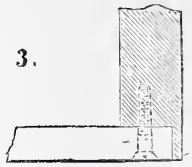
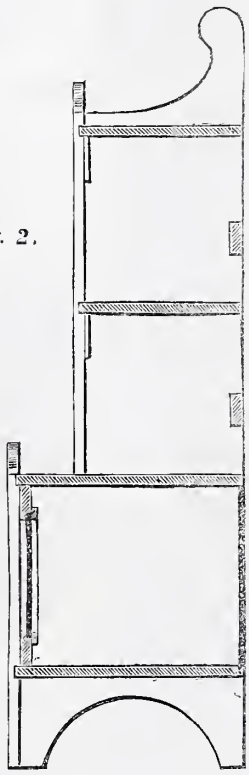


Fig. 6.

Fig. 2.



Bachelor's Bookcase. Fig. 2.—Section of Bookcase. Fig. 3.—Mode of housing Rails into Sides. Fig. 4.—Butt Mitre-Joint of Door Frames. Fig. 5.—Bracket. Fig. 6.—Panel of Door Frames. Fig. 7.—Showing housing of Shelves. All details to be enlarged to size of Bookcase determined upon.

smiths and fitters feel that in touching wrought and cast iron-work the plumber is infringing their rights. The inspectorship scheme would soon kill off "duffers," and the public and good men would reap the advantage. The Plumbers' Company, if it wants to justify a continued existence, should be to the fore in matters of plumbing reform.

STAGE DRAPERIES—THEIR PAINTING AND MANIPULATION.

BY W. CORBOULD.

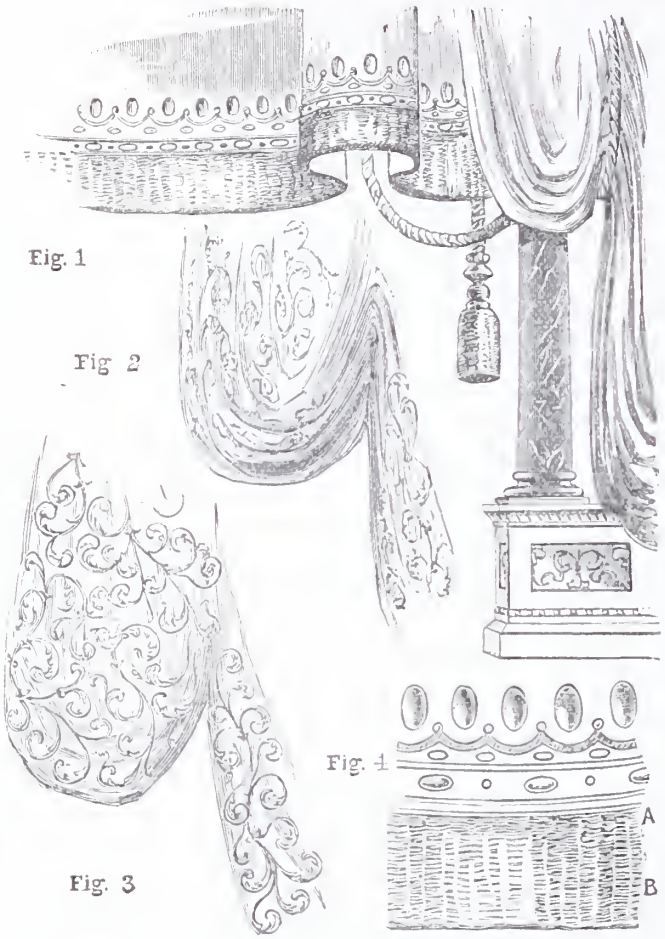
The amateur scenic artist will find the drawing-in of draperies, no doubt, difficult at first. The best way is to have a cloth or curtain, and hang it in the position he wishes to represent the painting. First mark in all the folds with charcoal, taking care to notice that when a curtain is drawn up, say with a cord and tassel (see Fig. 1), the folds are angular; particularly should the material be of a thick and stiff nature, such as heavy damask, repp, etc. When you are satisfied with the drawing, cover the charcoal lines with Vandyke brown, as taught in landscape (see Vol. II., No. 97); dust off with your flogger.

We now come to the painting. I will describe the way to manipulate three colours—viz., crimson, blue, and amber; any others may be worked in the same way. We will first take crimson. You must thin out some damp lake, and go over the whole of your work; let this dry. Thin out now some brown lake, and lay in all the folds with it. If you have bullion fringe, cords, tassels, or other ornaments which you have already drawn in with Vandyke, glaze these all over with Dutch pink. Fig. 1 shows a curtain of this description. Now glaze over your curtain with thin crimson lake again. You will by this time have got a considerable depth of tone. Now take a clean brush and some shadow colour—thin blue; go over the whole of the shadows—of course, every fold has its own shadow, but where the blue covers the brown lake it will be the deepest in tone—that is, purple; but on the larger wavy folds the blue goes over the crimson, a pale cool shadow of a bluish tint. I may here mention that all shadows on warm colours are cold in tone; the opposite with cold colours, the shadows would be warm. You must notice this when we come to blue painted draperies.

You must now put in your high lights, and for the crimson you are now painting this must be orange red or orange chrome. You must use it with care. Lay it on with a bold stroke; mind the angular form of the folds; soften the edges of these high lights into your crimson. When you have done this, and you think it satisfactory, have some crimson lake or damp lake, stronger in tint than what you have been using, but not much, or it will peel off. Use your large brush, and go over the whole of your work, shadows and high lights as well, but not the part you may have laid in with Dutch pink. I may say here that your size when working your first colours ought to be strong, to prevent them rubbing up in the after glazings; but in the last glazing have more water to it: this will prevent the damp lake from shaling. Now you have got thus far with your work, all you have to do is to consider whether you shall glaze it over again. Should you think that another glaze will enrich the work, go over it again; but before doing so, touch the highest lights with vermilion.

We will now take amber drapery. You make your drawing the same way as in the crimson; the folds and angular forms are the same, of course, in one colour as another. First painting. Take of yellow ochre and raw sienna in equal proportions, and glaze over the whole. When this is dry, lay in with brown lake the shadows and folds; soften the edges off into the yellow previously laid on. Now lay on the high lights with pale orange chrome. After this is all dry, glaze over with the colour you laid on first—viz., yellow ochre and raw sienna. You may now glaze over the shadows with thin damp lake. Now touch in your highest lights with lemon chrome. When this is all dry, glaze over the whole with raw sienna. You will find by this time your work will look finished, but should you think it wants bringing out more, you may glaze over again until you get it to the desired effect.

The next is blue. Of course, the drawing is the same as in the former; it is the manipulation of the colours that I wish to impress upon the pupil. Although I am giving a few colours, there are many other compounded colours, but it is not necessary to go into them here, as the artist will gradually gain the knowledge of compound colours. For instance, purple would be a compound of blue and damp lake; pale rose colours would be white with your crimson and damp lakes, according to the depth of tint; white lace curtains, worked out in patterns, try the skill of the artist—their shadows are delicate blue. Where heavy folds, a very little Vandyke brown would have to be added to the blue, or glazed over it. Then there are the different shades of green, from very deep to the palest sea or pea green; in fact, drapery painting is a study in itself, but "practice makes perfect."



Stage Draperies. Fig. 1.—Proscenium Wing and Border. Fig. 2.—A Draped Curtain, showing Scroll Figuring with the Folds. Fig. 3.—Bad Figuring if not painted as in Fig. 2. Fig. 4.—Enlarged Part of Proscenium Border, showing how to work with Brush.

After this digression, we will now go on with the blue. Assuming you have done your drawing in as before, and all is quite dry, you first glaze over with thin azure blue. Lay in the folds and shadows with thin damp lake. This will keep the shadows warm; blue being a cold colour, it would not do to put a darker blue for shadows, although some artists do it; but it is not right. I have known others to use ultramarine, which is a bad colour; in artificial light it goes black. Prussian blue may be used, but my experience has taught me that for stage drapery nothing beats azure blue when painting blue drapery.

We will now suppose you have finished the folds and shadows with damp lake; should you require the folds or shadows in any part very strong, use a little brown lake with your damp lake, using your own judgment for depth of tone. After this is all dry, glaze over all with your azure blue. When this is dry, should you wish to have it deeper in tone, touch up your high lights with white, and glaze over again with your azure till satisfactory. Green draperies are worked the same—that is, royal green, emerald, and the green lakes would come into their composition.

We now come to bullion fringe and other ornaments, such as cords, tassels, etc.

There may be figures, such as scroll-work, flowers, etc. You work these out with small fitches after you have finished the painting, taking care that the pattern falls in with the folds. (See Fig. 2.) It would not do to cross the folds with the pattern or figures. (See Fig. 3.)

To paint bullion fringe, you require in colours, brown, brown lake, lake, orange chrome, lemon chrome, celestial blue, and Vandyke brown. You have drawn in with Vandyke brown, and glazed over with Dutch pink (Fig. 2). Now take brown lake, and with your small fitch cover your former work that you glazed over with Dutch pink. Fig. 4 shows the work of Fig. 1 enlarged. With orange chrome you must touch or paint in here and there, not go all over your work; then with lemon chrome you go over other parts. When this is all dry, glaze with thin blue the top parts of your fringe (see A, Fig. 4), and all heavy parts should have their shadows bluish in tint, but glaze here and there with some thin lake. This is for the reflections of the crimson curtain caught up by the gold. All these colours placed

one against the other will produce brilliancy—that is, the highest lights will be pale lemon chrome, then deeper lemon to orange, and so to brown lake. A little practice will soon overcome any difficulties. It is almost impossible to give the idea fully without the aid of colour. Fig. 4 shows the sort of wavy line which you keep making with each colour, using small fitch brushes for the purpose.

DIVIDING AND REVOLVING FLOWER-POT AND TUB FOR HEAVY PLANTS AND TREES.

BY J. CHARLES KING.

To the horticulturist who has to handle large shrubs and trees in tubs this invention is of real practical value for its economy of labour in potting and shifting heavy plants, etc., without much trouble, as occurs with ordinary pots and tubs, and with no risk to the plant or pot or tub in the process.

For palms, orange-trees, cacti, and other tropical plants and trees, it is now necessary, when they have grown too large for the pot, to lift them out, or break the pots, or dig out of the tubs. As they sometimes weigh from half a ton to a ton or more, this means the use of a lot of muscular strength, but, withal, often unsatisfactory, by its delay and cost; and for turning a tree in a conservatory, to present foliage in a better aspect, or to receive the sun on an opposite side, crowbars are brought into use, often to the damage of the floor of the conservatory, and always injury to the bottom of the staves of a tub or box, and sometimes to the injury to the bloom of the plant or contiguous ones, where crowded together. And where the tree has to be shifted from a glass-house some distance into the open ground, it is a costly job in labour and appliances for the tub to slide on, as anyone who has seen the shiftings at Kew or similar large gardens knows well.

Mr. A. Taleyrac, of large experience in France, Algiers, and England, in connection with tree and plant growth in tubs, etc., has made the whole subject of pots and tubs a special study, and, being essentially practical, he has invented (1) a revolving flower-pot or tub, formed in two halves, (2) a double bottom for revolving, and (3) a cradle-frame for its transit for short or long distances. He has taken it out of the realms of theory into the workshop of practice. By detailing it, we at the same time are better able to describe the inventions, two of which are at the head of these notes; the third needs no illustration.

Assuming the tree to weigh, with its earth and tub, about two tons—and this has to be put into a bigger tub or box—his first course is to prepare a tub with a revolving bottom. The bottom he has made of galvanised iron, sufficiently thick to have a circular channel sunk in it (as shown by Fig. 1). This channel is for balls ½ in. diameter. This fits exactly over a similar stationary bottom of iron, so that one bottom revolves, by means of the ball bearings on the other, so easily that a boy can turn a heavy tree and its earth and tub completely round. Now, to lift a ton-weight tree that almost touches the top of the conservatory is not to be done easily; but to unhoop the common tub and take away the staves is easy enough, leaving the tree standing on its own old tub-bottom. A tripod of iron, with a jointed ring, padded, to grip the tree below its lowest lateral branches, and the three iron legs of this tripod being screwed into loose nuts let into base-blocks resting on the ground, enables the swivelled legs to be turned simultaneously in the nuts, to raise the tree 2 in. or more, so as to shift away the old tub-bottom, and insert the larger revolving tub-bottom under the bulk of earth. To obtain its environment of a larger tub is the easiest part of the work; for it is in two halves, and has two or more hoops on, that overlap each other at opposite sides of the tub. These overlapping hoops are secured by pins, that hold the hoops immovable. This is only the work of a minute for two men. The space between the bulk of old earth and inside of the larger tub has only to be filled in with extra mould, and the job is finished.

To effect easy transit of heavy trees and plants to or from the house to the open, Mr. Taleyrac secures the lower bottom of tub to

Fig. 2

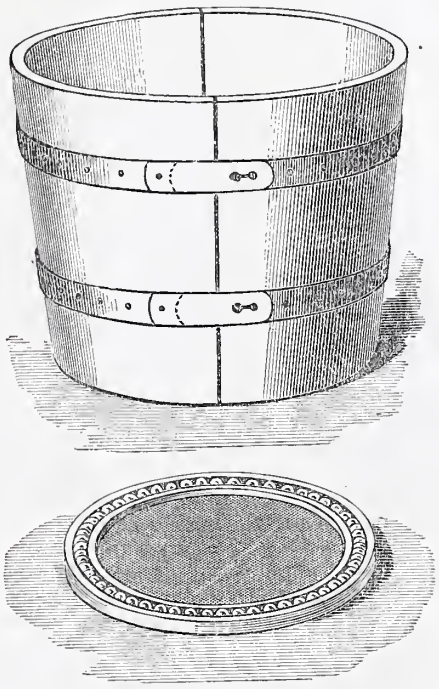


Fig. 1

Flower-Tub. Fig. 1.—Bottom. Fig. 2.—Dividing-Tub.

a frame, oblong in form. Under this frame, at each corner, is an improved caster-roller, which allows the whole to be pulled by a rope by two men, without the need of nine or ten men, with two or three crowbars, as with the old tub. A light lifting-jack, of simple make, raises the ends of the frame when wanted to be lifted on or off guide-planks, up or down stairways or steps or slopes, or over soft turf.

This oblong frame has holes for suitable staple-sockets for a pair of shafts to be attached, and an axle for a pair of wheels, fitted so as to use it as a "gig-frame" for horse draught, if needed for distant transit. For the more scientific handling of plants of large growth these inventions give facilities not attainable with the tub or box with fixed staves, as for opening the tub for root-grafting, fossicking for a worm amongst the roots, adding special manures, or introducing electrodes, etc., so easily done by lifting away one side of a tub or pot.

In the technical contrivance of half-tubs or pots there is no difficulty, as earthenware serves as well as wood, or compressed fibre, or anything suitable.

For the wooden tubs the staves are not bent, but left flat, so that the tub is polygonal, and either dowelled or tongued and grooved. Two inches up from the bottom is an inner curb or ledge on pots and tubs. This takes the pressure off the bottom, which the fastening of the hoops tightly holds securely to the inner periphery of the tub. A stave can be taken out and replaced by another if repairs are needed. In fact, the sides may be taken away, leaving the tree standing with supports in a glass-house, for painting and quick-drying in the open, and be replaced easily. The necessity for trees being quickly moved from open ground to shelter is an item of importance which can be appreciated by those owning valuable trees and plants. As every part of pots or tubs is to be made to uniform sizes the renewal of parts is simple.

The square boxes and tubs are found to be not the best shape for root-growth, the angles holding earth which is of no use to the vitality of the roots, and their shape cannot be regarded as ideal.

VOLATILE COMPOUND IN IRON.

Electric energy in any form is but change effected with intensity of motion; everything known is susceptible to electric energy, though some materials are better within the operation of our knowledge than others. Perhaps the simplest demonstration of energy not directly electrical, though incidentally so, is the heating of steel to a molten state. It assumes a white light, similar in many respects to the electric light. Perhaps by the polariscope its electric character may be demonstrated some day.

The magnetic receptiveness of iron has never been explained; investigations are being carried on by chemists into the volatile compound in iron. One method of procedure by Messrs. Langer and Quinke consisted of reducing ferrous oxalate in a stream of hydrogen at a temperature of 400° C., and passing carbon monoxide over the product heated to 80° C. The new body is volatile, and is decomposed on heating, depositing a mirror of metallic iron. The deposited metal gives the reactions of iron definitely, establishing its identity; only a minute quantity is obtainable from a large bulk of iron, so that at present satisfactory analysis is difficult. Whether this volatile product is in any way a link of magnetism to iron is a problem to be investigated by science.

PRESERVING WOOD.

A new method of impregnating logs with zinc chloride, to preserve them, is known as the Pfister process. The timber is impregnated in the forest as soon as possible after it is felled. The zinc chloride solution has a specific gravity of 1·01, and is forced into the thick end of the log by a force-pump. To this end, an iron disc of suitable diameter, and furnished with a cutting rim, is forced into the end of the log and secured by clamps. The time required for this preliminary work is only three or four minutes for each log. After a pressure of two or three atmospheres has been maintained at the thick end of the log for a few minutes, the sap begins to exude at the opposite end, and finally, a weak solution of zinc chloride comes through, showing that the operation has been completed. About 2¼ gallons of the solution are required per cubic foot of timber treated.

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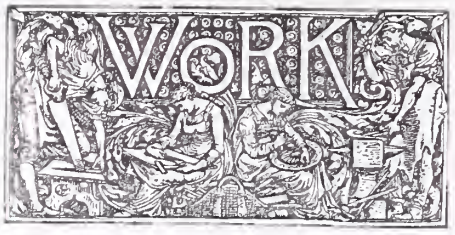

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PIANOFORTE TRADE APPRENTICES.—The scarcity of skilled labour in the musical instrument trade is forcing itself upon the responsible members of the trade. It is now sought to revive the question relating to apprentices. The idea is that it is not advisable to revert to the former method of teaching the whole of the branches, with the result of giving the youth only a smattering of his business, but rather that it would be best to thoroughly ground the apprentices in one branch, in which they may excel. [This apprentice question is one affecting every trade of the country, and cannot be too forcibly or honestly put before the tribunal of public opinion and trade council in every department of labour. If commerce is to go on in this great country, if Britain is to maintain its commercial supremacy, the out-going race of workers must be replaced by an equivalent. It behoves every firm, every manager, every head of a department to see that, while the old blood is dying out, a new element is being incorporated and trained in the traditional lines of past custom and usage. It is not only the pianoforte trade which is concerned with the question of apprentices. There is not an industry in the country that is not involved. Such a matter as this concerns every worker who has any true soul for, or interest in, the trade upon which he has been called to stamp his personality. We wish more enthusiasm could be roused among managers and workers upon questions such as these, which are truly worthy of being digested in preference to many of the useless topics upon which men fritter away their intelligence. Every British trade ought to have something to say about its apprentices.—ED.]

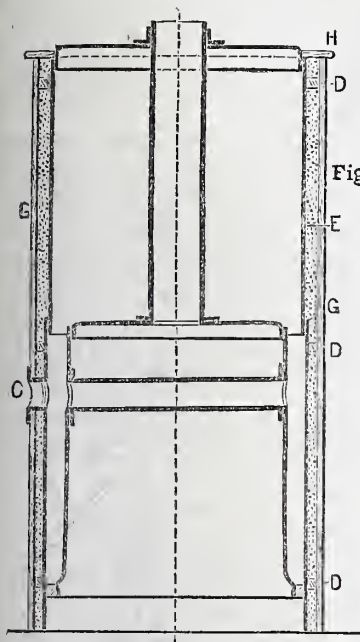
ARBITRATION V. STRIKES.—Labour troubles in the United States have again attracted necessary attention to the relations between labour and capital. Let us glance at the situation at home. Yesterday, as it were, London was the scene of a gigantic dockers' strike; then came the lesser movements of gas stokers and omnibus employés, and still more recently a disruption of the London building trades, owing to the carpenters' dispute. Turning for a moment to the provinces, we find Birmingham, Bolton, and Cardiff heading a list which, if alphabetically completed, would astonish us with its record of wasted time, energy, and treasure. What of the future? True it is that here strikes have not yet been carried to sanguinary extremes, but who can say how long this will continue? Thus we cannot watch with apathy the widening rift between labour and capital? What master and worker have to do is to look with a kindlier eye one upon the other. Surely such matters as a five per cent. advance or a half-hour's less labour per diem do not warrant such extremities as those resorted to in the Carnegie riots. Combination we fully believe in and uphold, but only combination of the right sort. Justice and equity are the foundation of all effort in this capital and labour solution, and their attainment should be distinguished by manliness, common sense, and personal respect. The real mission of trade combinations, on the part of capital, is to minimise the dangerous and laborious aspect of each industry, to encourage perseverance and original research, and, particularly, to advance the education of craftsmen and the training of apprentices. Now a word with our brother craftsmen. We labour from necessity; but this labour may none the less be a labour of love, and the greater the interest therein the better will be our results, and, consequently, of a higher monetary value. Labour and capital have no interests that are not mutual, and a commercial nation like ours should waste neither time nor money on inter-commercial warfare. Energy in this shape would be better employed in advancing technical education in every branch. The present discontent is but the shadow of the coming greater social problem—that of profit sharing. Sooner or later capital must grasp this fact; and the sooner the better! Meanwhile, let arbitration be the aim and hope of both employer and employed.

WORKING CLASSES TAXES.—There is no country in which fewer articles of consumption are taxed than this; yet, even so, people are beginning to complain of the unfairness of such taxes. Take tea, for instance, of which a washerwoman probably consumes more than a millionaire. The tax on this article is 4d. per lb. Now, the poorer people pay sometimes only 1s. a pound for their tea—8d. being the worth of the tea, and 4d. the amount of the tax. Rich people pay 4s. a pound, of which only 4d. is for the tax. Thus one-third of the whole price—or, if there were no tea tax, as much as would purchase half a pound of tea—is paid by the poor on every pound of 1s. tea they consume to Government; whereas the rich pay only one-twelfth on their pound of tea, or, if there were no tea tax, as much as would purchase less than $1\frac{1}{2}$ oz. of 4s. tea. The above may be brought more forcibly home by stating it this way:—Out of every twelve cups of tea that come from the poor man's tea-pot four are drunk for the Revenue, while out of the same number from the rich man's only one is so drunk. The same unfairness is exemplified from the tax on tobacco. The workman pays 3d. an ounce for his tobacco; of this 3d. as much as $2\frac{5}{8}$d., that is $2\frac{1}{2}$d. and half a farthing, is for duty. The millionaire pays 1s. for a cigar; of this 1s. only $\frac{3}{5}$d. is for duty, the remaining $11\frac{2}{5}$d. is for the article he smokes. Thus out of every 1s. the millionaire spends on cigars he contributes just over $\frac{1}{2}$d. to the Revenue, while out of every 1s. the poor man spends on tobacco he contributes $10\frac{1}{2}$d. to the Revenue. These inequalities ought to make men think.

"CLEADING" OR "LAGGING" VERTICAL BOILERS.

BY J. H.

PURPOSE OF CLEADING—PREPARATIONS—RINGS, ETC.—METHOD OF SECURING THE RINGS—SEATINGS FOR THE MOUNTINGS—THE LAGGING STRIPS—BONDING THE LAGGING—IRON CLEADING—COVERING FOR TOP OF BOILER.



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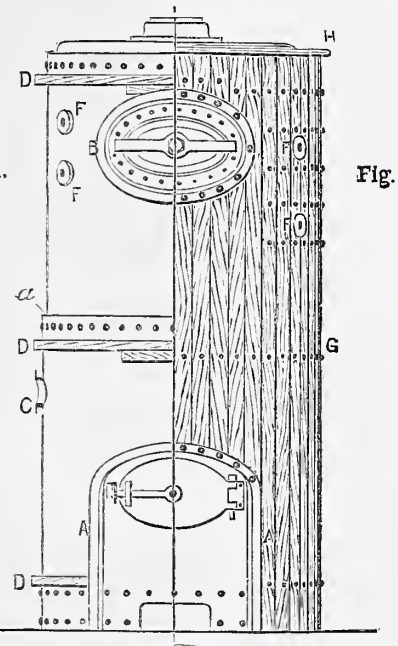

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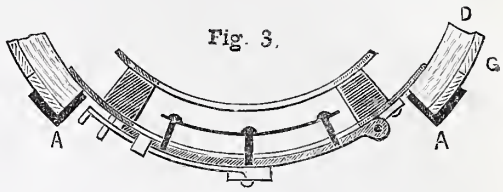

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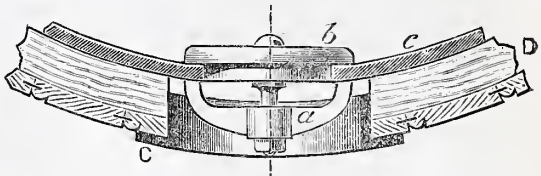

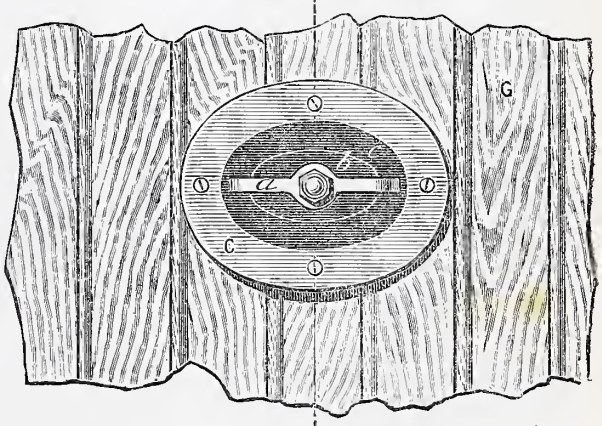

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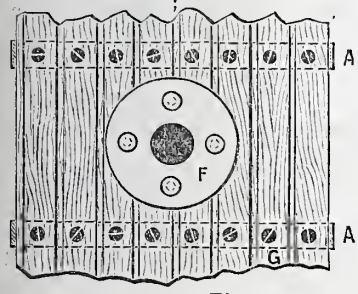


Fig. 7

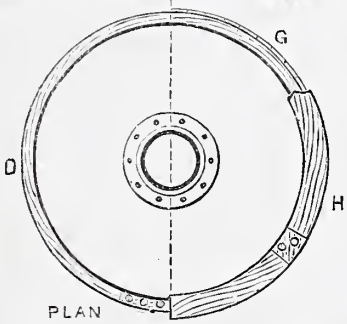
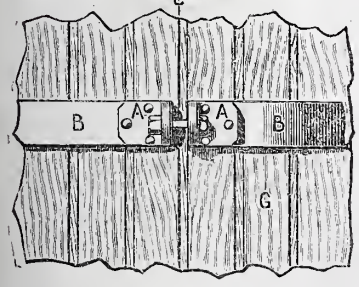


Fig. 6.

Fig. 8.



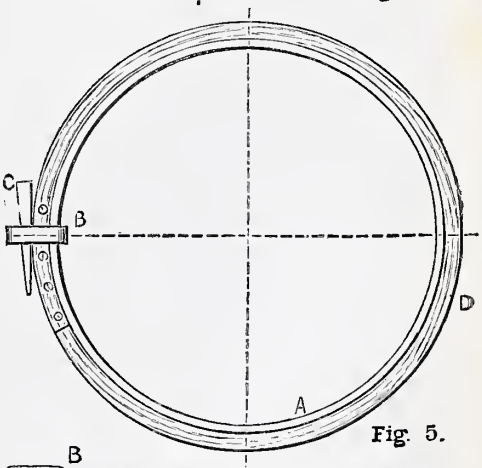


Fig. 5.

Purpose of Cleading.—Vertical boilers are cleaded, both to prevent radiation of heat and for the sake of good appearance. The usual practice is to clothe the boiler with a layer of felt, and to enclose and confine this with lagging strips of wood or with sheet iron. Fig. 1 is a section through a boiler and its cleading. Fig. 2 is an outside view, showing the cleading on the right-hand side and the naked boiler on the left-hand side, embraced only with the hoops upon which the lagging strips are screwed. Some enlarged details are shown in the figures.

Preparations for Lagging—Rings of Angle Iron.—When boilers have to be cleaded, the first steps necessary are to have all the fittings in place, and to make and fit the rings upon which the lagging is screwed. I will consider these points, therefore, now in turn. And first, as to the fittings: Before a boiler can be cleaded, provision must be made for leaving neatly finished openings around the fire-door and the ash-hole, the man-hole, and the mud-doors, and also for oringing such of the mountings as are fastened to the sides of the boiler out to the face of the lagging. For the first-named purpose, rings of suitable form, made of angle iron, are made and fitted; for the second, seatings of cast iron are screwed to the boiler-shell. Around the fire-door the angle iron, A, is bent (Figs. 2 and 3) in the form of an arch; around the man-hole it is made of elliptical form, B (Fig. 2). Rings of the same shape, but smaller, enclose the holes opposite the cross-tube or tubes (Figs. 1, 2, and 4). C, and the mud-doors at the bottom of the boiler, not seen in these views. These latter, being so small, are made of cast iron to angle iron section; the others are made of angle iron bent, and in the case of B, welded up. The large rings, as will be seen from the section at Fig. 3, stand radially in relation to the boiler, and their depth is such that the under face of the flat flange rests upon and covers the face of the lagging. The rings need not necessarily be deep enough to touch the boiler-shell; it is better if they are left to clear it by, say, $\frac{1}{8}$ in. or $\frac{1}{4}$ in. The small rings for the mud-holes (Fig. 4) are parallel internally, and are sufficiently large to clear the bridge-piece, *a*, by means of which the mud-door, *b*, is pulled up against the boiler-shell, *c*.

Rings of Ash.—The rings, D, in the various figures, upon which the lagging is screwed, are made of ash. They have a cross section of from $1\frac{3}{8}$ in. square to $1\frac{3}{4}$ in. square, dependent upon the size of the boiler. Three

Vertical Boilers. Fig. 1.—Sectional Elevation of Vertical Boiler, cleaded or lagged. Fig. 2.—Half Elevations of Vertical Boiler, with Outside Lagging, and Lagging Strips removed. Fig. 3.—Horizontal Section through Fire-hole Door and Angle-Iron Ring. Fig. 4.—Section through Mud-holes. Fig. 5.—Method of bending the Rings of Ash. Fig. 6.—Saw-Kerf Method. Fig. 7.—Fastening of Lagging around Seatings. Fig. 8.—Fastening of Bonds.

such rings are required for small boilers, four or five for those of large size. The rings are bent to the curve of the boiler, either by steaming or by saw-kerfing them. In the first method the strips are planed to section, and sawn long enough to encircle the boiler, and to overlap to the distance of 1 ft. or 15 in. They are then placed in a long wooden box, into which steam is turned. After, perhaps, an hour's steaming they are taken out and bent around an iron ring (Fig. 5) of the same diameter as the outside of the boiler on which they have to be used. A strip being clamped at one end, the free end is pulled round and clamped at intervals, until the ends overlap, when they are wedged together with a cramp, B, and wedge, C, and screws are put in to secure them fast. When dry, the rings retain their curvature. In boilers of small diameter, however, there is so much tension put upon the fibres by this method that the rings sometimes break.

The whole process is rather roundabout, and not so well as the second method of saw-kerfing. In this, the strips, after being sawn and planed, are saw-kerfed (as shown in Fig. 6) at intervals of about every 1½ in. or 2 in. Then, without having to resort to steaming, the strips can be easily bent to the curvature required, of course around the templet ring, and the overlapping ends will be screwed together. Before any lagging is screwed on these wooden rings, the angle iron enclosing rings and the felt have to be put around the boiler.

Method of securing the Rings.—The wooden rings are merely pulled tightly over the boiler. The overlapping ends are first unscrewed, the rings put in place, and the ends overlapped, and again screwed together. The friction of the rings will hold them in position until the lagging is screwed on. Note that the thicknesses of the rings are not alike. In consequence of the lapping of the plates, the upper ring is thicker than the lower ones by the thickness, A (Fig. 2). The large iron rings are partly held with screw-bolts—say, two—in the ring that encircles the man-hole, and three in the arch that encloses the fire-door. The small mud-door rings are not screwed on at all, but they are held for the present by means of the bridge-piece which is used for tightening up the mud-door, the bridge-piece being turned a quarter round and reversed, so that the convex portion of its arch just bears against the upper and lower edges of the enclosing ring. Presently, when the lagging has been fitted, screws are put through all these rings into those portions of the lagging that come underneath the rings, and these screws afford mutual support to the lagging and to the rings. The felt (Fig. 1), E, bought in sheets, is wrapped around the boiler, and is held while the lagging is being fitted with fine iron or copper wire wound round it.

Seatings for the Mountings.—Blocks, F (Figs. 2 and 7), that serve the purpose of seatings for the various brass mountings, are also studded and riveted to the boiler in their proper positions. There will be blocks for the water-gauge, check-valve, blow-off cock, and injector, if such is used. In small boilers, however, seatings are commonly used only for flanged fittings, such as the blow-off cock, and other fittings are tapped into the shell direct instead of into seatings. If this method will not allow the fittings to stand out far enough to clear the cleading, then, instead of seatings of cast iron, short pieces of steam-pipe of suitable length are screwed into the shell, and the mountings are screwed into these.

The cleading having to be cut off in shorter lengths to fit against the cast-iron seatings, and no means of screwing it existing as in the frames of angle section that fit around the large openings, it requires to be supported and held fast independently of the seating. This is done by laying short sweeped pieces around the boiler, above and below the seatings (Fig. 7, A), and screwing the cleading upon these. The sweeps, being extended to right and left, underneath the continuous strips, cannot yield, and so it affords support to the severed lengths.

The Lagging Strips.—All is now in readiness for the lagging, G, in the figures. This is made of deal or of mahogany, in strips measuring about 2½ in. by ½ in. It is grooved at the edges with saw-kerfs, to take hoop-iron tongueing. It is also beaded on one edge to break joint, for the sake of good appearance. The lagging is bought in this condition, and all that the carpenter has to do is to cut it to lengths, lay it round, and screw it to the rings.

Where there are no encircling iron rings in the way, the lagging strips pass right from top to bottom of the boiler; but at all other places their ends are cut to fit against the iron enclosing rings. As they are fitted, they are screwed to the wooden rings, one screw being put through each strip into each ring. Also a screw is put through each iron ring into each separate piece of lagging.

Bonding the Lagging.—However well strips may be fitted and laid round, the weather and the heat of the boiler will soon warp them out of truth, and they will bulge and become uneven between the rings. Hence one reason why bonds of metal are commonly employed to confine them in place. They are not essential with wood cleading, as they are with iron, and are not always put on. Still, they are used with advantage, and if made of brass, improve the appearance of the cleading. They are not shown in Fig. 2, but the ends of a bond are shown in Fig. 8. Bits of angle iron or light forgings, A, are riveted to the ends of the bonds, B, and a bolt, C, pulls these up nearly together, so tightening the bonds round the wood.

Iron Cleading.—With iron cleading the bonds are essential. There is not much to be said about iron cleading. The boiler is felted first, as when wood is employed, and wire is bound round the felt to keep it in position until enclosed with the iron. Wooden rings are frequently used, and the iron lays upon them and upon the felt, requiring no screws, and no fastening save the bonds. Generally, however, the sheet iron does not lay in direct contact with the rings and felt, but a rough wooden cleading is interposed, consisting of rough sawn strips without tongueing, nailed upon the rings. Around this cleading the encircling sheet iron is laid. The sheet iron has to be cut out to clear the various openings, and bent to the necessary curves in bending rolls. Some prefer sheet iron to wood, and it has the advantage of being unaffected by weather, and always presents a smooth and clean appearance.

Covering for Top of Boiler.—The top edge of a cleaded boiler is covered over with a piece of iron, or more neatly with a ring made of short segments (H in Fig. 2). Occasionally cast-iron covers, cast with openings for the safety-valve and chimney, are made use of.

Should any of the numerous readers of WORK, having to do with boilers, be in any difficulty, please put a question through "Shop" columns.

THE STOPS OF THE PHOTOGRAPHIC LENS.

BY AN OLD HAND.

VERY many amateur—I think I may include some professional—photographers are somewhat in a fog with respect to the use and effect of the diaphragm of the photographic lens. They know that a small stop sharpens the image and reduces the light, making the lens act more slowly, and that if a large aperture is used the exposure is much shorter, the image being less distinct; this being the sum total of their knowledge of the subject.

A photographer thoroughly conversant with the use and effect of stops has a power in his hands too valuable to be neglected, and he will succeed in making good work with a lens that in the hands of his less-informed brother would be almost useless.

Now, let us see what the stop will do, and why it does it. Suppose we examine the image on the focussing screen with the full aperture of a single lens: we find that there is a great falling off in definition towards the edges; also the different distances vary in sharpness. If we rack the camera to get the distance or middle distance perfectly sharp, the foreground is woefully blurred and indistinct, and *vice versâ*. It may be remarked lenses vary very much in defining qualities, some being much better than others *when used without a stop*, but with one, may produce equally good work. The so-called single lens is in reality two lenses of different kinds of glass accurately cemented together to form what is termed an achromatic meniscus. The advantage of making a lens of two pieces of glass of different density is that by so doing it loses its power of adding a fringe of colour to all objects depicted on the screen by it, or, in technical terms, it is achromatised; not only this, the power of giving equal definition over the whole of the picture or field is increased. It is a singular thing that certain kinds of single lenses, uncemented ones, or uncorrected, as they are usually termed, will give pictures practically free from the colour fringes, but to do this they must consist of *very thin* glass, the non-achromaticity depending almost as much on the *thickness* of the glass as on its density. Also very small stops must be used, or the depth of definition will be so small as to render such lenses practically useless for photographic work. The size of the stop, besides regulating the quantity of light to be admitted to the plate, also determines how many of the rays of light falling obliquely on the lens shall be allowed to pass. It may here be said that rays of light passing through the centre of the lens are parallel, and the further from the centre they are the more oblique they become. The use of the small stop is to restrict the formation of the image to these more central rays, which, when no stop is used, become confused and mixed with the oblique rays, which, coming to a focus at different distances from the lens, will produce a blurred picture. The quality of a lens is estimated by its power to produce a sharp image, with a large stop, over a large area: the better it will do this the greater the estimation in which it is held. Very indifferent lenses will produce fairly sharp pictures if very much stopped down. Here, again, we must notice if the glass of which the lens is constructed is free from defects, such as scratches, striæ, etc., for if such faults exist in the *centre* of the lens and we use a very small stop, which utilises just that part of

the glass that is defective, the small stop in this case, instead of improving the definition, will make it worse, owing to the defective part being *alone* used to form the image. The *central* portion of a lens should always be free from *any defect whatever*. Small striæ or scratches in other parts are not of such vital importance, although the lens is best without them, but if they occur centrally the advantage of the stop is considerably impaired. The position of the stop has great influence on the resulting image. With single lenses (that is, the achromatised meniscus) the stop is placed considerably in advance of the lens, for two reasons—the definition is better and the rectilinearity is improved, but we get a smaller area of illumination. If the stop is too much in front the corners of the picture are cut off, and if too near, the curvature of straight lines is more evident. It must be understood all single lenses give curved lines, more or less, in all parts except the centre of the picture; the distance of the stop from the lens is calculated so as to reduce the curvature to the least possible quantity by cutting off oblique rays without reducing the area of the image in too great a degree. In some lenses I have seen the position of the stop has been such that the plate would be properly covered with the larger sizes, but with the smaller ones the corners of the picture were shaded off, proving the distance of the stop from the lens was too great. If we place the stops behind the lens, instead of in front, we do *not* get rid of any of the curvature, the area of illumination is not interfered with, although the image is sharpened up in about the same proportion as though the stop was placed in front; the advantages are, however, decidedly in favour of stops in front. With portrait combination of lenses, the best place for the stop is about midway between the combinations at that point where the rays cross in passing from one lens to the other. On account of the great roundness of the field only a very small part of the image will be quite sharply defined, but that area will have better definition than with any other kind of lens—in fact, so far as it goes, we will term it optically perfect; but the perfection of this small area is at the expense of the larger. With all lenses not intended specially for portraiture a compromise is made by getting something less than perfect definition over a large area instead of excessive sharpness over a small one. The rapid rectilinear is an example of this compromise, and other lenses of like form are constructed to the same ends. With the improvements continually taking place in the manufacture of glass, we may hope eventually to have perfect flatness of field and depth of definition, with large apertures. The Ross concentric lens is a step in this direction.

In the use of single lenses for architectural work, for which special purpose they are unsuited on account of the curvature of the straight lines, especially as we approach the edges of the circle of illumination, the best plan is to only use the centre of the plate, where the curvature is scarcely perceptible for the more important architecture, and then, if there is a considerable amount of foliage, or other subject not consisting of straight lines, at each end of the picture, the distortion will be scarcely noticed. Use a small stop in *front* of a single lens; this remark may be deemed unnecessary, as the stops are usually fitted to the lens in their proper places, but if a lens is extemporised by the use of one combination of a doublet the advantage of removing the *front* lens will be perceived. According to theory, all lenses are equally rapid if used with a stop bearing the same proportions to their focal length as each other—that is, a lens of 12 in. focus would, with a stop of $\frac{1}{2}$ in. diameter, have the same rapidity as a lens of 6 in. with a stop of $\frac{1}{4}$ in. diameter. However theoretically correct this may be, it is not always borne out in practice; the colour of the glass and its thickness have considerable influence in determining the result. It must also be borne in mind that the activity of light on a sensitive surface is increased or diminished according to the square of its distance from it, but the small differences that exist with ordinary lenses make this factor practically inappreciable, unless in dealing with large-sized enlargements; the distance of the paper from the lens has then to be taken into account.

A good single landscape lens may be advantageously used for portraiture if large heads are wanted, working with a large stop, as in this work the surroundings are really better if not in focus. The leading lines in the face being well made out are all that is required. The number of stops supplied with the generality of lenses are really unnecessary, three being ample for all purposes. Take it all round, a stop representing F 32 will be sufficiently small for any ordinary work, one of F 64 for special subjects, and one of F 16 for rapid exposure. When the full aperture of the lens will not give sufficient definition, by making it a rule to work with one special stop—say, F 32—a uniformity and certainty is introduced into the exposures; that results in even and good work that is absent when the practice of shifting about from one stop to another is adopted. My advice is, alter your exposures, but do not alter your stop. Any lens that will not cover well the sized plate it is advertised to with F 32 is a bad lens, and should be got rid of. To find the focus of the lens, measure from the back surface of the lens to the ground glass when the image of some distant object has been sharply focussed on the screen. This will be the focus: we will suppose 16 in. Now, F 32 means $\frac{1}{32}$ of 16 in., which is $\frac{1}{2}$ in., therefore a stop $\frac{1}{2}$ in. in diameter is with the 16 in. lens F 32, and so on with regard to any lens or any stop that may be used. Again, suppose our lens has a back focus of 6 in.: for convenience we divide the 6 in. into $\frac{1}{16}$, which we find to be $\frac{96}{16}$; therefore, $\frac{6}{16}$ in. being made the diameter of the opening of the stop, we have at once F 32, and so on with any lens or stops, we have to calculate the length of focus, to be divided by the diameter of the stop to find its proper designation.

In picture-making by photography it is a good rule never to use a smaller stop than is absolutely necessary to give *proper* definition, and in copying work, use a very small stop in order to get the *utmost definition and flatness* obtainable.

In the diagrams appended the positions of the stops are shown, with the resulting effects.

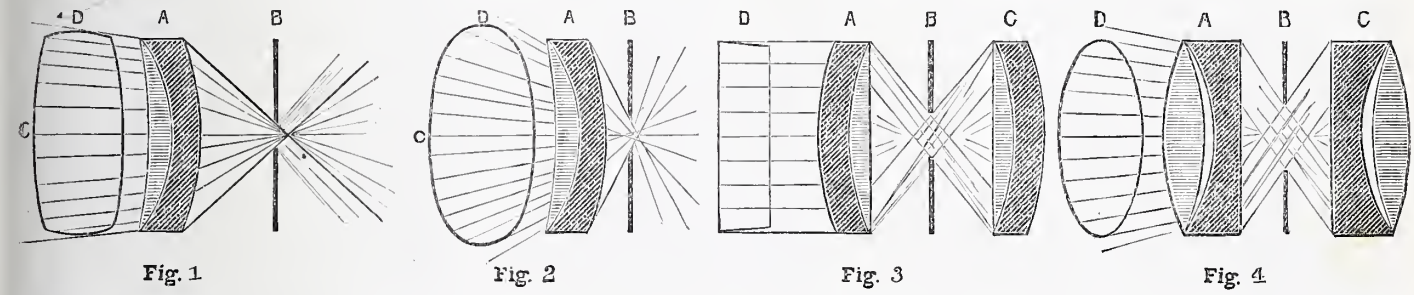


Fig. 1 Fig. 2 Fig. 3 Fig. 4

Photographic Lens. Fig. 1.—A, Lens; B, Stop at a distance in Front; C, Rays of Light forming Image; D, Showing distortion of Straight Lines. Fig. 2.—A, Lens; B, Stop close to Lens; C, Rays of Light forming Image; D, Showing greater distortion of Straight Lines. Fig. 3.—A and C, Rectilinear Lenses; B, Stop; D, Showing Straight Lines as they should be. Fig. 4.—A and C, Portrait Lenses; B, Stop with large opening; D, Showing roundness of Field.

SCIENCE TO DATE.

Calculation.—Another individual whose calculating powers are similar to those, already described in this column, of the young man presented at the French Academy, has turned up in America. Reuben Field is a native of Missouri. He is a man forty-five years of age, who has never been to school, having always been considered an idiot. He does not know how to read or write, and his intelligence is below the average, but in spite of this he has the keenest perception of relations between numbers, and can solve the most complicated calculations very quickly. Another peculiarity he possesses is the faculty of stating the exact time at any moment, even during the night after a prolonged sleep.

Caoutchouc.—In the district of the higher Orinoco have been discovered immense virgin forests of caoutchouc trees, which are said to furnish a superior product to that of Para. A curious point is that amongst the different varieties of caoutchouc trees found in the upper courses of this river there are some which appear identical with those of the Malay archipelago.

Gilding Aluminium.—It is impossible to silver or gild aluminium by the ordinary processes, by reason of the chemical action of this metal on solutions of the cyanides of silver or gold. It can, however, be done if the aluminium is first covered by a thin coating of copper. This may be effected by first rubbing the aluminium with emery, dipping in soda ley till hydrogen escapes all over the surface, treating with concentrated nitric acid, and then placing it in a solution of sulphate of copper, to which nitric acid has been added.

Carbide of Silicon.—A compound of the composition SiC has been recently prepared by long heating of silicon mixed with silica in carbon crucibles. The product of this action is heated first with caustic potash, which dissolves the unchanged silicon and some of the silica, and then with hydrofluoric acid, by which all the remaining silica is removed, together with some other impurities. Silicon carbide—SiC—is thus left as a clear green pulverulent residue. It is infusible, and at a white heat becomes converted into SiCO.

TRADE: PRESENT AND FUTURE.

**** Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

TAILORING TRADE.—At Newport (Mon.) union men are locked out, and the employers express themselves determined to fight the exclusive workshop system. The lock-out in the Manchester tailoring trade is not general. In Liverpool, Newcastle, and Bradford only a few men are affected. London will not join the movement.

ENGINEERING TRADE.—There is a distinct improvement in the condition of the Lancashire engineering trade. Large stationary engine makers have secured good orders, while orders for locomotives have been placed in this district. Boiler makers report an improvement. No improvement is reported in the Mersey shipbuilding trade, but at Barrow shipbuilders are fairly busy. The returns of the Amalgamated Society of Engineers for the past month show a slight increase in the number of unemployed. As there is a fair demand for pattern makers, it may be taken that a fair amount of new work is coming forward. In the Steam Engine Makers' Society the number of unemployed is still about 2½ per cent. The iron trade of the district has now a stronger tone in some departments.

SILVER TRADE.—Better prospects prevail, and Sheffield houses who combine the manufacture of cutlery with that of silver are reaping the benefit of the strike at Messrs. Rodgers'.

MARINE IRON TRADE.—For general marine work trade has not been so bad for some years. Large numbers of ships are laid up for want of work.

FILE TRADE.—File workers of Sheffield are only working three days per week. This is one of the fruits of the new tariff in Spain and Portugal.

RAILWAY MATERIAL TRADE.—A few orders are to hand, and of late a number of indents from abroad have helped a fair home demand.

ARMOUR-PLATES TRADE.—The Sheffield armour-plate mills are engaged on English Government work.

CUTLERY TRADE.—The strike at Messrs. Joseph Rodgers & Sons', Limited, promises to be keen. Three branches of the trade are affected—forgers, grinders, and cutlers. The "team" system is the bone of contention.

TIMBER TRADE.—London sales have consisted of nearly every kind of wood imported into this country. Prices are unaltered—a parcel of pitch pine timber from Pensacola fetching from 33s. to 62s. per load; 1¼ in. by 6 in. 1st yellow flooring, 13s. 6d. per square; 1 in. by 6½ in. yellow flooring, 13s. per square; ⅞ in. by 6½ in., 7s. per square. Reports from the provinces show no great demand.

COTTON TRADE.—Operatives favour the adoption of the eight hours day in the cotton-spinning industry. Employers are of opinion that an Eight Hours Bill would result in the ruin of the Lancashire cotton trade. As yet, however, no organised attempt is being made by the operatives to reduce the hours of labour. The suggestion to reduce wages 10 per cent. has been abandoned by the masters, and a 5 per cent. reduction is now proposed, but some time must elapse before the opinions of the whole of the master cotton spinners can be obtained.

STEEL TRADE.—Important developments of the Staffordshire steel trade are in progress, and the Midland district will soon be independent of importations from Sheffield and the North of England.

COAL TRADE.—An immediate development of coal mining in the Ashton-under-Lyne district is expected to follow the important discovery of coal in that locality.

SHIPBUILDING TRADE.—Our Liverpool correspondent writes:—There is no alteration in the shipbuilding trade. Everything remains very quiet; the freight market continues to be depressed, but there is a slight improvement for freights from San Francisco, which will allow some of the Liverpool ships that have been lying idle at that port to come home. The grain shipments from America are so large that it is difficult finding storage room, and some of the enterprising merchants have been inquiring upon what terms owners of idle vessels will let them for wheat storage. Negotiations are in progress to bring about the termination of a dispute between ship-carpenters and ship-joiners employed in the Aberdeen building yards.

JEWELLERY TRADE.—The London trade is still stagnant to a degree—holidays and departures from town being the chief cause. Next season we hope the coming royal wedding will put West End jewellers on better terms with themselves.

SHOP:

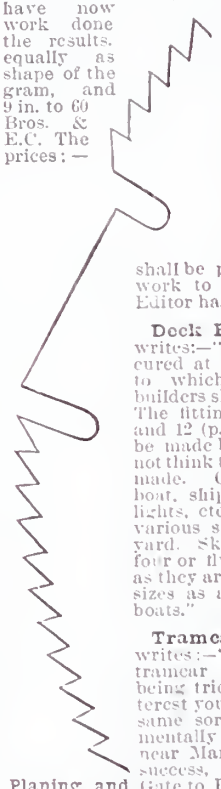
A CORNER FOR THOSE WHO WANT TO TALK IT.

**** In consequence of the great pressure upon the "Shop" columns of WORK, contributors are requested to be brief and concise in all future questions and replies.*

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of WORK in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given.

I.—LETTERS FROM CORRESPONDENTS.

Circular Planing Saw.—A. J. H. (*Brixton*) writes:—"In answer to several correspondents who have written about the new circular planing saw, I have delayed the reply until I could satisfy myself that it could do what the manufacturers state it can—*i.e.*, 'cut and plane all kinds of wood by the same action as an ordinary circular saw, producing a beautifully smooth surface equal to hand planing, with little additional power and no more labour than is required for ordinary sawing.' I have now seen the saw and some work done by it, and am surprised at the results. It will plane cross cuts equally as well as deep cuts. The shape of the saw is shown in the diagram, and can be had in sizes from 9 in. to 60 in. of Messrs. Sanderson Bros. & Co., 101, Leadenhall Street, E.C. The following are some of the prices:—9 in., £4; 12 in., £4 10s.; 18 in., £5 10s.; 22 in., £6 10s.; 30 in., £8. Those readers of WORK who require one can, by mentioning this paper, be allowed a discount of 10 per cent. I shall be pleased to show the saw at work to anyone interested. The Editor has my address."



Planing and Cutting Saw.

Dock Fittings.—A CRAFTSMAN writes:—"Most of these can be procured at Stevens' Model Dockyard, to which place intending boat-builders should send for a catalogue. The fittings represented by Figs. 7 and 12 (p. 155, Vol. IV.) will have to be made by the boat-builder, as I do not think they can be procured ready-made. Capstans, binnacle, ship's boat, ship's bells, cleats, small skylights, etc., can all be procured of various sizes at the Model Dockyard. Skylights large enough for a four or five-foot boat must be made, as they are only kept in stock of such sizes as are suitable for three-foot boats."

Tramcar.—A. J. P. (*Manchester*) writes:—"Seeing in No. 173 that a tramcar worked by ammonia was being tried in America, it may interest your readers to know that the same sort of tram is being experimentally run at Moses' Gate, Bolton, near Manchester. If it proves a success, it will run from Moses' Gate to Bolton instead of the horse tram."

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Text-Book on Electricity.—P. L. (*Selly Oak*).—"Elementary Lessons in Electricity and Magnetism," by Silvanus P. Thompson, price 4s. 6d., is one of the best books on the subject for a beginner, because the lessons given therein are simple and sound. You did well to repeat your question in your second letter, but must not expect an answer to it in three weeks from date. The reason for this delay has been frequently given by our Editor in "Shop."—G. E. B.

Model Yacht.—J. E. W. (*Islington*).—J. E. W. asks too general a question for me to answer. If he gives the size of his model and the kind of rig he wishes, I will send him the proportions that the masts, sails, spars, etc., should be, as they will differ very much for a cutter, schooner, yawl, or lugger, each rig requiring spars, sails, etc., of various measurements. Send what you require, and I will at once reply; but I must first have description of rig and model.—L. Y.

WORK, Vol. I.—L. H. (*Bolton*).—Vol. I. is out of print, but if you watch the "Sale and Exchange" column you will sometimes see one offered for sale; or you can advertise therein for the volume. The published price of each volume of WORK is 7s 6d. Glad to hear you think so well of the publication.—ED.

Watch Tools.—WATCH.—Catalogues of watch tools can be obtained from any tool dealer's—as a rule, without charge if a trade card or bill-head is sent with the application for one. Any of the following firms will, I expect, send you an illustrated catalogue if you write: Gray & Sons, Clerkenwell Green, E.C.; Plucknett & Co., Poland Street, W.; or Grimshaw & Baxter, Goswell Road, E.C. If you are not in the trade, and will send to the Editor, I will see what my influence will do towards getting you one.—H. S. G.

Electric Alarum.—L. C. (*Maidstone*).—You will find a full illustrated description of an electric time alarum in No. 32, p. 497, Vol. I., of WORK. Several other designs for alarums were given in Nos. 40 and 48, pp. 636 and 763, Vol. I., and in pp. 157, 175, 226, 416, 582, 699, and 723, Vol. II., of WORK. A continuous ringing electric bell, suitable alike for a time alarum or a burglar alarum, was illustrated and described in No. 20, p. 312, Vol. I., of WORK.—G. E. B.

Stain for Drawers.—A READER OF "WORK."—The light oak appearance of the wardrobes and bedroom furniture, as seen in the shops, is not done by the usual stains, as used by French polishers—it forms a trade by itself. You will find full particulars of "how it is done" on referring to "Graining Cheap Furniture," p. 187, No. 116, of WORK, Vol. III., June 6th, 1891.—LIFEBOAT.

Black Lacquer.—LACQUERER.—Mix lamp-black, gold size, and turps to the consistency of thin cream, and apply with a camel-hair brush. Should it rub off on drying, add a little more gold size. Chemical black: Make a strong solution of nitrate of silver, and also of nitrate of copper, mix, and dip the articles in it, and heat over a gas flame till the required blackness is obtained.—R. A.

Incubator.—ONE IN A FIX.—I cannot say definitely why your regulator and thermometer will not work in unison, but, judging from your letter, I should imagine you have failed to fix these fittings in their proper places. Possibly the J tube is not fixed quite high enough; vary its position and note results. You will also do well to read up that part of the original article dealing with this portion. If you follow the instructions there given, and have made fittings as described, or obtained them from Mr. Stevens, they cannot fail to work satisfactorily.—LEGHORN.

WORK Volumes.—A. G. (*Lambeth, S.E.*).—Some of these are out of print. They cost 7s. 6d. each, bound. You should advertise for any you want in WORK, or write to Cassell & Company, London, E.C.

W. C. Connection.—SHARP.—If you write to Kemp, Coldharbour Lane, Brixton, London, he will furnish you with all particulars. Kindly mention WORK.

Carpentry Tools.—AMATEUR.—For tools, you cannot do better than apply to Melhuish, Fetter Lane, London, or others advertising in WORK.

Glass Blowing.—TWIX.—As soon as a capable writer submits the subject to us it shall receive attention.

Analytical Chemistry.—STUDENT.—We intend to deal with this. Make it known.

Bicycles.—D. B. D. (*Penryn*).—Our correspondent is now in Liverpool. You had better write to the Patent Office, London, E.C.

Gum for Envelopes.—AGRICOLA (*Gartly, N.B.*).—The gum used for envelopes, as also for postage-stamps, is, I believe, dextrine. It is made from starch by treatment with acid or diastase, and is much cheaper than gum-arabic. It can be bought as a powder at the chemist's, and dissolved in water.—M. M.

Telescopes.—W. H. (*Chorley*).—Some short illustrated papers on the hand-working of glass specula for the Newtonian telescope, which were commenced in No. 160 of WORK, and are now publishing, will give you the information you want.—E. A. F.

Engine.—NO NAME.—Many models are made without "pet cocks," which is the correct term, but they ought to be put on a cylinder of 3 in. by 2 in. size: if not, there will be accumulations of water at the bottom.—J.

Smithing.—ASPIRANT.—As regards your trade, there is no literature worth naming. There are four small volumes on "Blacksmithing," published by M. T. Richardson, New York, which it would be worth your while to get. You can get them of Trübner, Ludgate Hill, E.C., at 5s. each. There is also a very elementary work, entitled "The Smithy and Forge," published by Crosby Lockwood, Stationers' Hall Court, at 2s. But I should advise you to take a range of reading much wider than this. I should study generally engineering and metallurgy. I hardly know what books to recommend, there are so many good ones. Supposing you take the following:—Holmes on "The Steam Engine," price 6s., published by Longmans, Paternoster Row; "The Strength of Materials and Structures," by Sir John Anderson, also published by Longmans, at 3s. 6d.; "Metals: their Properties and Treatment," by C. L. Bloxam, also by Longmans, 3s. 6d.; "Steel and Iron," by W. H. Greenwood, published by Cassell & Co., E.C., at 5s.; "Practical Iron Founding," by myself, published by Whittaker & Co., at 4s. Look out for Cassell's New "Technical Educator" articles.—J.

Iron Rivets.—W. H.—You can get rivets of the Phœnix Bolt and Nut Company, Handsworth, near Birmingham.—J.

Bent Iron Work.—AN OLD SUBSCRIBER.—You can get the bent iron of Whiteley, Westbourne Grove.—J.

Institution of Engineers.—M. J. M. E. (*Kirkdale*).—The qualifications necessary to enable a

man to become a member of the Institution of Mechanical Engineers are entirely of a practical character. Besides members, there are graduates, associates, and honorary members. According to the articles of the bye-laws: By article 2, "Candidates for admission as members must be engineers not under twenty-four years of age, who may be considered by the Council to be qualified for election." By article 3, "Candidates for admission as graduates must be engineers holding subordinate situations, and not under eighteen years of age; and they may afterwards be admitted as members at the discretion of the Council." By article 4, "Candidates for admission as associates must be gentlemen not under twenty-four years of age, who, from their scientific attainments or position in society, may be considered eligible by the Council." By article 5, "The Council shall have the power to nominate as honorary life members gentlemen of eminent scientific acquirements, who, in their opinion, are eligible for that position." A recommendation for admission to the Mechanical Engineers must be signed by not less than five members, and forwarded to the secretary, who will then submit it to the Council for their approval. It is then inserted in a ballot-box approved by the Council, and signed by the president, and forwarded to the members for election or otherwise. The form of proposal is as follows: "Mr. —, being not under twenty-four years of age, and desirous of admission into the Institution of Mechanical Engineers, we, the undersigned, proposer and seconder, from our personal knowledge, and we, the three other signers, from trustworthy information, propose and recommend him as a proper person to become a member thereof. Witness our hands this day of . Signatures of members." The proposer and seconder must write from personal knowledge of the candidate. The remaining three may write from trustworthy information, without personal knowledge. The ballot lists sent out to members specify the name, occupation, and address of each candidate, and by whom proposed and seconded. These lists are opened only in the presence of the Council on the day of election by a committee appointed for that purpose. When the candidate is elected, the secretary gives him notice of the fact, and he is then required to pay his entrance fee and his first annual subscription, and also to sign a form expressive of his loyalty to the regulations of the institution. The entrance fee is £2, and the annual subscription £3. Any further information you may require may be obtained of the secretary, Alfred Bache, Victoria Chambers, London, S.W.—J.

Water Supply.—PUMP.—As your water is to be drawn from a well, it must be pumped up. If the well is sunk near a shed, your cheapest way to get the water will be to use an ordinary plunger forcing pump, driven by a hand crank, for the small quantity you want—twenty gallons a day is very little if it is to supply your house, for we reckon at least twenty gallons a day for each inhabitant. However, I should not advise you to sink a brick well; a tube well would be better, and the pump then could be fixed on the top, and the cost of sinking would be very little. These tube wells are the same as those used in Abyssinia, and I have found them very successful in small holdings in the valley of the Thames.—F. C.

Leaky Roof.—PUMP.—On the next course of brickwork above the line of your roof, you should pick out the "pointing"; then flash the roof with strips of zinc bent over and forced in between the brick courses; then repoint the brickwork joints with lime mortar; you can leave the flashing straight on the roof with an overlap of five inches, but fasten it to the tops of the corrugations, about every ten inches, with galvanised rivets. *Do not use copper rivets.*—F. C.

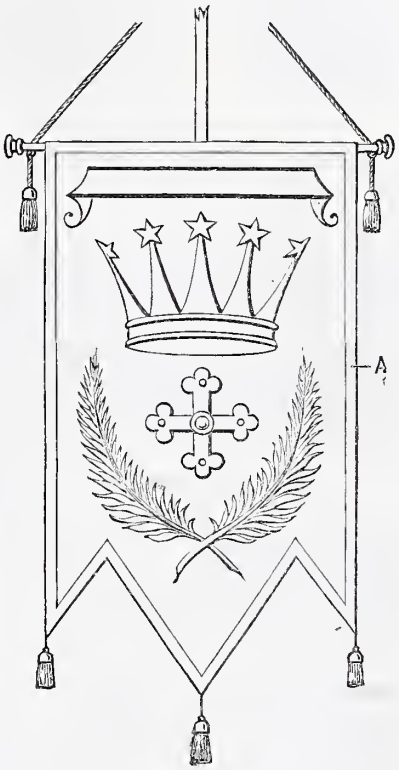
Piano.—MECHANIC.—Take out the backing of piano, and examine carefully, and see that the glue has not started in any of the joints behind the wrest-plank and bent side. If this has occurred, you must glue and put some bolts or screws in; if it is only the wrest-pins loose with frequent turning, you must replace these with a size larger, which you can obtain from W. Hughes & Co., 37, Drury Lane, London, W.C. If the wrest-plank is split where the wrest-pins enter, it will require a new wrest-plank.—T. E.

Piano Questions.—W. H. E. (*West Hartlepool*).—Bone is not used for piano keys, though I have seen it used for German harmonium keys; ivory and celluloid are used for piano keys. You could obtain these from a manufacturer of keys; but I cannot tell from your letter whether you require these for repairing purposes or making. I may say it is an awkward job laying ivory, unless you have had experience. You can obtain the ivory, strings, and wrest-pins from J. & J. Goddard, 68, Tottenham Court Road, London, W.C. The best wood to make a sound-board is Swiss pine, but a good substitute is spruce of first quality. The sound-board has no open space in it. Obtain index to Vol. I. of WORK from Cassell & Company, and read articles on "How to Make a Piano"; you will obtain information as to sound-board.—T. E.

Pianoforte Making.—B. J. (*Bingley*).—If you will obtain Vol. I. of WORK from Cassell & Company, or through your bookseller, and read articles on "How to Make a Piano," you will obtain all the information you require.—T. E.

How to Make a Door.—B. H. R. (*Cardiff*).—If B. H. R. will read *below* for *above* in the sentence "find the centre of height of door, and 1 in. *above* the centre square across the top of the middle rail" (see page 629, No. 144), I think he will acknowledge that this makes matters very much better; and if, in addition to this, he is told that the article referred to was an answer to a question where the door required would not be more than 6 ft. 6 in. high, I think his well-founded criticism will be met.—E. D.

Making a Small School Banner.—A. M. (*Glasgow*).—As you give no idea of the kind of device you require, I shall perhaps help you best by giving a sketch of a banner made by me for some St. Stephen's schools, and describing the method of making it. The ground was a very finely twilled silk, called "bishop's purple"—one yard silk; usual width; cost, 11s. The devices on it were in oil paint and gilding. The silk having been shaped, and the outline of the devices drawn on cartridge-paper and pricked through, the pattern was pounced upon the silk. The parts to be covered were then sized with a fairly strong solution of isinglass full up to the outline, and the little pounce spots mixing with the size made the outline sufficiently visible. When dry, the crown, except the stars, was laid in with gold-size, and gilt when properly tacky; then the stars were sized and silvered with silver-leaf. The crown is, of course, symbolic of Stephen—



School Banner.

Stephanos, a crown. The remaining devices were painted in tube oil colours, freely mixed with varnish as a medium; the cross, vermilion; the palm, green; the lettering, blue, with red initials, on a buff ribbon; all devices being shaded and lined with deeper shades of their own colours. The legend, not given in the drawing, was "*Ecc. S. Stephani.*" The border, A, was sewn on; the cord carrying tassels was a twist of three colours; and the pole was of oak, with a brass finial. The devices might be embroidered instead of painted, if time were no object; or a quicker and cheaper way in which to get up a banner would be to use simply calico, and paint the ground colour and devices in distemper. Gilding can be done on this. There is another way in which I once made an effective banner of the "Creation." Seven medallions were cut out in white silk; in the centre one was painted the church to which the schools belonged, and the other six bore emblems of the six days of creation. These were sewn on to a ground of suitable coloured material. Or, again, devices may be simply cut out in one coloured material and sewn on another, all painting being dispensed with. I have made banners of the "cardinal virtues"—thus, "Prudence" among these was very effective. It was a "humble-bee"—the body black velvet with yellow bands, the wings a light brown stuff, and the eyes gold paper, all sewn on. These are all alternative plans; but for a really fine banner nothing will equal the first.—S. W.

Safety Bicycle.—T. C. (*Birmingham*).—Articles on the Safety Bicycle appeared in WORK, Nos. 107, 111, 115, 119, 124, 127, 132, 137, and 142.

WORK Volumes.—ANXIOUS.—Volume I. of WORK is out of print; Vol. II., price 7s. 6d.; post free, 8s. 3d. Send postal order to Cassell & Co., London.

Maguay Electric Lamp.—J. M. & Co. (*London, E.C.*).—This can be obtained of the Secretary, Sherborne Electrical Installation Company, Dorset.

Naturalists' Papers.—TAXIDERMIST.—Thanks for your letter. When a thoroughly competent writer comes before us, we intend to give space to this subject.

Umbrella Stand.—G. H. (*Stockton-on-Tees*).—A design has appeared in No. 175.

Fire-box.—F. W. R. (*Sunderland*).—I think the proportions will do; but there is generally trouble with these small boilers, the difficulty being to keep up sufficient pressure of steam.—J.

Incubator.—H. J. (*Blackburn*).—For size of one-hundred-egg machine, see my reply to J. B. N. (*Lancashire*). Thanks for your offer. If you would like full-size drawings, please write to the Editor.—LEGHORN.

Dialling.—A. R. (*Moseley*).—The difference between sun and clock for each day is given in "Whitaker's Almanack" (London: Whitaker & Son, Warwick Lane, Paternoster Row, E.C.).—A. Y.

Plumbing.—PLUMBER.—Before you see this probably the plumbing papers will be with the printer awaiting publication.

Rubber Solvent.—C. E. S. (*Taranaki*).—Benzene is a good solvent for indiarubber, also sulphide of carbon. It may also be dissolved by naphtha, spirit of turpentine, and chloroform; these solvents will not destroy its elasticity.—A. S. P.

Tire Cement.—A CONSTANT READER.—I have no recipe for making these cements, as it is not worth anybody's while attempting to make them in small quantities. Cement for fixing tires to iron rims can be bought at 1s. per lb. or in 6d. boxes; solution for mending tires or joining rubber to rubber can be had for 6d. and 1s. per bottle; both of any cycle dealer.—A. S. P.

Astronomy and Chemistry.—READER FROM THE FIRST.—Our staff is already a large one, and much matter awaits publication, but the subjects of astronomy and practical chemistry shall be dealt with as soon as some really attractive papers are submitted to me.—ED.

Lathe for turning Elliptic Sections in Metal.—D. R.—I do not see why the ordinary oval chuck should not be made strong enough to do such work. If the work were long, there could be a second oval chuck attached to the poppit, so as to carry the other end, and this second chuck would be turned by the work itself, or might have an independent motion communicated to it. There is a lathe invented by Messrs. Koch & Müller. This is very ingenious and rather complicated, and would require a whole page of WORK to make it all clear. The principle is that of the French oval chuck, in which there is no ring, but a mandrel within the ordinary one, and a short cross slide in the face-plate. In the German lathe, however, which is intended for metal-work, the inside mandrel may make any proportional number of revolutions compared with those of the main mandrel, so that not only ellipses, but three, four, or more lobed sections can be produced. I do not know how such work as this is actually done in practice, but if I wished to turn the oval flanges of a quantity of brass stuffing glands, I should prefer to use the principle of the copying lathe. Have one pattern flange made, and fit it on a kind of back shaft, so as to make equal turns with the mandrel; then take out the screw of the cross or traversing slide of the saddle, and fix a rubber or roller upon this slide, to press upon the revolving pattern and be kept up to it by a weight; this would cause the cross slide to move in and out twice in the revolution. I would use a milling cutter instead of a tool, and have the roller on the pattern of the same diameter; thus the lathe would turn very slowly, and one revolution would complete the work. See also Northcott's "Multi-purpose Lathe," in his "Lathes and Turning."—F. A. M.

Window Sashes.—R. A. DE N. (*Kensington*).—If a simple plan for reversing ordinary window sashes could be devised without infringing on one of the many patents that already exist, the very fact of its being unlike any other would cause the inventor to patent it at once, especially if it could be done very cheaply, as you desire. There are a great many wonderfully ingenious inventions for combining sliding with reversible sashes, but, as you have found out, they are more adapted for new than old sashes. The especial patent to which the article mentioned refers is a Mr. Hough's, of 135, Great Suffolk Street, Southwark, and he claims for it that *existing windows can be adapted to this principle in a few hours at a small cost.* It was the fact of its being easily adapted to existing sashes and its practicability that caused it to be noticed.—E. D.

Electricity Examination.—A. W. (*Lynmouth*).—Write to the Secretary, Central Institute, Science and Art Department, South Kensington, enclosing a stamp, and ask for a prospectus. From this you will learn how to proceed in studying for an examination in electricity and magnetism. Lists of questions are published by the same department for a few pence each copy. Each year, for several years back, has its own list, and the price of each full list, containing all the questions in full, is 6d. The Science and Art Directory, price 6d., gives full

instructions respecting the course of study for examinations. Both Guthrie's and Thompson's books on Electricity and Magnetism may be studied by you with advantage.—G. E. B.

Balance Staff to Lever Watch.—HOROLOGY.—I scarcely know how to answer this query, which seems so simple, but which to do, even to one that gets such a job once a week, is not easy, if it is to be done as it should. However, the tools necessary are: First, a lathe or turns, a graver, screw ferrule, bow, pivot file and burnisher, one or two bell-metal polishers, a little oil-stone dust, and diamantine for finishing, a douzième gauge or pinion gauge for measuring the length, etc. To begin, take out the old staff, take off the roller and hair-spring, and knock the balance off the staff, keeping it for measurements. Now get a needle slightly larger than the body of old staff; let the temper of it down to a blue. Get a little piece of brass, and drill a hole through it rather smaller than the needle, and drive it in tight. Now file it off half as long again as the old staff, and file centres on its ends. Put on ferrule, mount it in turns, catch the brass true, and square the shoulders. Now turn the steel down till the roller begins to go on, then mix a little oil-stone dust with a little oil; put a little on your polisher, and grind it down till roller will almost go up to the brass collet. Carefully clean off all oil-stone dust. Take another polisher, mix a little diamantine and oil, and repeat grinding till roller is just free of the collet; then finish with the burnisher. With the pinion gauge measure from roller to seat for balance, and fit it on tightly; do the same for the hair-spring. Gauge from balance-seat or roller-seat to whichever pivot is left on, and turn new one a very little longer. Turn it to the proper shape and nearly to size, then finish with file and burnisher till it fits the hole nicely, and comes through far enough to rest on the endstone. Now take the measurement outside both holes, and turn the remaining pivot to agree to this measurement, allowing a little for rounding up the pivots when all is done. Now rivet on the balance, and see it is running flat and true; if it does not, you must make it by bending the arms. See also it is in poise—that is, that one part of the balance is no heavier than the other—else your watch will vary in position. Put on your roller, and see that it is true and flat, and then place your hair-spring in position, and put watch in beat by adjusting the hair-spring or the roller. This is a rough outline for a common job, but it is difficult to give instructions on paper for a delicate job like this. Besides, in your query you do not say whether it is for a full plate or three-quarter plate, over-sprung or under-sprung, plain or compound balance: each requires a little different way of working in. Neither do you say which pivot is broken, or whether the old staff is a brass collet or a solid steel.—A. B. C.

Clock Movements.—J. H. R. (*Sheffield*).—J. J. Stockall, Clerkenwell Road, London, imports all kinds of American movements, and I daresay will supply you with one; or you can obtain any you require from C. Churchill & Co., Cross Street, Finsbury; or Mr. Cohen, Kirkgate, Leeds. In any case, a letter to either, enclosing stamped addressed envelope, will get you particulars; and for Seth Thomas' clocks and movements only, write to R. M. Marples, Cripplegate Buildings, Wood Street, London, E.C.—A. B. C.

Trade.—ANXIOUS.—You can go as an apprentice to a joiner till you are twenty-one; or you can go as an articled pupil to a builder, spending part of the time in the workshops and part in the office: in the former case you would receive a wage, in the latter you might have a premium to pay. You should also attend the science and art classes in the evenings, studying mathematics, geometry, building construction, mechanical or architectural drawing, and perspective. You might travel on your bicycle in the summer months, and go to lodgings in the winter, when you could attend the classes. I cannot give you any names; but by making inquiries, or by consulting a directory, you could ascertain the names of suitable firms; or if you know anyone in the building trade, they might be able to give you the name of a suitable firm.—M.

Mahogany Filling.—H. E. (*Eastbourne*).—Cover the mahogany with a thin paste of plaster-of-Paris in water. When this has set and is dry, rub the surface down with fine glass-paper held on a cork hung. Coat with boiled linseed oil, let this soak into the pores, then apply another coat; allow this to get firm, then commence with the French polishing. Mahogany stopping is merely white-lead putty tinted with red lead; it is used to fill up cracks in mahogany surfaces before "filling" and polishing.—G. E. B.

III.—QUESTIONS SUBMITTED TO READERS.

*** The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Reversible Gas Alarm.—F. G. H. (*Torquay*) writes to D. B. (*Glasgow*) (see No. 172, page 252):—"Will you kindly inform me of the cost of fitting the above to your premises, and of maintaining the same, say, at per year; also how long you have had the system working, and whether you have seen it tested elsewhere?"

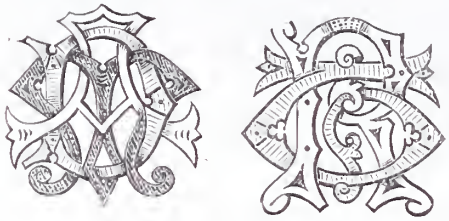
Firewood.—J. (*Penge, S.E.*) writes:—"Will any reader kindly give me information as to firewood making, bundling, etc.—how to buy the wood and materials, prices, etc.?"

Leather Belt.—VENO writes:—"I have a leather belt, which is made to revolve round two pulleys; it requires a smooth dry surface. I have varnished it with shellac varnish, but it cracks when it has been running a short time. Can any of your readers inform me if there is anything I could put in the varnish to prevent cracking?"

Parquet Flooring.—HERRINGBONE writes:—"Would any reader kindly enlighten me as to an effective, and at the same time inexpensive, way of fixing parquet flooring, ¼ in. thick, to an old under-floor of ordinary *deal*, and also to *stone* hall floor? I think at present glue is used in the first instance, and a mixture of asphalte, mastic, and tar in the second, but no doubt there is a cheaper and equally good way of fixing oak to wood floor than using glue only. Please tell me also the proportion of mixing the mastic tar. As I know that there are a good many parquet layers among your readers, the question will be of general interest."

IV.—QUESTION ANSWERED BY A CORRESPONDENT.

Fret Monograms.—T. B. P. (*Winlaton*) writes:—"Enclosed are two monogram designs—one



"A. M. D." and "R. T." Monograms.

'A.M.D.', in reply to C. H. D. (*Shepherd's Bush*); the other 'R. T.', in reply to R. T. (*Glasgow*). I trust they may be favourable to each."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—A. N. (*Newark*); C. W. L. (*Newcastle-on-Tyne*); A. L. C. (*Camberwell*); CONSTANT READER; H. J. (*Prestwich*); V. D. (*Portsdown Road*); MAIL CART; WILGIB; HARDY PATENT PICK CO. (*Sheffield*); G. A. F. (*Pontefract*); R. A. (*Leeds*); A. L. C. (*Camberwell*); W. C. (*Wolverhampton*); J. D. (*Cheadle*); W. K. (*Manchester*); T., LIMITED (*Birmingham*); READER OF "WORK"; P. B. H. (*Southampton*); H. A. (*Thornhill Edge*); P. E. (*Birkenhead*); J. B. (*Weymouth*); W. D. (*Wellingborough*); R. P. W. (*Worcester*); T. J. H. (*Nuneaton*); FRAMEMAKER; J. H. (*Leith*); A. D. J. (*Notting Hill, W.*); F. K. (*Bradford*); W. W. H. (*Mirfield*); MAPLE LEAF; W. S. (*Liverpool*); J. S. (*Leith*); W. P. B. (*Birmingham*); AMATEUR PHOTOGRAPHER; A. F. (*Leicester*); OIL PAINTING; E. H. (*Dundee*); W. H. J. (*Halifax*); W. H. (*Nantwich*); J. T. (*Blantyre*).

NOTICE TO READERS.

AMONG the principal articles in next issue (No. 182) will be:—

SOMETHING NEW IN SINKS.
PHOTOGRAPHIC SCENERY PAINTING.
BOOT AND SHOE MAKING.
EARLY CHRISTIAN DESIGN AND ORNAMENT.
HOW TO FEED MODEL BOILERS.
WHAT THE GOLDSMITHS' COMPANY SHOULD DO.

*** The Editor makes this intimation in the hope that readers, having friends interested in any of these subjects, will bring the same to their notice.

"WORK" PRIZE SCHEME.

FOURTH COMPETITION.

"Tourists' Road, Water, or Rail, Travelling Requisite" Competition.

THE Briton who does not tour or travel when he can get the chance must be an exceptional individual. We meet with people bound, not only for the Continent, but for destinations quite near home, so loaded with packages that a hand-truck is needed to move them. Generally, the Englishman has good reason to wish he had not tried to be so comfortable, with his Noah's Ark of cumbersome oddments, and that he could condense the lot into a single package, to strap on his back or carry in his hand, so that he could at times label it and send it on by quick train or carrier, while he roamed a free man. Such a light, handy "hold-all," or outfit, might be suggested for an improved travelling requisite, or anything else more useful. To give zest to, and widen the field of original research, such an outfit might, for instance, combine with it some useful appliance to be used in case of emergency—such as life-saving, or in pleasure hunting while holiday bent. This we must leave to our readers' judgment, and feel sure that anything to make travel more enjoyable will be welcomed by the public and the readers of WORK who have to travel. By the time this announcement is made most of us will have had some experience of holidays and the pleasures (?) of luggage. For the three best suggestions for an "Improved Tourist's Travelling Requisite," the following prizes will be awarded—

First Prize, £3;
Second Prize, £2;
Third Prize, £1.

CONDITIONS AND RULES OF THE "TOURISTS' TRAVELLING REQUISITE" COMPETITION.

ALL Descriptions to bear the WORK Prize Coupon, cut from one of the numbers of WORK in which the Prize Scheme is announced.

Each Description to be signed with an original *nom de plume*, and to have the writer's real name and address securely attached to the manuscript in a sealed envelope.

Each Suggestion should be fully described in respect to its purpose, construction, and working, and, where possible, should be illustrated with a drawing of the article itself and its various parts, to elucidate the description.

A Suggestion not illustrated will have an equal claim in the competition, provided the description be sufficiently in detail to convey a full idea of the article suggested.

In the work of judging regard will be had to the practical nature and utility of the suggestions, and their prospective popularity.

The Prize Suggestions and Drawings, and any others, to be published, if desired by the Editor, in WORK, but the copyright thereof to remain with the authors.

Copies of MSS. and Drawings to be retained by the competitors, as in no case can the return of MSS. be undertaken.

The Editor of WORK will supervise the judging of the Suggestions, and the selection, or decision, as determined upon by him is to be final.

All manuscripts intended for the "Tourists' Travelling Requisite" Competition must be addressed to the Editor of WORK, c/o Cassell and Company, Ltd., Ludgate Hill, London, E.C. They must reach him on or before SATURDAY, OCTOBER 29, endorsed, "Tourists' Travelling Requisite" Competition.

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Amateurs and Technical School Workshop Managers should call at 100, Houndsditch, London, and see large stock, or send 2d. for the Monthly Register, containing nearly 4,000 lots of New and Second-hand Engines, and Engineers' and Woodworkers' Tools, and all kinds of Machinery.—Address, Editor, Britannia Tool Factory, Colchester.

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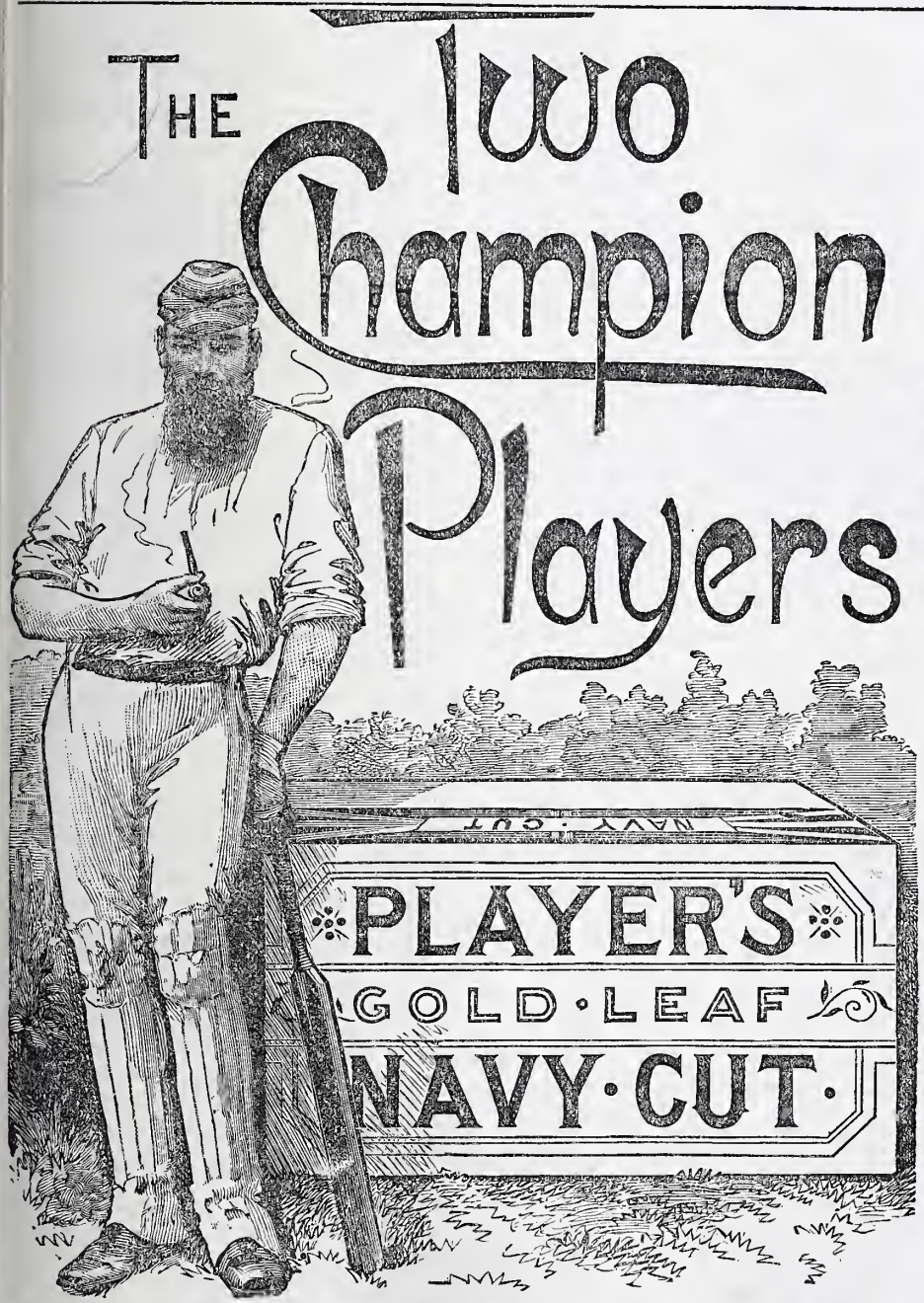

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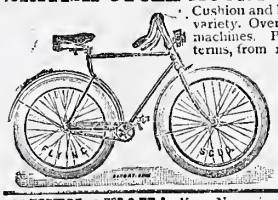

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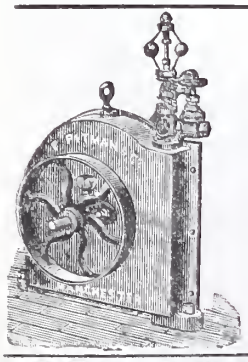

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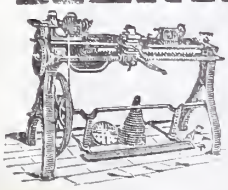

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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Vol. IV.—No. 182.] SATURDAY, SEPTEMBER 10, 1892. [Price One Penny.

WORK WORLD.

A Paris newspaper is being printed from type made from glass, and the results are reported to be gratifying. It ought to furnish very light reading.

* *

A sky-cycle, or wheeled flying machine, the invention of a Boston man, is to be exhibited at the Chicago Exhibition. Who will try it?

* *

Under the regulations of the Science and Art Department, 1,170,340 pupils were taught drawing in 6,211 elementary schools last year.

* *

The new mode of constructing steel buildings at Chicago has created a new industry. Employees have already their organisations under the term, architectural iron-workers.

* *

A new iron bridge over the Farrar, in Strathglass, Inverness, lately collapsed, with a cart of about one ton going over it! The rivets were cut as clean as a razor would slice a potato.

* *

Buildings erected at Chicago are no less than seventeen stories high. The peculiarity is the rapidity with which they are built, as only three days and a quarter are occupied in building solidly and completely one floor with its numerous rooms.

* *

An automatic arrangement in connection with the telephone has been recently devised, with a view of increasing its usefulness. Communication with the chief office is secured by putting a penny in the slot. If the line is occupied, or the person called is absent, the money is returned by the machine.

* *

In some of the ancient temples of Egypt —known to be more than four thousand years old—the stones were dowelled together with hour-glass shaped ties of the Timarish or Shittim wood, the dowel sinks being only about 1 in. deep. This wood is not now in the market, but some of the timber from Australia and New Zealand approaches it very nearly in general properties.

* *

A test has been made of a "Harveyised" nickel-steel armour-plate 8 ft. by 6 ft. and 10½ in. thick, weighing 18,000 lb. Five rounds were fired at the plate; the shot weighed 250 lb., and was thrown from an 8 in. rifled gun by a charge of 81¾ lb. of powder, giving a velocity of 1,700 ft. per second. The skin of the plate was pierced, but no crack was visible. The projectiles rebounded from the plate in fragments.

* *

"Semakuir," a Finland stone, turns black before a fall of rain, while in fine weather it is mottled with spots of white. Analysis shows this stone to be a fossil mixed with clay, and containing a portion of rock-salt and nitre. The salt, absorbing moisture, turns black when the atmosphere is supersaturated with aqueous vapour, and a dry air brings the salt, in white spots, to the surface.

* *

The Pinna, or wing-shelled bivalve, found chiefly on the coast of Sicily, is unquestionably a silk-spinner. Its silky filaments, by which it attaches itself to rocks, are extremely fine, and, after being washed, are spun, in the ordinary manner, into fabrics of very delicate texture. This material was known to the ancient Egyptians, who used it in the manufacture of mummy cloths. A veritable sea silkworm.

* *

The world's output of coal is about 488 million tons, divided as shown. The quantities stated are for 1890, unless otherwise noted :—

	Million Tons.
British Islands (1891)	185
United States (estimated 1891) ...	141
Germany	90
France	28
Belgium	20
Austria	9
Russia (1889)	6
Others	9
	488

* *

Experiment has shown that it is not indifferent, from the point of view of longevity of an incandescent lamp, to place it in any position whatever. Particularly for those which have fine long filaments, the horizontal position is not suitable; still less that which is adopted with a decorative aim, and which consists in inclining the bulb upwards. In buildings subject to vibrations, the lives of the lamps are considerably shortened if care is not taken to mount them judiciously.

* *

One hundred years since, Murdoch hit upon the application of coal-gas to purposes of illumination. He placed some coal in a tobacco pipe, and, plugging the bowl, put it in the fire and lit the gas issuing from the stem. Subsequently he lighted his offices at Redruth with coal-gas, and invented a method of extracting colouring matters from coal-tar. His steam road engine, on which he travelled from mine to mine, solved the question of steam locomotion twenty years before George Stephenson applied it to railways.

* *

Piles—23 ft. long—for the new Blackpool pier are driven by water pressure at a rate of 20 ft. in fifteen minutes. They are set in position by a pair of shear legs, and a suitable connection is screwed on the head, to which a hose pipe is connected from the steam pump. The water is forced down the inside of the pile, and being turned at the same time by levers clamped to the side of the pile, is forced down through the sand. The levers can be raised as the pile is screwed down. For screwing the piles into the clay, longer levers worked by a chain and windlass are used.

* *

A new smokeless powder—apyrite—with valuable properties, has recently been experimented upon in Sweden. It is a nitrate of cellulose, and the properties claimed for it are that it burns without a flame, it does not heat the gun in which it is fired, it can be handled and transported without danger, and is not affected by damp or heat. A gun from which 800 rounds had been fired with this substance was put aside without being cleaned, and when examined eight days afterwards was found as clean as before. Fifty grains of apyrite give an initial velocity of 2,100 ft. per second, with a pressure of 30 lb. per square inch. War Office—note!

A PORTABLE EASEL.

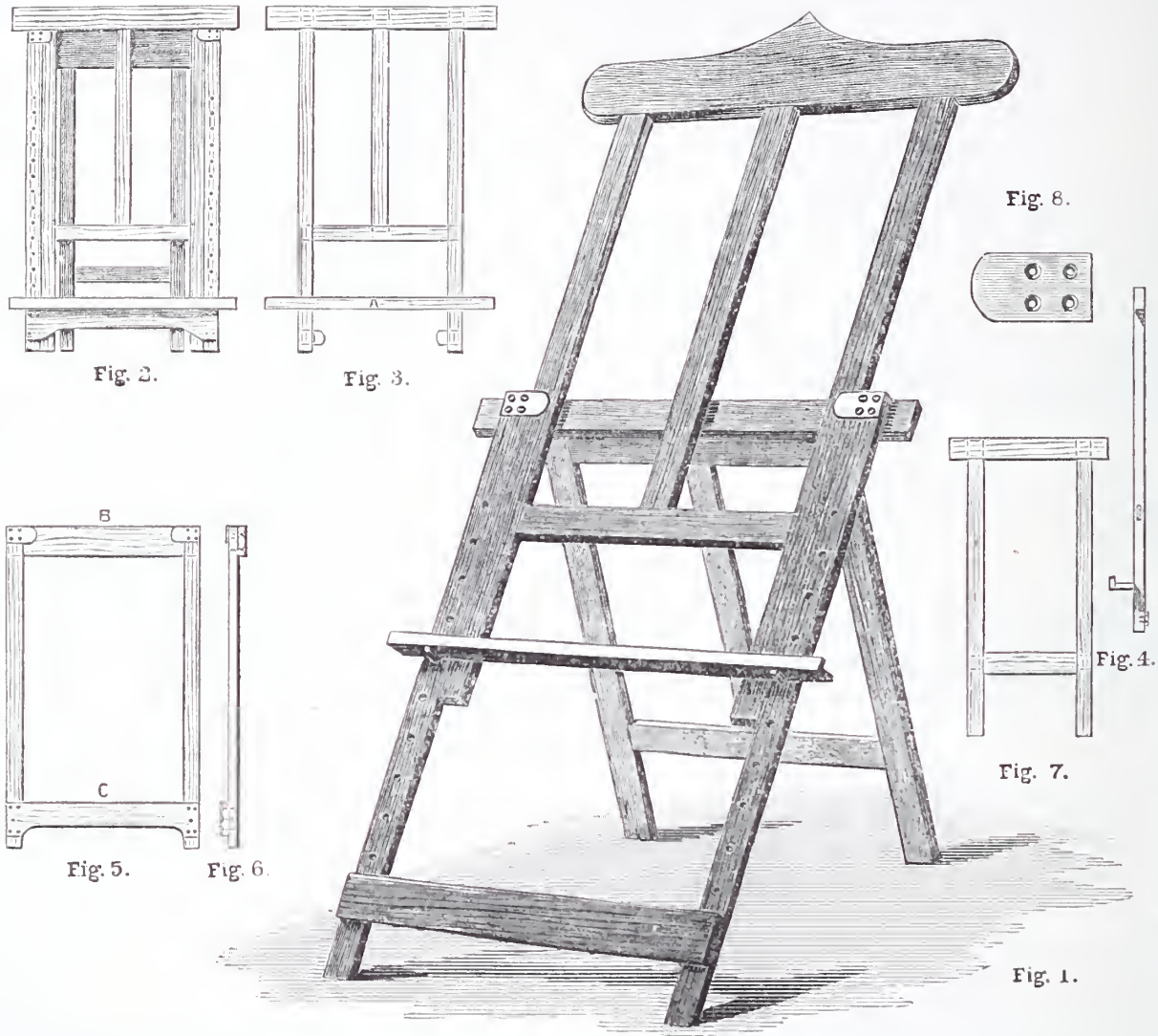
BY OPIFEX.

ADAPTABILITY — MATERIALS — CONSTRUCTION — FRAMEWORK—HINGED PROP—SIZE—FINISHING WOODWORK—BRASS CLIPS.

THE easel represented in the sketch (Fig. 1) is of very simple construction, and possesses some useful qualities. When closed it forms a good table easel, and when raised it is of a convenient height for sitting at. It is also very suitable for travelling, and may be carried carpet-bag-wise on "the tramp."

I shall not occupy valuable space in a minute description of the details of construction, trusting to the accompanying drawings to guide the reader who may be disposed to make this article for himself.

Materials.—Easels are, I believe, generally made of pine or mahogany, but I think that good straight-grained ash is better for one of this kind, which is meant to stand a good deal of knocking about; and, as it allows of much smaller scantlings being employed, the difference in weight will be very slight, and will be more than compensated for by the advantage of much greater strength.



A Portable Easel. Fig. 1.—Perspective Sketch of Easel. Fig. 2.—Front Elevation of Easel closed. Fig. 3.—Ditto, Inner Frame. Fig. 4.—Side Elevation, Inner Frame. Fig. 5.—Front Elevation, Outer Frame. Fig. 6.—Side ditto, ditto. Fig. 7.—Prop. Fig. 8.—Brass Clip (four).

Framework.—The easel consists of two frames (Figs. 3 and 5), sliding one (Fig. 3) within the other (Fig. 5), the frames being held in position by the cross-pieces A, B, C in the respective Figs. A also serves as a support for the picture, etc., while painting, and may consist of a plain slip, as at Fig. 1, or, better, formed of two pieces, as shown at Fig. 4.

Brass Clips.—As the cross-pieces are not alone sufficient to hold the frames together, two pairs of brass clips are required, one pair being placed at the upper ends of the outer frame (Figs. 2 and 5), the others at the back of the lower ends of the inner frame (Fig. 3). These clips should be of $\frac{1}{16}$ in. brass, and of the shape shown at Fig. 8.

Prop.—The easel is supported by a framed prop (Fig. 7), which is attached to the lower edge of the upper cross-piece, B (Fig. 5), by means of a pair of suitable brass butt hinges. With the exception of the cross-pieces, the frames and prop are of $1\frac{1}{8}$ in. by $\frac{5}{8}$ in. stuff, which should be well-seasoned, dry, and straight-grained ash. The top piece of the easel may be shaped as suggested in the sketch (Fig. 1), or made plain as in the other drawings, according to taste, but it should be at least $2\frac{1}{4}$ in. wide by $\frac{5}{8}$ in. thick. The cross-pieces B and C (Fig. 5) should be at least $2\frac{1}{2}$ in. wide by about $\frac{3}{8}$ in. thick, and are attached by gluing and screws, as indicated; and if C is shaped as shown at Fig. 5, the ends being about 3 in. wide, it will give more rigidity to the frame. The easel may be made any size.

Finishing Woodwork.—Careful work will be necessary, and the mortises and tenons—indicated by dotted lines in the various cuts—should be accurately made, as the success of the undertaking, which means the rigidity of the easel, depends upon such good work. The several parts should be well cleaned up with a sharp, closely set trying plane, and finished with finest sand-paper. With regard to the treatment of the finished surface, the frames, etc., when made, and before putting the parts together, may have two coats of very hard-drying varnish and be allowed to dry thoroughly, or they may be French-polished or simply oiled.

GOLDSMITHS' HALL: THE GOLDSMITHS' COMPANY.

BY A WORKING GOLDSMITH.

IN a magazine like WORK, whose aim is to be useful to workmen of all kinds, we do not feel that our duty is properly carried out by merely advising this or that workman on a technical difficulty, or by printing special articles of interest to the different trades. We hold to the idea that our position is one that calls for more than this attention to the needs of to-day, and we feel that we should clearly and distinctly speak out whenever we can see an opportunity of obtaining better facilities for the coming race of workmen: hence this series of articles to the City Companies.

For this reason we naturally give all the support and publicity we can to the classes held in technical education; and this support is not based on theoretical grounds, either, for in the mass of correspondence that comes to us from all parts of the world we have a tangible proof that men are glad to be able to refer to some centre where their doubts and difficulties will be carefully considered and answered.

From our experience, we feel ourselves to be in a position to point out a practical course to the City Guilds—one that they should consider well—for it is to them the various trades should look for guidance and help.

The City Guilds are Companies which have been formed for the purpose of pro-

moting the interests of the particular trade or calling to which the members belong. Since that is, or was, their origin, we, in this paper, who regard things from a workman's point of view, are naturally interested in the way they have been fulfilling the object of their existence; and we have lately been prosecuting inquiries with regard to the Goldsmiths' Company to that end.

Our information, being derived from the working members of the trade, may not be an exact report of the present state of things; but it will be an unbiassed report of things as they are believed to exist by such workmen.

In this article we will try to clearly set forth the view taken by the jewellery and silversmiths' trades of the Goldsmiths' Hall.

In the first place, it is mainly known as the place where the goods are sent to be hall-marked. That branch of its work we can leave out of consideration, for it has no bearing on our view of the subject.

In the second place, it is heard of as a munificent donor to trade charities.

In the third place, as the founder of a polytechnic—the Goldsmiths' Institute at New Cross. This institute is for general instruction, however, and has no special bearing on the trade matters that we are interested in.

With regard to the two last items we have nothing but praise; and it is to further an evident wish of the wardens of the Goldsmiths' Hall to assist the cause of education that we ask them to consider what follows, for it is based on thoughtful inquiry.

The first and most important step for them to take is to bring themselves in touch with the trade; at present they are not in a position to get their good deeds known and appreciated. We can give, as an instance of this, the trade's almost absolute and entire ignorance of the opportunity of learning drawing which this Company provided at Clerkenwell for many years. Then, again, there are the valuable prizes offered through the Society of Arts. Is it any wonder that they failed to raise the interest of working jewellers that could compete when not one in five hundred ever heard of them? Why not advertise in WORK?

We can make allowance for some lack of interest on the part of a guild when its prizes are passed by in an apparently contemptuous manner, although it is brought about through an oversight or fault; for as no notices ever reached the trade, a response could hardly be expected.

If the Goldsmiths' Company wish to do anything, they must let their ideas be known; and surely it would not be difficult to let notices be sent to members of the trade, even if the members of the Company cannot themselves help to spread the announcement of that prize or this competition that they institute.

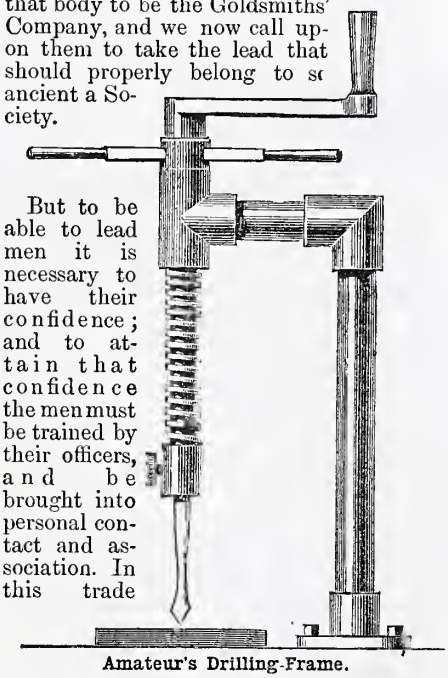
We have not been able to find out how many actual members of the trade are now members of the Goldsmiths' Company; therefore, we cannot say how far such personal influence will go. If there are so few—and it is that we rather fear—then, can they not call a meeting of the trade together to consult and consider what should be done? In this they would have plenty of precedents: from Parliament and the Imperial Institute downwards.

We understand that there is an Association of Jewellers and Silversmiths at Birmingham which has taken the lead in providing technical and artistic instruction. Surely, what they can do in the country we may ask the premier trade fraternity to do in London—if merely as a matter of justice to the trade whose name they bear, and whose interest they were founded to advance!

The opportunity they now have in their hands is one that should be proudly and gladly seized by them; for in London there is hardly anything being done to equip the young workman for the tussle he will soon have to enter on with his technically instructed rivals from France, Germany, and even our own large provincial towns.

Even what has been done in this direction in London is due to the Polytechnic, in Regent Street; and while acknowledging the energetic and successful way they have set about all kinds of education, still, it is almost a matter of self-preservation, and is certainly important enough to be taken in hand by the most powerful representative body that any trade possesses. We take that body to be the Goldsmiths' Company, and we now call upon them to take the lead that should properly belong to so ancient a Society.

But to be able to lead men it is necessary to have their confidence; and to attain that confidence the men must be trained by their officers, and be brought into personal contact and association. In this trade the leading men are not known, except by name, and are not likely to be, as opportunities are only given at trade dinners, the cost of which bars those on whose behalf we write.



Amateur's Drilling-Frame.

It does not appear to us an insurmountable difficulty to get in touch with the trade: it has been done with other City Companies.

In the short space at our command we cannot enter fully into details; but from our informants we arrive at this conclusion—viz., that opportunity should be given to young jewellers to see the many allied branches carried on—as is done, we understand, in Germany. By seeing (and practising too, if he will) any one branch, or all of them, he will be given a double chance of succeeding in life—for he may find he possesses talent for a class of work—quite different from that he happens to be doing at the present time; and besides, he will be better fitted to work single-handed, as many have to do in our own country places and in our ever-extending colonies. Such knowledge as may be given at a technical school may—nay, will—go far towards reducing the number of journeymen who are more or less like machines, able to make only one or two articles properly.

This article will not be complete without a reference to the two subjects now included in the programme of the City and Guilds of London Institute for the Advancement of Technical Education. We refer to silversmiths' and goldsmiths' work. The latter has but been in existence for one year; the former for some five or six years. And much as we regret the failure of classes in silversmiths' work, we are not surprised, because we cannot find that any trade influence is exercised to support the teachers.

If the Goldsmiths' Hall will but take up the syllabus as it is issued by the City and Guilds Institute, and get it put into practice, we have but little doubt that a year or two's experience will do much towards improving it; and, even as it is, it will put such junior members of the trade as wish to improve themselves on a level with, or even in advance of, continental workmen.

Are we asking too much of so important a body as the Goldsmiths' Company? We hope and trust not; and we may surely beg them to take steps—other than the mere giving small sums of money—to smooth the road for such working members of the trade as are willing to improve themselves if they get the chance, but who are, from their humble position, unable to bring any pressure to bear; and even if they could be heard, and their requests granted, still, it is not to be expected that they would be the best judges of their wants and requirements: for to decide on a course of education older heads are wanted; and the council to direct this can be assembled, if their trade guild but wills it. We trust that it will. To let the lead, in such a matter as this, pass into the hands of a provincial town—even such an energetic one as Birmingham—is not a condition of affairs that should be in existence. Nor do we expect that the Goldsmiths' Company will let things rest. Let them show that they are the guardians of the goldsmiths' trade.

AMATEUR'S DRILLING-FRAME.

BY J. T.

THIS drilling-frame may be readily made by an amateur. It is formed of wrought-iron gas or steam pipes and fittings. The lower portion on which it rests is a flange which has four bolt-holes in it, the top part being screwed. Into this is screwed a piece of pipe of the required length; upon this is screwed an elbow, with another short length of pipe screwed into it, and on the outer end of this a T-piece is screwed; the T-piece should have the tap run right through it, as sometimes a portion in the centre is left unscrewed. The screw for feeding the drill is a short length of pipe screwed right down the outside. The inside should be rimed out with a parallel rimer, and the drill spindle turned and fitted to slide in it. On the top of the screw a double handle for turning it is fixed. The lower end of the drill spindle is made larger, and bored for the drills to fit in, and a handle keyed on the top; the drills are prevented from turning by a small set-screw at one side. The flange is bolted down to a bench, and in order to give more width for drilling a parallel block of wood is fixed under the drill. The size of the pipes should be suitable for the size of hole to be drilled, but pipes 1¼ in. or 1½ in. outside diameter will be a fair average size. The T-piece may be a forging, if it cannot be screwed right through.

BOOT AND SHOE MAKING.

BY WILLIAM GREENFIELD.

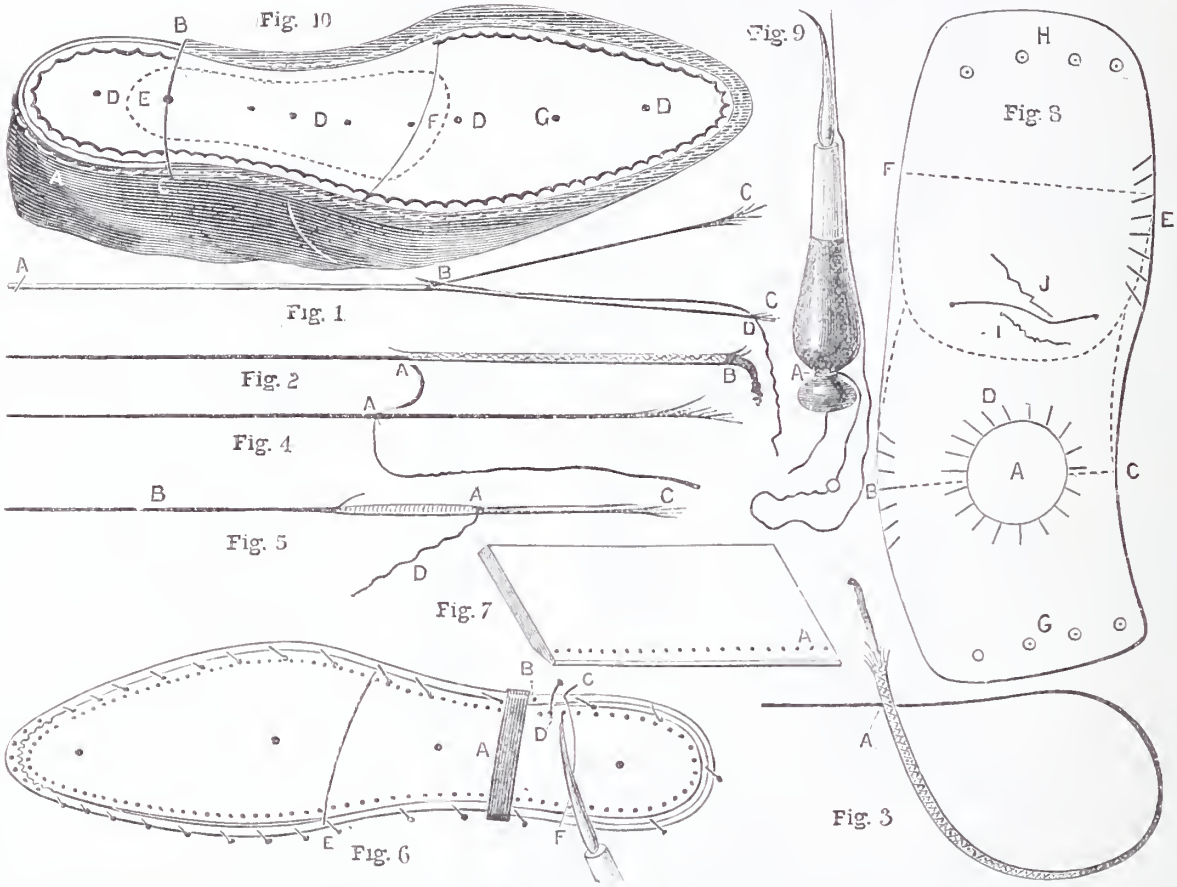
How to Put the Bristles on—How to Sew in the Welts — Method of filling up the Bottom.

How to Put the Bristles on.—For a sewing thread you want not only a good pair of bristles, but—as they so often have to pass through a soft inner sole, a linen lining, and various other substances — a stout pair. Therefore, pick a stout transparent pair, from A to B (Fig. 1). On the end of each bristle there is a dry, glutinous substance. This is the part that is in the hide when on the animal, and is of no use for our purpose. This, therefore, is cut off in a slanted direction, as shown by the line across it at A.

When the two points are made in this way, put them together, and hold them about 1 in. from the end, and rub them up and down on a piece of sand-paper, somewhat in the same way that you would use a paint-brush, only, at the same time, twisting them round. This will give them a nice round top, which, with a little pressure, will find its way through almost anything we require. Now, just bend the bristles at B against the thumb-nail, and split them both down to this point. This is done by taking hold of the other end, which is bushy, and having equal portions in each hand, as shown at C and C, and pulling them asunder, making a crutch at B. The extremity of the waxed thread you have made is placed between this at B, and held tightly by the thumb and finger of the left hand, the palm of the hand being towards you. Then take the split part of the bristle C, and the thread D with it, between the thumb and finger of the right hand, and twist them together, twisting towards you; and each time you want to take another sweep, hold the part CD, for the time, between the little and third fingers of the left hand, and when it is twisted just tight enough, hold it while you twist C, the other half, in the same way, being very careful not to break or twist it off. This done, you put it with C and D, so that you have CD and C together. These you hold firmly at this point in the thumb and finger of the right hand. Then let go with the left. This will, of course, make A twist round a little. This you twist (in the direction that it is now going) with the left hand, and you have a neat splice, as shown at AB (Fig. 2). It is now changed over, and B held in the left hand. Then through the thread at this point make a hole with a fine stabbing-awl, as at B, and the point of the bristle is put through this eye, as shown at A (Fig. 3). This is drawn through, and then smoothed between the thumb and finger from the point downwards. This is to secure the ends of the bristles, and prevent them from unplaiting. The above method is called "plaiting."

I will now explain how to construct what is called "run," or "twisted on." In this case you do not split the bristle, but wax it from A to B (Fig. 2). For this kind of adjusting, the taper of the thread has to be very fine—in fact, tapered away to *nil*. This is laid across the middle of the bristle, as A (Fig. 4), while it is upon the finger of the left hand, and the thumb is pressed on to it. The thumb is then drawn downwards, pressing very hard, so that the fine point may be twisted round the bristle while it is being rolled round. This you can continue till you get down as far as A, in Fig. 5, which can be done by holding it at A, in the right hand, and twisting with the left at B. Then hold it at A with the left hand, and separately twist C and D, and finish in the same way as with C and CD in the first process. This is done at both ends of the thread, and the two bristles are put together. The thread in this way is halved. At the half it is twisted a little, to know it when starting to sew, and to have both ends the same length in work.

How to Sew the Welts in.—The sewing in of the welt is one of the most important things in boot and shoe making, inasmuch as the ripping of a welt-seam nearly spoils the boot, since it cannot be well repaired without re-welting. This is far from pleasant, if it has to be done before the sole is worn out. Therefore, before starting to sew, see that the thread is well made—that is, nicely twisted, waxed, and smooth throughout. See, too, that it is of about the same substance as the awl to be used, which should be a good and sharp one. It may seem strange to some that the thread should be as stout as the awl, considering that the double substance of the thread has to pass through the hole made by the awl, but it is in the method of using the thread that tends to prove the hole large enough. The way in which the thread is pulled through accommodates it to the hole.



Boot and Shoe Making. Fig. 1.—Bristle and Thread ready to be twisted together. Fig. 2.—Bristle plaited ready for fastening. Fig. 3.—Way the Bristle is made secure. Fig. 4.—Bristle ready with taper end to run on. Fig. 5.—Bristle ready with taper for twisting and finishing. Fig. 6.—Boot Lasted and in position, showing how to commence sewing in the Welt. Fig. 7.—Piece of Welt, showing where to start sewing. Fig. 8.—Hand-Leather, size according to hand. Fig. 9.—Awl and Bristle, showing position while pulling out. Fig. 10.—Section of Boot, showing Welt sewn in, the Shape of Shank-Piece, and place for filling.

Now the welts are fitted, the threads made, and the boot lasted. If it has dried, before sewing, just damp it all round over the holes, and well rub your wet brush (an old tooth-brush) round the heel part, to moisten the edge of the stiffener. Then you can commence to sew.

Your strap should be under the left foot. If a strap is used, put the buckle under the foot; or if a stout piece of cord or rope be resorted to, put the knot under, so that the thread does not catch in it while you are sewing, or it will break it. Place the boot between the legs (which should be held close together) with the toe towards you, letting the strap go over the waist of the boot, as at A (Fig. 6), so as to keep it fixed while it is sewn. The tack at B can now be drawn, and the sewing-awl put in the first hole of the waist, as at C. Fig. 7 is an illustration of the section of the welt under

process of sewing. It will be seen that it is used grain side downwards, with the side that had the angular piece taken off nearest to the upper. While the awl is in the position shown at C (Fig. 6), the part shown (Fig. 7) is placed upon it, in order that the awl may be passed through it at A. The awl is then withdrawn. The thread being held in the left hand, one of its bristles is put through at A (Fig. 7) and C (Fig. 6). This is pulled through until it has reached the twisted centre of the thread. Then you have an equal length on each side, one in each hand; and now, with the awl in the right and the hand-leather on the left, you are ready to set the first stitch.

A hand-leather is indispensable, but it is very simple to make. Take a piece of leather—the leg of an old Wellington or the top of an old water-tight will do; but, failing these, a piece of new leather, not too stiff—about 8 in. to 10 in. long, and 2½ in. to 3 in. wide, shape it as in Fig. 8, then a third of the way from the end, at the left, cut a piece out about 1 in. in diameter, as at A, 1 in. from B and ½ in. from C, then snip it through at B C and D, as shown by the short strokes. It is then doubled over at the dotted lines, B C and F E. Four holes are made through the two ends, as G and H, and laced together, as at I and J, and made secure. It is then placed over the left hand: C E being the bottom and G H being in the palm of the hand. The thumb is passed through A, and the cuts, B and E, soon permit it forming itself into the shape of the hand.

Now to set the first welt stitch: the awl is put in as before, through the next hole, D, the left bristle is put through just about 2 in., the right follows similarly. The points of the bristles change hands—the left to the right and the right to the left—and they are pulled through simultaneously for nearly half a yard each. This is done by holding the bristles between the thumb and finger (with their points in a direction from the work) with the palms of the hands upwards. When they are pulled a little way out, the hands are twisted round, so as to bring the thread round the hand at the bottom of the little finger, and round again, to be held by the thumb and finger of both hands. The first pull is finished in this way. When the thread (not the bristles—keep these between the thumb and finger, ready to use again) is dropped, and picked up again near the work, another stroke is made. This will, in all probability, pull the whole of the thread through. If not, another pull must be taken; but, anyway, they must be pulled in quick succession until the stitch is set. This cannot be until you have made the final stroke. This is not to pull the thread in, but only as a tightening pull. It must be hard—more especially on the right side, which pulls the stitch into the welt, whereas an over-strong pull on the left may possibly pull the stitch through the in-sole. But to get this extra strong stroke you must wind the left end round the hand-leather on the left hand, and the right end must be wound round the end, or knob, of the handle of the awl, as A (Fig. 9). This done and pulled in tight, the next and all following stitches can be proceeded with in a similar way.

When five or six stitches have been set, the seam can be knocked down with a hammer to make it smooth; but do not hit so hard as to bruise it. While this stoppage in the work is being made, it is well to wax your ends, or at least one of them. It is best to wax only the one on the right side. Set another stitch, and then wax the other which this time is on the right. This process is adopted because the first time the wax passes through the leather it is very apt to chip off the thread a little here and there, and fly on to the work. If the right side be worked from the wax falls on the inner sole, where it does no harm; otherwise, it would fall on the upper of the boot, and would not only need getting off, but would also spoil the leather, if Russian or any coloured leather. The waxing is done by holding up one end straight above the work with the left hand, and holding the wax in the thumb and finger of the right, and rubbing it up and down quickly and evenly. Then you proceed with the rest of the welt-sewing as above, until reaching the other joint at the commencement of the waist (see E, Fig. 6). Here skive off the remainder of the groin which has been left on the welt, turning it back upon the sole or a piece of thin wood, and skiving it as you did the other end. Then sew it in till you get to the point F. There it is cut off, and the last welt stitch set over it. You will find, however, when you get to the toe, that the boot will need turning round, toe from you; also that it is best to draw each tack, so that the work shall not come unlasted.

Now comes the sewing-in of the seat. If you do not start with a new thread, you must well wax the two ends, which must be long enough to go the whole way round; otherwise, a new thread must be used, for there must not be a join in the thread.

Start sewing in the same way as you did before, but you use no welt; therefore, the stitch on one side will lay on the inner sole, and the other on the upper, as at A (Fig. 10). This sewing you commence at B and end at C, making very solid stitches, and pulling the last end through to the inner sole. Then tie the two ends into a good knot, in order that the finish may be quite solid.

If the seat be sewn in first, you can continue to sew the welt in with the same thread. If the welt is first sewn in, then the boot has now got stitches in place of tacks, and all round there is surplus stuff (upper stuff), which must be cut off quite close to the stitch, but not so that it weakens the seam. The knife must be sharp, and the point dipped towards the inner sole, save at the seat, where it is held a little more flat than with the inner sole. The whole seam can now be hammered down, to make it as smooth as possible.

Filling up the Bottom.—A piece of chalk is rubbed round on the top of the stitches, and a piece of felt laid on top and tapped down all round. This will leave a chalk mark upon the felt, to show the size the felt will need to be. The whole of the inner sole is pasted, and the piece of felt laid on, hammered all over, and then left to dry. It is then trimmed off all round level with the welt. Of course, prior to this the four tacks, D, D, D, D, must be taken out. A piece of leather is then pegged in the waist with about four pegs. It should be good solid leather, and of the size marked out by the dotted line E and F. It should be skived thin at each end and each side, so as to leave it thick in the centre only. This piece of leather is pasted, and a thin piece of felt placed over it. This can be done by warming the felt and splitting it. If the bottom is at all hollow at G, the felt must be pasted, and another layer put in the same way as the first; but it only wants to be just level with the welt. By this time the whole surface, from heel to toe, should be quite smooth, and when a sprinkling of powdered French chalk has been rubbed in it is ready to receive the sole.

PHOTOGRAPHIC BACKGROUND SCENERY.

BY WILLIAM CORBOULD.

A correspondent (A. E. A., *Suffolk*) has asked for information on a subject which cannot be treated in the limited space of "Shop." Hence this brief article.

In the first place, the material for painting on must not be less than 6 ft. wide and 8 ft. high, and should be in one piece—that is, without a seam. The calico sheeting or canvas must be two yards wide. I can send it for 1s. 1½d. per yard—the proper canvas for painting on—should he not be able to get it.

Secondly, get some battens, say about 2½ in. wide and 1 in. thick; let two be 7 ft. 10 in. long and two 6 ft. 3 in. long; place the two short ones on top and bottom of the two long ones. Put two nails in each corner, about 2½ in. long (see Fig. 1); you need not drive them right home, they will be easily taken out after the painting. The frame should be 8 ft. high and 6 ft. wide, and perfectly square.

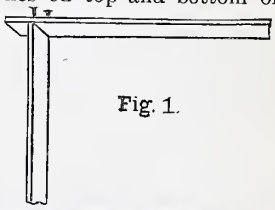


Fig. 1.

Fig. 2

Photograph Background.

Now tack your canvas on the frame by tacking the two top corners, then the two bottom corners; stretch it moderately tight. Now tack the top and bottom centres, then the sides; keep dividing the centres until the tacks are about 6 in. apart. It will now be ready for priming.

There are several colours which may be used for photographic backgrounds, but space here will not admit of their treatment. I shall only deal with one, and the simplest.

Have about 4 lb. or 5 lb. of whiting; break it up, and put sufficient water to it to just cover it. When soaked, drain off all the water you can. Have now 3 lb. of jelly size, and put it on the fire with about a pint of water; melt it, but do not let it boil. Pour this over the whiting, well mixing it to about the consistency of castor-oil. We must now have a little vegetable black; mix this with a little water into a paste. Now a little celestial blue must be mixed in the same way as the black. We are now ready to start painting.

A single tie brush, about 10 oz. or 12 oz., would be best to use. Take a little of the whiting out, and put it on one side for future use. Add some vegetable black and celestial

blue to the large portion of the whiting. Do this very carefully, adding a little at a time, well mixing it, and keep trying the tone of it by putting a little on a piece of white paper or the back of the hand, letting it dry to try the colour, which should be a pale French grey or drab. You must be particular in this, as on it depends whether you get a good photo or not. When you are satisfied, cover your canvas with it, beginning at the top right-hand corner, working to the left, and so on downwards until all is covered, taking care to cross and recross the work with your brush, making sure you do not miss any part; leave this to thoroughly dry. You should now have two or three brushes, such as foliage brushes, and a fitch or two (see Vol. II., No. 92, Figs. 2, 3, 4, and 7). In commencing the painting of the subject after the priming is dry, you must keep the centre very light in tone—that is the part where the person being photographed would stand—gradually gaining in strength of colour as you advance to the outer part of the painting. The best way to execute the centre is to put a little blue and black on a slab or board, take your priming-brush with priming in it, press the ends of the hair into the blue and black, then touch it in the pure white, which you have previously put on one side; lightly punch the brush against the board or a piece of paper—anything clean will do; stipple the whole of the centre, which will give it the appearance of distant foliage. Your own taste and judgment must guide you as to when you have the desired effect. As you work from the centre, the foliage becomes more marked and stronger in tint (see sketch). The front of the scene, showing the grasses, reeds, and leaves of the foreground, should be well defined. As I have said before, there are other colours and subjects innumerable suitable for backgrounds.

For the method of roping a roller I must refer you to Vol. III., No. 154, p. 793, Fig. 9.

MEANS, MODES, AND METHODS.

Pointers for Amateur Electrical Experimenters.—In making induction coils, bells, and other electrical apparatus where platinum is to be used—this metal now is very costly—the contact points can be made from the small pins that are in false teeth. There are two pins in each tooth, and old teeth can be procured from a friendly dentist for little or nothing, and it is a good idea to secure some so as to have them when needed.

Waterproof Cement.—Take 1oz. of gum sandarach and 1 oz. of gum mastic. Dissolve in 1 pint of alcohol; add 1 pint of turpentine and 1 quart of strong vellum glue. Put gums and alcohol on a kettle of boiling water; when dissolved, add the boiling glue. Keep boiling and well stirred till thoroughly mixed, then strain through a cloth. It dries quickly.

Photo. Dryer.—A useful contrivance worth knowing, and which is very valuable for drying photographs, is the following:—Get a small (say, 1 in.) piece of watch mainspring, bend double, and heat in a gas flame to prevent snapping; hang this on a line, and put a corner of the print between the ends. This is much better and cheaper than the clips used by most photographers, and does not tear or mark the paper.

MODEL BOILERS: HOW TO FEED THEM.

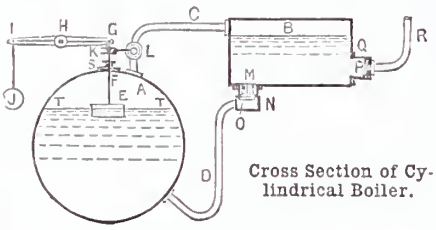
BY FRANCIS CAMPIN, C.E.

The term "model" is merely comparative, and in this sense I use it in describing a mode of feeding high-pressure boilers illustrated in the accompanying diagram.

Some years since a beautiful little model marine engine to drive paddle-wheels was made by one of Messrs. John Penn & Son's workmen, and fitted into a walnut shell; a short time afterwards I saw at the Crystal Palace a "model" of the engines of the steamship *Simla*. The model was thirty horse-power.

The mode of feeding I am about to describe may be used for any sized boiler, and as it is not patented, it may be adopted without fear of infringement. My remarks are, so far as models are concerned, addressed especially to those who take an interest in them, and who, therefore, do not mind a little dirty work in dealing with metals, and perhaps tedious work in perfecting the apparatus. My practical readers may perhaps look a little farther into the design.

The diagram represents a cross section of a cylindrical boiler, A, and a feed-tank, B, with the necessary connections. The tank,



Cross Section of Cylindrical Boiler.

B, is placed slightly above the normal water level, T T, in the boiler, A. It is of advantage to place the feed-tank two or three feet above the boiler, to avoid the constant pulsation that would accrue from too slight a difference of levels. Now, the principle of the apparatus is this: So long as the water in the boiler does not fall below its normal level, no communication is open between the boiler and the feed-tank; but communication *may* be open between the feed-tank and an ordinary water-supply through the pipe, R, the only pressure necessary to supply the tank being that necessary to raise the water to the level of the flap-valve, P. I wish this to be clearly understood, that we may have 200 lb. or 300 lb. pressure per square inch in the boiler, A, and only 2 lb. or 3 lb. above the atmosphere in the tank, B. The way in which the water is allowed to flow into the boiler through a system of automatic valves I will now explain.

The tank, B, is steam-tight, and made sufficiently strong to bear the highest pressure in the boiler, A; but it is, of course, very much smaller, as the feed-water may be almost continuously passing through it into the boiler. Water is supplied, under circumstances subsequently described, under ordinary pressure through the pipe, R, and flap-valve, P, into the box, Q, attached to the lower part of the tank, B. The seat of the valve, P, deviates but slightly from the vertical: just enough to allow the valve to seat itself by its own weight in still water. At the end of the feed-tank nearest the boiler is fixed a valve-box, N, from which runs a pipe, D, to the lower part of the boiler, A. Within this valve-box is a stalk-valve, M, opening downwards. Its weight is partly carried by a light spring, O, which holds it near its seating, but will not close it against the pressure of water in the tank, B.

Communication is made between the steam space of the boiler, A, and the top of the tank, B, by a pipe, C, in which is a valve or stop-cock, L. This valve or cock, as the case may be, is operated by a float arrangement.

A lever is fulcrumed to a convenient standard at H, and carries at the end, G, a rod, F, fixed in a float, E, counterbalanced by a weight, J, pivoted to the end, I, of the lever, I H G. The float, E, must be *solid*, to prevent the possibility of its collapse by the pressure to which it is subjected, and therefore it must be counterbalanced to the extent of the difference of its specific gravity from that of water. The rod, F, passes through a lightly packed stuffing-box, S, and carries a pin, K, embraced by the forked end of a lever, which operates the valve, L.

The action of the apparatus is this: When the water in the boiler falls below the normal level, T T, the float, E, descends and operates the cock, L; steam flows through the pipe, C, into the tank, B, and equality of pressure is established in the tank and the boiler. This pressure firmly closes the supply valve, P, and the valve, M, previously closed by the pressure in pipe, D, is released; then water flows by gravity through the pipe, D, until the normal water level is restored in the boiler, and the float, E, raised, whereby the cock, L, is closed, and steam communication cut off from the tank. Then the steam remaining in the tank condenses, the pressure in the pipe, D, firmly closes the valve, M, and a partial vacuum is formed, which facilitates the opening of the valve, P, and the tank is re-filled through the pipe, R.

Now, it may be asked, What is the advantage of this method of feeding? Well, in the first place, it is independent of a steam engine or other motive agent; so is the injector, but the injector must be put into action and regulated by an attendant, whereas this contrivance is automatic, and may, therefore, be used with boilers with which no motive power is connected, and also with those which, being worked by waste furnace gases, do not require the attention of a stoker.

MASRIUM.

An examination of a mineral which is provisionally termed *masrite* has revealed traces of a substance which differed in several important respects from any known metal, and was therefore recorded as a new one, under the name *masrium*. This word is derived from the ancient name for Egypt, the mineral in which the supposed new element is found being of Egyptian origin. A sample of masrite analysed by the authors contained 10·62 per cent. of alumina, 2·56 per cent. of manganous oxide, 4·23 per cent. of ferrous oxide, with small quantities of ferric and cobalt oxides, and 36·78 per cent. of sulphuric anhydride. The balance was made up of water of crystallisation, the mineral being an impure manganese alum crystallising with twenty-two molecules of water. The quantity of unknown oxide present was 0·2 per cent., and the total amount of mineral being small, the examination of the properties of the element was less complete than is desirable. The properties, as far as they have been determined, are as follows: The metal masrium (formula Ms) falls in the

second series and twelfth group of the elements when arranged in their periodic order; it has an atomic weight of about 228, and the formula for the oxide is MsO. It gives no precipitate with hydrochloric acid, nor with sulphuretted hydrogen in hydrochloric acid solution, but yields a white precipitate with sulphuretted hydrogen in the presence of acetic acid. It gives a white gelatinous precipitate with ammonia, insoluble in excess, and similar precipitates with ammonium sulphide and carbonate. With potassium ferrocyanide it gives a white precipitate, insoluble in excess of the precipitant, but soluble in excess of masrium chloride. Potassium ferricyanide yields no precipitate. Oxalic acid gives a white precipitate soluble in acetic acid, and in excess of the chloride of the metal. A basic salt is precipitated on boiling a neutral solution of the acetate, but re-dissolves on cooling. Neutral potassium tartrate gives a precipitate soluble in excess of the precipitant, and from this solution ammonia does not precipitate masrium hydrate. The caustic alkalies give white precipitates soluble in excess. The soluble salts are also white, and of those that have been examined the sulphate $MsSO_4 8H_2O$ crystallises best, either from its aqueous solution, or preferably from 50 per cent. alcohol. This appears to form an alum, in which it takes the place of the potassium sulphate in ordinary alum, and also gives a double salt with potassium sulphate. Efforts to prepare the metal itself have been at present unsuccessful, and further information, notably on its spectroscopic character, is necessary before it can be definitely admitted as a new element.

Perhaps the hardest of all cements is made of 100 parts of white sand to equal parts of litharge and limestone powder mixed with 7 parts by bulk of linseed oil. Under pressure this cement will strike fire from steel.

MYSTERIOUS MONEY-BOX.

BY CAROLUS REX.

The trifle here described is only worth the attention of such as are novices in the wood-turner's art and mystery. I well remember when, having at length become the happy proprietor of a small lathe, I was at my wits' end to know what to attempt in the way of turning. The mastery over the tools was achieved at the expense of much wood, worthy of a better fate; but the newly-fledged turner's skill seemed to be limited to the production of peg-tops and egg-cups! I should have welcomed such a suggestion as the present, which affords scope for a tolerable degree of manipulative dexterity, yet is easy of attainment. Moreover, the article itself may be considered merely as a hint, all manner of developments being possible.

Fig. 1.

Fig. 2

Fig. 3

Mysterious Money-Box. Fig. 1.—Beehive-shaped Box. Fig. 2.—Pillar Box. Fig. 3.—Squat-shaped Box.

Fig. 4

Fig. 5

Mysterious Money-Box. Fig. 4.—Apex and Plug Key. Fig. 5.—Plan of Top.

Fig. 1 above shows an outline very easy to turn, while Figs. 2 and 3 are alternative forms. In the shapes indicated by Figs. 1 and 3 the bottom is in each case turned separately, and is joined by means of screws through the knobs shown; but Fig. 2 is turned in two sections, which are afterwards united at the flange. The puzzle is how the money, which can be heard rattling inside, was introduced into the box; but a glance at Fig. 5, which shows the real top of the box, and at Fig. 4, the actual lid, leaves nothing to be explained. The dotted lines in Fig. 5 show the position of the cross-piece on the peg of the lid when the box is closed; and if the "key" is made to work tightly, the whole will bear considerable handling and minute scrutiny without the secret "leaking out." The black dots on Fig. 5 are to suggest stops, to prevent the entire rotation of the peg. They may be inserted or omitted at the pleasure of the maker. I need scarcely add that to withdraw the money the screws at the bottom must be removed

SCIENCE TO DATE.

Action of Light on Silver Chloride.—Recent experiments by Mr. Baker tend to show that the black substance formed by the action of light on silver chloride is really an oxychloride. For instance, silver chloride exposed to light in air or oxygen gas evolves chlorine and absorbs oxygen. Again, no darkening is produced when the chloride is exposed in a vacuum or under liquids which do not contain oxygen—such as *pure dry* carbon tetrachloride. Further, when darkened silver chloride is boiled with a solution of pure potassium chloride, the whole dissolves, silver chloride being found in the solution together with potash, the production of the latter showing that oxygen is present. When darkened silver chloride is kept in the dark, it turns white again; and Mr. Baker adduces reasons to believe that another oxychloride is formed, a fresh absorption of oxygen taking place.

Properties of dry H_2S.—Mr. Hughes has lately observed the interesting fact that *dry* sulphuretted hydrogen gas has no action on magnesia, baryta, or on salts of silver, copper, mercury, lead, bismuth, cadmium, arsenic, zinc, iron, or cobalt, nor does it in this state redden litmus paper.

Electric Locomotive.—An electric locomotive, which is to be more powerful than any yet made and designed for a speed equal to that of a steam locomotive, is to be built by Messrs. Brown & Boveri, of Baden. It will be provided with motors of 1,500 horse-power.

Liquid Air.—A very remarkable lecture was given lately by Professor Dewar at the Royal Institution, in which a wine-glassful of liquid air was actually prepared in view of the audience. It is a remarkable fact that air is liquefied without change of composition, but the liquid air becomes fractionated by spontaneous evaporation, the nitrogen vaporising faster than the oxygen, and leaving the latter pure.

NOTES FOR WORKERS.

To dilute sulphuric acid (oil of vitriol), always pour the acid very carefully into the water, and never the water into the acid, for in the latter case the acid is liable to spurt on to the operator.

Linseed Oil is obtained from the seeds of the flax plant. Owing to its tendency to become solid when exposed to the air, it is called a "drying oil"; this tendency is much increased by heating it with about one-twentieth of litharge or one-tenth of black oxide of manganese. The oil thus treated is called "boiled linseed oil."

A new porcelain has been obtained by grinding asbestos to a fine powder, dissolving out all soluble matters with hydrochloric acid, making the powder into a paste with water, and baking it in a porcelain furnace for eighteen hours at 1,200°.

Professor Koch has not yet succeeded in perfecting his refined tuberculin, and will not supply any to the doctors till he has.

The French Government think so well of the new type of forts with iron-cased turrets, designed by the Belgian engineers to defend the line of the Meuse, that it has decided to erect one of the same pattern near Lunéville, at Manonvilliers, on the eastern frontier.

The eight bones of the human cranium or brain case are united by means of irregular saw-like edges, which firmly lock them together and yet allow for their growth.

To stain wood a mahogany colour before polishing, boil logwood chips in water, adding a little soda to bring out the colour, and apply with a brush. When dry, use French polish.

New South Wales, Australia, has a population of 1,132,234, including 14,156 Chinese and 8,280 aborigines. This is an increase of 380,766 since 1881. The population of Sydney is 383,386, being an increase of 158,447 since 1881.

Mineral lubricating oils have, on the whole, less action on metals than vegetable oils have.

Cork is the bark of a description of oak tree (*Quercus suber*) which grows in great abundance in Spain, Italy, and France.

The effect of the electric light current on the compasses of some vessels is so great that it becomes necessary to determine how many hours the dynamo has been running before working out the vessel's reckoning.

"WORK" PRIZE SCHEME.

NOTICE.

"WORK" COMPETITION COUPON

will be found on page 415.

NOTICE TO READERS.

Illustrated and leading articles in next issue (No. 183) will be :—

Dining-Room Buffet.
Watch and Clock Cleaning.
Whitening Keys of Pianos.
How to Put on a Lock.
Border Ornament.
Curricle Harness.
Releasing Pole Straps.
Carpentry for Boys—Tools.

*** The Editor makes this intimation in the hope that readers, having friends interested in any of these subjects, will bring the same to their notice.

"WORK" PRIZE SCHEME.

"Useful Household Article" Competition.

This competition has been an unusually heavy one, and the very large number of suggestions sent in has made the work of adjudication an extremely difficult task. Great care, patience, and much deliberation have been exercised so as to give every competitor the full benefit of his or her suggestion. The result is that the necessity for dividing the prizes has in this instance presented itself, so equal, when considered, as they have been, from all points, do the selected suggestions appear. It would be obviously a disadvantage to the competitors to allot three prizes when six suggestions are adjudged of equal merit, both as regards utility and originality. I have exercised my discretion, therefore, and decided to distribute the prize money in sums of £1 each to the senders of the following suggestions—a course which it is hoped will give satisfaction :—

£1—"Easily Removable Sash" suggestion, bearing the signature "Improvement."

£1—"Improved Bookmarker" suggestion, bearing the signature "Bookmarker."

£1—"Steps Steadier" suggestion, bearing the signature "Aster."

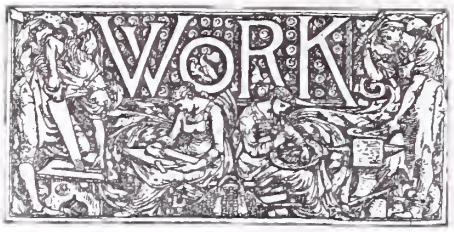
£1—"Hot or Cold Cabinet Bath Frame" suggestion, bearing the signature "Pater."

£1—"Hot Water Dish Cover" suggestion, bearing the signature "Forkless."

£1—"Improved Clothes Horse" suggestion, bearing the signature "Dhobie."

*** The names and addresses will be published when the sealed envelopes are opened and the MSS. printed.

In making this award it should be mentioned that many really good things, which would have taken prizes, were shut out for the reason that the application of the idea was already adopted, or the market contained the same or better things, or the suggestion did not come into the category of a household article. Some of these competitors, however, may look forward to seeing their suggestions put into print as space and opportunity offer.—Ed. Work.



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*** Advertisements should reach the Office fourteen days in advance of the date of issue.

*** All letters suggesting Articles, Designs, and MS. communications for insertion in this Journal will be welcomed, and should be addressed to the Editor of Work, Cassell and Company, Limited, London, E.C.

Underground Railway Light.—Why do not the Underground Railway authorities bestir themselves and do something with the electric light both inside the carriages and along the routes which run under and around London? With the progress made during recent years with electricity, it is astonishing that the Metropolitan and District Railway Companies have done nothing to alleviate the misery and mischief which attend travelling along these dark and sulphurous cuttings. Ever since the formation of the underground lines the complaints and clamourings for more light and air have been continuous, and blundering and expensive experiments have, it is true, been attempted to quell the reasonable demands of men and women compelled to travel day and night along these dismal routes. But why do not the authorities turn to electricity, and light these pitch-dark tunnels? They might go further, and tile the walls up to an eye-line. Surely, too, with a little energy in the engineering departments, it would be possible to devise plans by which the miserable lights in first, second, and third-class compartments alike—which are useless for reading purposes—shall be superseded by a light which will permit comfortable reading to relieve the tedium of travelling along these subterraneous passages. We know something of the journey from the "Royal Oak" to Aldgate, and have no hesitation in pronouncing it as ruinous to the eyesight of the thousands who endeavour to read a book or newspaper. Considered in the light of present-day science, it is really disgraceful that the lines remain the dismal and lung-irritating channels they now are. We commend to the directors electricity as a motive power for the engines and an illuminant for the tunnels and carriages. If every season-ticket holder made this matter a condition ere renewing a ticket, the realisation would soon come, and nobody would be the worse. On the contrary, directors and shareholders alike would soon find themselves the recipients of greatly improved dividends.

Electro-Motors for Small Workshops.—When electric light mains are laid along all the streets of our towns and cities as the gas and water mains are now laid, and the producers of electric power are prepared to supply consumers by day as well as by night with electricity at a reasonable rate, we shall see a rapid development in small electro-motors. Poor dressmakers, now bent double over sewing-machines whilst performing treadmill motion, and wearing out their lives in a ceaseless round of monotonous labour, will then be able to sit or stand, as they please, at machines erected at a suitable elevation, and find pleasure in guiding the work under the swift, regular movements of needles impelled by electro-motors. Ladies will be able to amuse themselves by embroidery with suitable machinery, whilst their servants in the kitchen are grinding the coffee, making mincemeat, cleaning knives and metal-work, and other domestic work, done by machines driven by electro-motors connected by a switch with the electric mains. Shoemakers in their home workshops will be able to stitch uppers and close the boots and shoes at a rapid rate with a minimum of personal labour; jewellers will find pleasure in working polishing-lathes driven by electrical power; dentists will find small motors convenient for driving dental lathes; and hair-brushing by machinery will receive a fresh impetus. Small gas-engines and oil-engines and water-motors will then have to give place to the electro-motor in small printing establishments, butchers' shops, groceries, and bakeries, in working printing presses and in driving sausage-chopping, fruit-cleaning, and mixing machines. But perhaps the most appreciative user of these small motors will be the gentleman amateur engineer or wood-turner, who now owns a small lathe, and finds his pleasure in working wood or metal as a hobby. We can imagine his pleasure in being able to have a clean and cool workshop at all times, unsoiled by the mess inseparable from gas, oil, or steam motors, and free from the din and danger attending these sources of motive power. Then, again, the new era will herald the birth of a new industry—namely, that of small electro-motors suitable to the work. Much has been done in this way already, but much remains to be done; and we may yet live to see establishments rise to cope with the special work of electro-motor making, even as now there are special works for making cycles. Advance, England!

Technical Teachers' Payment.—Some of the County Councils are actually going to guarantee a certain payment to technical teachers. This is as it should be; for, as we have said on previous occasions, the conditions are not such as to tempt a first-class workman to undertake the job of conducting a class, when, at the end of the session, he might find himself out of pocket, his remuneration having depended on the result of the examination. When technical teaching receives its due share of attention, and it is the practice to guarantee payment, then we shall get competent men to come forward. So far, they have not done so. Sir Philip Magnus noted this at a recent meeting at which the Duke of Devonshire presided. No wonder!

DESIGN AND DECORATION OF ALL AGES.

BY M. H. C. L.

Early Christian.

The first specimens of purely Christian art are from the catacombs. These mysterious labyrinths, underlying the great city with their miles and miles of narrow passages, that have never known the light of day, are, to the writer's mind, the most interesting sights in Rome. Here, as we all know, the Christians took refuge, sometimes for months together, from the savage persecutions of the emperors; here their dead still lie buried, row above row. Only parts of the old catacombs have been excavated. Taper in hand, one follows the guides through what seem interminable passages, and constantly on either side is seen, rudely scratched on the rock, a dove, a fish, a palm-branch, showing the dead was a martyr (Fig. 6), whose significance we now know well.

When the sign was drawn, however, it was only to the eyes of the few that it conveyed its sacred meaning, and heathen searchers would pass it by without being any the wiser.

The symbolism of the earliest art of

Early Christian Ornament. Fig. 1.—Guilloche Diaper. Fig. 2.—Mosaic Border in Sixth Century Church. Fig. 3.—Carlovingian Ivory Carving. Fig. 4.—Vine Border: Eleventh or Twelfth Century. Fig. 5.—Lamb: Enamel Casket. Fig. 6.—Palm-Branch. Fig. 7.—Sacred Symbol. Fig. 8.—Very Early Crucifix. Fig. 9.—Border on Casket: Northern Work. Fig. 10.—Gem Box: Eleventh Century. Fig. 11.—Design on Portable Altar: German Work. Fig. 12.—From a German Oliphant. Fig. 13.—Capital of Venetian Well-head. Fig. 14.—Border on Old Casket. Fig. 15.—Design on Eleventh Century Pyx. Fig. 16.—Carving from Cathedral: Salerno. Fig. 17.—Russian Triptych. Fig. 18.—Lamp from the Catacombs, Rome. Fig. 19.—Old Form of Cross. Fig. 20.—Border on Enamelled Casket. Fig. 21.—One of the four Evangelists on the same.

Christianity has come down to our own days, and in the first centuries after Christ it was a very distinctive mark in all ecclesiastical design. In those times nearly all the art was ecclesiastical, though it was grafted on to the Pagan system of decoration with not the happiest results. It is curious to see in the mosaics of some of the early Roman churches dancing girls and little Cupids and Psyches occupying the circles in the guilloche diaper (Fig. 1), which was a favourite form for the covering of surfaces. In the church of St. Costanza the subject of a mosaic is the culture of the vine. At each corner are vintage scenes: the bringing home the grapes, and treading them out in the wine-press. In the centre is a vine, the branches of which meander over a large space, the grapes being pecked at by birds and beasts and gathered by boys. The whole suggests a fit ornament for a temple of Bacchus; but the artists had, no doubt, in mind the sacred symbolism of the vine, which soon came to represent the Holy Eucharist.

The stiff wreathings of the Romans were adopted by the Christians. In the church of St. Cosmo and St. Damiano (sixth century) there is an apsidal mosaic of Christ surrounded by apostles. Above are some very favourite symbols—a lamb laid on an altar, seven candlesticks, a sealed book, and a roll with seven scenes. The border is a garland with a ribbon twined round. At each turning of the ribbon the flower changes—from a lily to an olive, from an olive to a pomegranate, and so on (Fig. 2).

The Roman churches were built in the form of the pre-Christian basilicas, or halls of justice, with an apse or arched portion at one end, where the altar was placed. It was the vaulted interior of these apses which were decorated with mosaics. Many of these remain intact to this day, and the colours are as fresh and brilliant as ever.

One of the most important of the early Christian churches was that of St. Paolo fuori le Mura, built on the place of St. Paul's martyrdom. It is now destroyed, and a new church stands in its place, built on the old plan, and very beautiful; but portions of the cloisters remain, and are one of the loveliest and most picturesque monuments in the neighbourhood of Rome.

In the age which followed that of the catacombs carvings in stone and ivory became common. The early ones were almost entirely of scripture subjects, very naively treated. In the Lateran and other Roman museums there are sarcophagi cut in stone, with Jonah and the Whale and the like biblical scenes most quaintly depicted, with a multitude of figures crowding each other out of perspective and anatomy.

The Roman Christian art was not confined to Rome. It spread to other Italian cities—notably, Ravenna—which at one period, when Rome itself lay desolate from the hands of invaders, was the capital of Italy. It spread over the South of France and up the Rhine, distinguished in the west of Europe by the general appellation, Romanesque, though developing somewhat differently in the different countries where it took root. Many ivory carvings remain from the Carlovingian age—that is, the period when Charlemagne and his successors ruled over Germany and a considerable part of France.

The Romanesque ivory carvings were generally the outsides of diptychs or triptychs—the former having two leaves and the latter three, with pictures of the saints or other sacred subjects inside. The backs were ornamented since, when, standing upright on a table, as they were intended to do, both back and front were seen.

The heathen Romans borrowed the Christian idea, and secular diptychs were produced with waxen interiors, to be used with a pointed style as writing-tablets.

In the South Kensington Museum, among many other specimens of ivory carvings, is one of these secular diptychs, perhaps a present from some newly-appointed consul to a friend who had helped to gain him his place. It represents a female figure offering at an altar of incense. She stands beside a tree, and a child is in attendance upon her, holding a basket of fruit and flowers. A border of debased "honeysuckle pattern" runs round the picture. The Carlovingian ivories are numerous. Sometimes each leaf contains two or three distinct scenes in the life of our Lord. In this case the scenes are placed one above another, with no dividing line. Adam and Eve were favourite subjects for representation. We have Adam naming the beasts; Adam and Eve mourning on two little hillocks, with three symmetrically arranged trees. The Carlovingian trees seem to have had but two, or, at the outside, three, branches, each with three leaves and two bunches of fruit (Figs. 3 and 4). Caskets were also made in ivory, and tombs of the saints elaborately covered with sacred subjects.

In the middle of the fourth century began a very important development in art—the Byzantine. In 324 A.D. Constantine removed the seat of his empire from Rome to Byzantium, to which he gave the name of Constantinople. He pulled down all the heathen temples and re-built the city; and with its re-building came into existence a new school of art. Many influences combined to produce it—the old heathen tradition of architecture and ornament, the symbolism of Christianity now developed and fixed, the oriental influences which came in through the position of Byzantium as a great trading port with the East, and perhaps a certain inspiration from the immediate neighbourhood of Greece, whence, no doubt, the new artists were largely drawn.

Mr. Stannus finds in the great palace built by Domitian at Spalato, when he retired thither after resigning the empire, the germs of Byzantine architecture. The workmen who built it, unversed in classical tradition, left out the entablature over the abacus, and committed other solecisms, which formed an important new departure.

The Byzantine churches were built on the plan of a Greek cross, with a systematic arrangement of arches and cupolas, surrounded by a dome. The Aya Sophia, built by Justinian—now a mosque—is considered the *chef d'œuvre* of the Byzantine style. A more widely-known specimen of this school of architecture is St. Mark's, at Venice, over which Ruskin goes into rhapsodies.

After the vastness and severe proportions of the Roman basilicas and the impressive grandeur of the Gothic cathedrals of France, Germany, and our own England, the first impression of St. Mark's is apt to be marred by an idea of insignificance; but the more one sees of it the better one learns to know and appreciate the exquisite refinement of its form, the harmonious blendings of its colouring, and the reality of all its decoration, none but the noblest and most lasting materials being used.

Colouring was one of the strong points of Byzantine decoration. From a literal reading of the Second Commandment no images were allowed in the churches of Byzantium—a restriction which still exists in the Greek Church—and the representations of sacred subjects was entirely in painting. As any colours applied to a surface are apt to be fleeting and perishable, mosaic work was soon substituted for painting proper, and the gorgeous Byzantine mosaics—like those of the Roman churches on a gold ground—became famous in the history of art. Costly and beautifully coloured marbles, stones, and gems—cut round, and not with facets—and gold and silver, were lavishly employed in the decoration of the sanctuaries. The mosaics became more resplendent when tesseræ of coloured glass were invented. Wrought metal work was used in the vessels of public worship—the lamps, shrines, chalices, etc.—and the art of enamelling was brought to a high degree of perfection. Of the two kinds of enamel in use respectively in the East and West—the cloisonné, divided by gold wire, and the champ-levé, let into the surface—there is not space to speak here. Both were inventions of this period. The Greek Church has preserved the Byzantine tradition to the present day, and the art which had birth in the fourth century still lives in Russia and modern Greece. Some Russian sacred pictures on a gold ground—crosses, triptychs, etc.—brought from the Crimea by the writer's father, singularly recall the work of the earliest Byzantine days (Fig. 17).

Byzantine art spread widely, especially in some parts of Italy—at Venice, Ravenna, and in other towns. It so affected the whole art of the pre-Gothic period—leaving out, perhaps, that of Rome itself—that the word "Byzantine" is sometimes used for the whole of that era; but a broad line of demarcation may be drawn between the three styles—the Byzantine of Eastern Christendom, the early Romanesque of Western Christendom, with that of actual Rome between. Some writers fuse the terms Byzantine and Romanesque, and treat them as synonymous. Redgrave, in his valuable "Outlines of Historic Ornament," a book which should be in the hands of every student of design, takes the Romanesque as originating in the time of the Crusades; but what appears to the writer the simplest distinction is that given above, the period of Western art before the Crusades being considered the early, and that after it the later Romanesque. The latter will be referred to in the paper on "Gothic Art."

Byzantine as an early Christian art was highly symbolical. Natural forms were also much used. The foliage is stiff, and in the decorations of the capitals is not used as Roman and Greek foliage was—to suggest a springing from the shaft, and supporting the weight above it—but simply as the ornament of a flat surface, which might have been in any position. Fig. 13 is the capital of a column from a well-head at Venice, where the stiff Byzantine foliage is used, though with a tradition of the original idea of leaves so placed. Animals and birds were constantly introduced among the foliage (Figs. 12, 15, and 16), often very quaint in form.

Throughout early Christian art the circle was a favourite form—possibly as an emblem of eternity—either stiff and geometrical, or formed by foliage, and filled in with a head, a figure, or an animal (Figs. 5, 11, 12, 14, etc.). Crosses of all kinds and shapes were, of course, very largely used, and the emblems of the four evangelists (Fig. 21) are of constant recurrence, one often being placed at the end of each arm of a cross, in the shape of Fig. 19.

The subject of early Christian art cannot e left without reference to the illuminated anuscripts—principally of the four gospels -which came into existence in very early ays. The Byzantine manuscripts were of xquisite workmanship, and those of Western urope developed as early as the fifth cen- ıry into works of consummate art. The eltic illuminations will form part of the ıbject of the next paper. The designs sed for illuminating, throughout the rest Christendom, presented little difference om that used for decoration in its other ranches. At first their ornament consisted mply in colouring and beautiful lettering.

SOMETHING NEW IN SINKS.

BY PERCY C. RUSHEN.

DARESAY everybody has experienced the uisance of having to dip one's fingers into ıe dirty water which is standing in a sink,

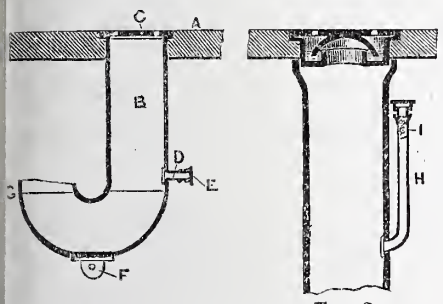


Fig. 1. Fig. 2.

ig. 1.—Device for Air-Screw Pipe. Fig. 2.—Alternative Method.

ı order to lift the trap to allow the water) descend into the drain. Without this, will never go down if it does not descend t once. Very few people, xcept those experienced, now what it is that causes his. The reason for it is that ıe water, suddenly covering ver the holes, imprisons the ir in the tube, and unless he weight of water presented t the holes is sufficient to xpel the air, the water will n some cases the air comes up through he water in bubbles. Of course, the more he holes are choked up the ess weight of water is pre- ented, and for this reason nany people think it is this lone that causes the water o stand.

To remedy this, a small pipe vith a screw cap may be oldered in it. This is only uitable for pipes which are rapped below the lid, as they ıre often done now, and ıaving a screw cap to clean he trap. Fig. 1 represents his device, where A is the sink, B the pipe, the lid of the pipe perforated with holes,) the small air pipe, and E its screw cap; F is the screw cap to withdraw to clean the trap, ınd G is the water level in he trap. When the cap E is ınscrewed, it allows the air to escape. The air cannot be foul, and if the water is found to come out of the pipe D before the cap E can be screwed on the pipe may ascend a little.

In Fig. 2 is represented a device for pipes in which the portion at the lid is trapped. The air pipe is the same, except that a piece of sponge is preferably placed before the cap, as the air in this pipe is foul, and the cap must be kept on when not wanted to be removed; H is the air pipe, and I is the sponge. If required, the pipe could be continued to the outside, and in this case a cap would not be needed; or if a stop be wanted, a seated spring valve could be placed in the middle of the pipe. Or, doubtless, if it were carried up to the lid descending again, and if the valve were placed as low down as possible, the sudden expansion of the air caused by the opening of the valve would be sufficient to enable the water to descend.

Of course, many modifications will occur, but the foregoing will be very good examples.

SOME GOOD THINGS.

Gold Paint.—We have recently had an opportunity of testing the properties of Pavitt's Ardenbrite Liquid Gold, an advertisement of which frequently appears in our columns. With the sample before us, and the experiments we have tried with it, we have no hesitation in pronouncing it a really good thing, answering all the points the maker claims for it. We have tried it upon deal, oak, and white enamel, and find it answers as well almost as the ordinary process of leaf gilding. With the experience before us of having to get some old English picture-frames regilded—a process which, when too late, we discovered to be more costly than the buying of new frames—we shall in future stand independent of the frame-maker and try Ardenbrite Liquid Gold instead. For this purpose, and all others where gilt can be applied in or out of the household, Ardenbrite can be thoroughly relied upon.

Harness.—We have pleasure in calling our harness-making readers' attention to a straight-pull and easy releasing buckle introduced by Smith & Co. This ingenious buckle for harness has the merit of a tongue, apart from the buckle-frame, standing upright at right angles to the strap, se that the pull on the hole in the leather is never oblique as with the common buckles, which tends to tear the leather at the hole, shown by Fig. 1. The buckle-frame has a middle-bar and a heel-bar, each with a distinct purpose; the heel-bar is for the frame to turn upon, the middle-bar serves as a lift to the strap, raising it off the tongue in the act of lifting, as shown by Fig. 2. The easy release of a strap from such a buckle is an advantage to horses who have been thrown down by the greasy asphalt roads. This meets a want such roadways create. Fig. 3 shows the buckle of a trace with a straight, level pull. Its neatness is obvious, and it deserves a trial of all well-wishers of the horse.

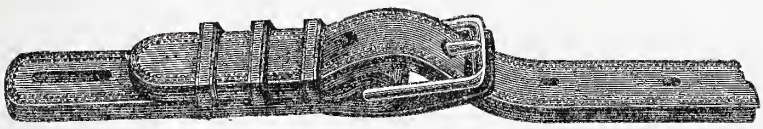


Fig. 1.—Old Style, showing Bent Pull.

Fig. 2.—New Style, showing Releasing Arrangement.

Fig. 3.—New Style, showing Straight Pull.

BOOKS.

Electricity.—"A Guide to Electric Lighting." S. R. Bottone. (Whittaker & Co.)—Now that electric lighting is asserting its supremacy over gas, it is reasonable and right that everyone concerned should know something of the new illuminant—one which must before many years be with us in our every apartment. With this view, the handy guide now before us will supply a real want. Designed for the use of householders and amateurs, the merest tyro will be able to acquaint himself with the essential features of electric lighting, whether on a large or small scale. It is taken for granted that the reader knows nothing about the subject: hence everything touched upon is explained sufficiently to enable him to form an intelligent idea of the results indicated.

Chip Carving.—"Hints on Chip Carving." Eleanor Rowe, with a Preface by T. R. Ablett. (Sutten Drowley & Co.)—This little manual, issued with the sanction of the Science and Art Department of the Committee of Council on Education, will be found very serviceable to the thousands who take interest in wood carving. Miss Rowe, the Manager of the School of Art Wood Carving, is so pre-eminently fitted to speak upon the subject, that a wide field is sure to be found for the present manual. The preliminary chapters are simple and interesting, leading on to some very pleasant and beautiful work in Icelandic, Swedish, and Norwegian carving.

Photography.—"Photography Annual for 1892." Henry Sturmey. (Iliffe & Son.)—This compendium of information and statistics of the year relating to photography, now in its second issue, has developed wondrously on its first issue. Its object is to bring the subject of which it treats absolutely up to date, and this we have no hesitation in saying it does thoroughly well. So vast an amount of valuable information is pressed into its 900 pages, that we shall predict for it as phenomenal a success as attended the issue of its predecessor.

Timber.—"Timber Piling, in Foundations and other Works," by Henry Adams, M. Inst. C.E. (Cowell.)—This is a very interesting and instructive paper, read by Professor Adams before the Society of Architects, in which the important subject of timber piling in bridge making and damming is treated under the following heads:—Material; Its Preparation; Pile-driving; Supporting Power of Piles; Examples of the Use of Piling. Attached to the pamphlet is a well-executed sheet of really valuable diagrams bearing upon the subject of timber piling.

Inventions.—"Practical Guide for Inventors." E. Eaton, C.E., M.S.A.—This is a fourth edition of a useful handbook issued by Mr. Eaton detailing much valuable information connected with the subject of patents. Every year the field of patents, designs, trade marks, and the like, is becoming more and more extended; and the general public, and inventors and patentees in particular, cannot become too familiar with the details involved in protecting a good idea should it occur to them. A good deal of discussion has already gone on in the pages of WORK, valuable alike to inventors and patent agents. We have much pleasure, therefore, in noticing Mr. Eaton's publication.

TRADE: PRESENT AND FUTURE.

*** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

MARINE ENGINEERING TRADE.—No change in the Mersey shipbuilding trade is reported, but the Barrow district marine engineers are fairly busy, as are also the shipbuilders.

RAILWAY MATERIAL TRADE.—Manufacturers of railway material are booking orders.

CHEMICAL TRADE.—The chemical market is steady, prices being unchanged. Bleaching powder is reported as scarce.

BUILDING TRADES.—In Durham county trade is still brisk, and, as a rule, the relations between masters and men are friendly. Building operations in Newcastle and district are vigorous.

CUTLERY TRADE.—One or two firms have been fortunate to book special lines. Orders from Australasia are very scarce. The Rodgers' strike continues, the firm not being inconvenienced, while the men are receiving support which will enable them to fight for some time to come.

GLASS BOTTLE TRADE.—This trade is cramped, owing to the limited number of orders and the overstocked condition of the market. The largest glass bottle makers in St. Helen's have served notices upon seventy of their workpeople. Several operatives in this trade, trying America, have been literally boycotted there, and cannot find work.

SILVER TRADE.—Improvement is noted in the Sheffield silver and electro-plated trades. Good orders have been booked for first-class table silver.

FIRE-BRICK TRADE.—There is a fair demand for fire-bricks. Some makers report heavy exports. Prices unchanged.

TIMBER TRADE.—This is steady; imports large.

ARMOUR-PLATES TRADE.—The armour-plate houses are well employed. The distribution of a few good Government orders for armour-plates to Sheffield would have a beneficial effect, as, with the heavy trades doing well, the minor trades prosper.

TAILORING TRADE.—Our Liverpool correspondent writes:—The lock-out of the tailors is in full swing. The official statement of the operatives gave forty-five as the number locked out of five shops, and there are seven hundred and fifty men working in fifty shops where no workpeople are locked out.

COTTON TRADE.—It is doubtful whether employers will be obtained to enforce a 5 per cent. reduction of wages in the spinning section of the Lancashire cotton trade. If 10 per cent. reduction cannot be obtained, 5 per cent. is not worth contending for. Meantime, the depressed condition of the trade is becoming intensified; the stock of yarn is increasing, and machinery is stopping.

ENGINEERING TRADE.—Rather more activity prevails in the engineering trade of the Lancashire district. Some of the leading machine tool makers are busy, and the large stationary engine builders have also a moderate amount of work. Boiler makers report work coming forward. Locomotive builders have very little work on hand, and the prospects in this branch are disheartening. Railway carriage and waggon builders are also slack.

COAL TRADE.—At Newcastle best steam and gas coals are steady; household and bunker coals dull; best Northumberland steam, 10s. 6d. per ton f.o.b.; best Durham gas, 8s. 6d. to 9s.; bunkers, 7s. 6d. to 10s. for best Durham screened. Coke, steady from 15s. to 17s. per ton. At Sheffield the demand for house coal is limited. Locomotive sorts and coal for shipping are selling well. Coke is not easy to place, but engine slack is selling moderately. Prices per ton: best Haigh main, 13s.; seconds, 12s.; Silkstone hards, 12s.; house coal and coke, 11s. 6d.; Stanley main seconds, 9s.; steam coal, 9s.; coke, 8s. 6d.; slack, 6s. to 7s.; smudge, 3s. 6d. to 6s.

IRON TRADE.—Very slow business is being done in the Lancashire iron trade. Manufactured iron shows no improvement. The steel trade is practically unchanged, but prices for raw material fluctuate considerably. Our Sheffield correspondent writes:—The dulness continues, and the firm tone of the pig-iron market appears to be giving way. In the Middlesbro' iron trade the demand for pig iron is in excess of the supply.

SHOP:

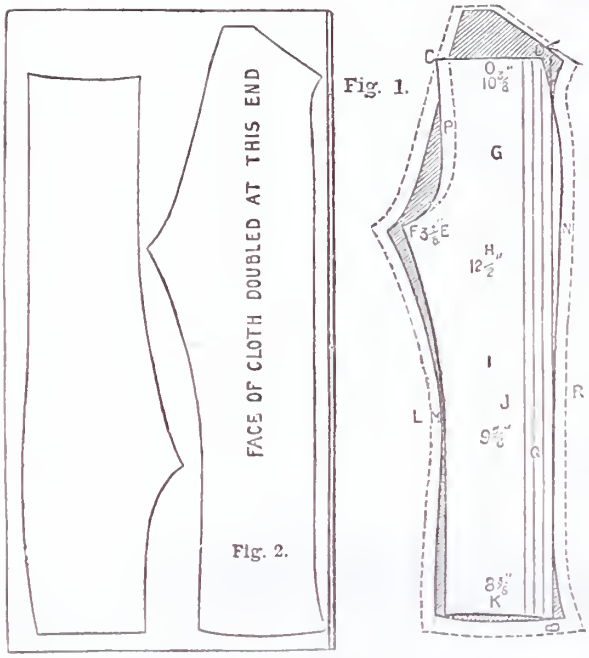
A CORNER FOR THOSE WHO WANT TO TALK IT.

*** *In consequence of the great pressure upon the "Shop" columns of* WORK, *contributors are requested to be brief and concise in all future questions and replies.*

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of WORK *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given.*

I.—LETTERS FROM CORRESPONDENTS.

Trousers Cutting.—AMATEUR TAILOR writes:—"I cut my own trousers from my own cloth as follows: For my requirements I cut a paper pattern to the size suggested by the figures. First draw the line A B, with a straightedge near the edge of the paper, about 45 in. long; then square over the line C D, the size of the waist being 37½ in. We take one quarter of that, 9¼ in., add ½ in. for the waist, and ½ in. for the two seams at C and D. This makes a total of 10¾ in. Mark off that distance at C; then draw the line C E parallel to A B; at E, 14 in. down, square out a line to F. This projection is called the crutch, and is governed by the waist measure, 37½ in. Take one-twelfth of this—that would be 3¼ in.—mark it off at F, adding ¼ in. for seam, and draw the curve joining the line about 9 in. down from the waist; then measure down 33 in., the length of the leg seam, and add 1 in. for turning up at the bottom. Halfway down at the knee, measure over from the long line 9¼ in., add the two quarters for seam, then join the line at F by a gentle curve, and so on. I don't profess to teach, but simply want to show that it is a simple enough job, involving only a sort of free-hand geometry, with variation to suit different shaped figures. Trouser patterns are laid on as shown in the diagram. Black-faced cloths must be cut with the nap running downward only. A great deal of information concerning tailoring appliances, books on cutting, etc., is to be seen in one of Messrs. Platt's catalogues, St. Martin's Lane, London, W.C. In cutting, no expensive tools are required by the amateur. A straightedge, a square, a 2 ft. rule, if you have not a measuring tape, a pair of sharp scissors, if you have not a pair of shears, and a piece of pipe-clay, are all that is necessary. The following are the measures (in this instance my own) which would have to be taken: Waist, 37½ in.; hips, 45½ in.; leg, 33 in.; side seam, 45½ in.; thigh, 26 in.; knee, 19 in.; bottom, 19 in. The diagrams show how to lay the patterns on the cloth, so as to make the best of it."



Trousers Cutting. Fig. 1.—Trousers Pattern—G, Hip; H, Thigh; I, Fore Part; J, Knee; K, Bottom; L, Leg; M, Inlay; N, Inlay; O, Waist; P, Fly; Q, Strips; R, Side Seams. Fig. 2.—Showing Trousers Pattern on Cloth.

Mail Cart.—W. H. M. (*Grimsby*) writes:—"I have observed the design in No. 174 (see page 284), and think it a very nice one; but I consider there is one serious drawback to it: no protection against tipping backward is provided."

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Cement for Carbon Plates.—T. H. (*Dublin*).—The cement employed with fine carbon dust in making carbon plates is a strong syrup of sugar or treacle. The pasty mass is pressed into an iron mould and baked. The resulting cake is again dipped in syrup, returned to the mould, and again baked at a white heat. It does not pay an amateur to make carbon plates in this way. In making them from gas retort scurf by sawing the scurf, do not attempt to cut them smooth. A rough, irregular surface is an advantage rather than otherwise.—G. E. B.

Sash Making.—F. W. H. (*Aylesbury*).—Articles appeared in WORK, Nos. 147 and 153.

American Organ.—E. B. (*Manchester*).—These articles are in hand.

WORK—Back Numbers.—H. H. (*Coleford*).—Messrs. Cassell & Company, London, E.C., can supply most of these. Those which are out of print you would get, probably, by advertising in WORK. A carpenter's bench was treated in No. 180.

Wall Mirror.—S. P. (*Nottingham*).—I am not acquainted with any firm who would make the articles; and in designing the mirror, I thought there would be little trouble in getting something to suit at any good brass furnisher's, and still think so, if the inquirer will write one of the many large firms in that line.—R. C.

Sign-Writing.—F. C. C. (*Manchester*).—Articles on Sign-Writing appeared in WORK, Nos. 1, 2, 4, 11, 13, 17, 19, 23, 30, 34, 39, 43, 44, 45, 47, 49, and 51; on Painting and Decorating, in Nos. 27, 29, 35, 36, 42, 43, 44, 46, 47, 50, and 52; on How to Paper a Room, in No. 161.

New Fireplace.—P. G. A. (*Liscard*).—This can be obtained of the Teale Fireplace Co., Leeds.

Quarter-Horse-Power Steam Engine.—D. D. (*Leven*).—Articles appeared in WORK, Nos. 106, 110, 121, 125, 131, 136, 141, 145, and 149.

Bell Indicator.—DAILY READER OF "WORK."—You should have no difficulty in getting a glass for your indicator. It is simply a piece of glass made to fit the frame of your indicator, blackened on the inside, with little round spaces left clear. There are no holes in it. If you have made your indicator yourself, you are quite capable of accomplishing this part of the work, which to me appears to be the easiest part. Get your glass, and where you want the spaces to appear paste round pieces of paper, and after having cleaned the glass, varnish over with "Castle Brand" black lacquer. Give two or three coats, and when all is dry the paper circles will peel off easily. If you do not succeed, and must buy your glass, write to Messrs. Gent & Co., Faraday Works, Leicester.—W. D.

Work Table.—R. N. (*Glasgow*).—Rather than dive haphazard among probabilities, I prefer to ask you a question or two. There is more than one table with a lift-up top, but as you are about to use turned legs in connection with your prospective article, I assume that what you want is the oblong job which has a double-hinged top, which revolves and opens book fashion, exposing draught and backgammon boards, and having a draw-out well for loose work. Is this so? If so, please state or sketch, as well as you can, particulars of the appearance of the article you need information of.—J. S.

Zither Teacher.—"IN REQUEST."—You might have ascertained this long ago by making inquiry at the various music warehouses in your district. I am unable to mention anyone resident in your locality. Write and ask Herr Goebel, of Museum Street, W., who will, no doubt, be in a position to tell you whether there is or is not a teacher in your vicinity.—A. O. T.

Library Chair.—J. W. P. (*Holborn, W.C.*).—I do not know of a firm that sells chairs exactly of the section shown in Fig. 2, page 68, but I daresay by looking up a few dealers you will find the thing you require. As a general rule, in those which are burdened by superfluous ornament very little attention is paid to provide a comfortable back and seat; and you will sooner discover a good outline in a plain chair than in an elaborate one.—F. J.

Barometer.—T. H. W. (*Liverpool*) has purchased a barometer from a dealer, who warranted it in working order; but when hung on the wall it stuck at "Set Fair." On an examination, he finds the mercury is divided: portions filling the extreme ends of the tube, with an empty space between. Shaking, tapping, etc., fail to bring the broken column of mercury into conjunction, and he now asks what to do. It is clear if the instrument was bought under a warranty, then the only course is to return it to the dealer and let him set it right; but I presume there will be some flaw discovered by the dealer in the form of warranty by which he will creep out of the responsibility. The present condition of the instrument will arise, I think, from one of two causes—first, in carrying it home he was not careful to hold it perpendicularly, and so a portion of the mercury was allowed to run to the other end of the column, and a bubble of air has got between the two portions, and so prevents an union; or else the

mercury has become very impure, and when at its greatest expansion the upper portion has stuck to the tube, and the other portion has contracted and left the space between. If the former is the cause, then I should carefully heat the lower portion so as to expand the mercury, gently tapping the tube the meanwhile, so as to dislodge the air. Care must be taken not to make the tube very hot, especially at the bend, lest it should break. T. H. W. will find it a somewhat troublesome job, but with care and patience it will yield, I think. On the other hand, if the mercury has stuck through impurity, then the only thing to do is to empty the tube, and either distil the mercury and re-fill, or, what is simpler, press it through a piece of clean chamois skin; this will permit the mercury to pass, but will retain the dross. When the mercury is made pure, the tube must be filled as at the first. Pour a small quantity through the open end, and let it fall as far as it will in the other limb; a cushion of air will prevent it falling to the bottom. Heat must now be applied, which will force bubbles of air past the mercury. When a portion has reached the bottom, then another portion must be introduced in the same way. Bubbles of air must be looked for between the mercury and side of tube—a hand-glass will be necessary; if any are visible, they must be expelled by heat, as before. If now the mercury sticks to the glass, it means that moisture has been introduced into the tube by some means; this too, like the air, must be expelled by heat. If T. H. W. will carefully attend to these directions, I think he will find his instrument answer all right. If, in emptying the tube, particles of impure mercury adhere to the inside of the tube, they must be removed by nitric acid, after which the tube must be carefully washed and dried before introducing the mercury.—O. B.

Gas Meters.—E. F. B. (*Darlington*).—It is absolutely imperative for all gas meters to be stamped with the Government stamp, and any testing must be done by the Government inspector. The general method adopted, if there is anything wrong with the meter, is to adjust the rate of payment by a reference to the account for the corresponding quarter of the past year. If the gas company have broken the Government stamp, and have failed to have another one put on by the proper authorities, they are certainly guilty of fraud, if the facts are as you state. But I should advise you to buy the "Act for Regulating Measures used in Sales of Gas," published by Eyre & Spottiswoode, Queen's Printers, London, price 6d.—E. D.

Camera.—PHOTO.—In WORK, Vol. I., No. 23, you will find full instructions for all required to make a good camera. There are a great number of elementary works published. "Beeton's Modern Photography" or "The A. B. C. of Photography," by the Stereoscopic Company, would probably suit you.

Reckoning Sizes of Pulleys. — HULL.—You forgot to mark with an X the pulley you wished the size of; but I can help you best by explaining how you can yourself find the sizes. Begin with the 200 revolutions of the engine, and suppose you wish the line-shaft (main-shaft) to run 300 revolutions; then if pulley on engine is 12 in., multiply 12 by 200 and divide the result by 300, thus $\frac{12 \times 200}{300} = 8$; therefore the pulley driven by the engine pulley must be 8 in. in diameter. Now you want to run the saw at 900, and its pulley is 6 in. which is driven by the line-shaft running at 300—that is, you want it to run three times as fast; then, since 3 times 6 is 18, you must have an 18 in. pulley on the line-shaft to drive the 6 in. pulley of the saw. Now as to the lathe, why do you want it to make 2,000 revolutions? I should not like that even for the smallest work; 900 or 1,000 are surely quite enough for the fastest speed. Suppose you are content with 900, then have the countershaft run the same rate as the line-shaft strap running on equal wheels, and have the largest step on the countershaft pulley 9 in. and the smallest on the lathe mandrel 3 in.—that will give you 3 to 1 again, and make the 300 revolutions of the countershaft into 900; also the slowest speed will be from 3 in. pulley on countershaft to 9 in. on mandrel, or 1 to 3, which will make your slowest speed for turning 100 revolutions.—F. A. M.

Chain Gear Cycles.—DOUBLE GEAR.—There are several change gears for safeties already in use. Of course, I am not prepared to say whether any of them are exactly like your correspondent's idea. The latest two-speed gear is that of the Cycle Gear Co., Coventry. I have not yet seen it, so cannot describe it. To get reliable guidance in the matter, write to Mr. R. E. Phillips, Consulting Engineer and Patent Agent, Royal Court Chambers, 70 and 72, Chancery Lane, W.C. He will supply copies of patents relating to double-chain gears at a very small cost.—A. S. P.

French Polishing and Stains—Book.—GUMPOT.—Why do you want to buy books when you have all you may require at your fingers' ends in the pages of WORK? Vol. III. contains a series of articles on the subject, and the replies in "Shop" deal with points and difficulties such as you and amateurs generally may meet with, and which it would be impossible to foresee and embody in any book on the subject. There is no book on the subject of staining to our knowledge; there is generally a chapter devoted to the subject in works on French polishing. It shall, with the Editor's permission, receive due attention in time in the pages of WORK. Meantime, fall back on H. C. Stephens's stains, which can be bought ready made either in liquid or powder—they are used in many cabinet shops in preference to making their own by reason of their uniformity of colour and depth of tone—that is, if you can find none in "Shop" to suit.—LIFEBOAT.

Incubator.—W. H. S. B. (*Derby*).—Order from your bookseller Nos. 143, 150, and 151 of WORK, or send 4½d. in stamps to publishers for same, and you will find full instructions on this subject.—LEGHORN.

Tool for Boring Pulleys, etc.—J. A. (*Middleton*).—Fig. 1 is a sketch of an ordinary chucking-drill as used for boring cast iron; it usually has no point, since it is used for *enlarging* holes which have been bored or cored. Fig 2 shows the process —B is the pulley boss, A the drill, C the back-centre, R the boring-rest, which both steadies and prevents

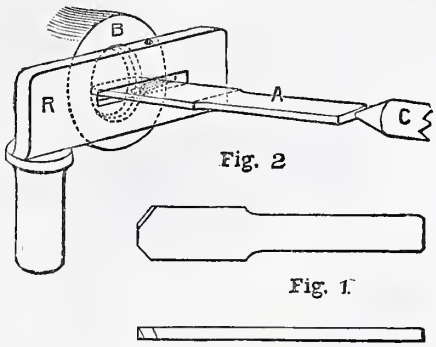
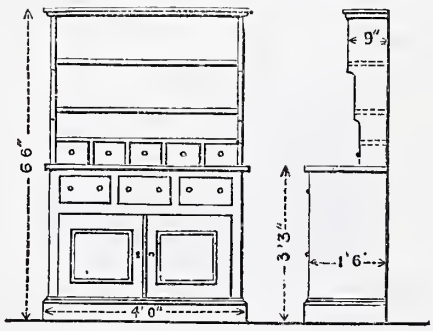


Fig. 1.—Chucking-Drill. Fig. 2.—Tool in Process of Boring.

the drill from turning. The hole is started with a slide-rest tool so as to get a true entry, and in Fig. 2 the drill is supposed to be just beginning its work. I don't know of an expanding mandrel not patented, but you should have a set of solid mandrels rising by eighths. It is best to have them of hardened steel and ground true.—F. A. M.

Viola.—F. H. (*West Ham*).—Before attempting to make a "viola," which is a "tenor" violin, why not try your hand at making an ordinary violin? You have full directions, patterns, and dimensions given in the back numbers of WORK. The instructions for making a viola would, to a great extent, be a repetition of those you possess, the outline and the various dimensions only being different; the method of making both instruments is exactly the same. To give a full outline and patterns would occupy too much space for "Shop." Here are the measurements you ask for: Length of back (exclusive of "tab" or "button"), 16¼ in.; width of upper bouts, 7¼ in.; width of lower bouts, 9½ in.; width of waist, 5½ in.; depth of ribs, 1½ in. at the top, deepening to 1 3/16 in. at the bottom; length of bass bar, 12 in.—B.

Kitchen Dresser.—J. G. (*Edinburgh*).—You will find most of your questions answered in Vol. III., p. 530, but perhaps this arrangement (see sketch)



Kitchen Dresser. Fig. 1.—Elevation. Fig. 2.—Section.

would suit you better, and the sizes marked thereon will be more convenient than those given in the design referred to above.—F. J.

Greenhouses.—H. F. (*New Cross*).—Several designs have been given in the present volume (IV.) of WORK. Consult previous indexes and "Shop."

Poker Work Machine.—M. T. (*No Address*).—I am sorry to say that you have evidently made a mistake with regard to the machine for poker work at that low price. The cheapest apparatus I have ever come across was one of German make, the price of which was 10s. 6d. I am sure it could be obtained of Derry & Tims, Kensington High Street, W.; or try one of Messrs. Hallam & Scott's, Manchester. A machine at the price you mention could not be made strong enough for the purpose. It is necessary to use the best materials, otherwise there might be an explosion of the benzoline, and the work would turn out to be rather dangerous.—J. N.

Incubator.—F. C. B. (*Deptford*).—Your ether is too strong, or else you are using too much of it. Half an inch above the mercury is ample. The proportion you are using is correct, but possibly your drops are not all the same size. If the ether forces past the mercury it is evidently too strong, and must be weakened. You will then find the mercury resume its normal position.—LEGHORN.

Electro-Silver-Plating.—F. C. (*Plymouth*).—(1) Your silver-plating solution is not the best obtainable. When silver is precipitated from its nitrate solution by adding a solution of carbonate of potash, and this precipitate is dissolved in cyanide of potassium, there is an excess of potash in solution, which does no good then, and eventually does harm. The silver should be thrown down as silver cyanide by adding a solution of cyanide of potassium to the nitrate solution; then dissolve this in a solution of potassium cyanide to form the plating bath. (2) The Daniell battery with 6 in. porous cells is all right. Your failure in successfully plating the cruet-stand is due to more than one cause. First cause: The frame, having lead mounts, or so-called "silver edges," is composed of two kinds of metal, which form a galvanic pair in the solution, and the lead dissolves under the influence of the current. Consequently, it will not receive an adherent coat of silver. Second cause: The silver remaining on the unworn parts increased this local action in the plating solution. Third cause: The anode surface was just one-fourth too small, and the quantity of solution also too small for the job. The solution was not strong enough at first, and was weakened by trying to plate such a large article. (3) The lead mounts, together with the whole frame, *must* have all the old silver stripped off in an acid pickle. The whole frame *must* then be coppered in an *alkaline* coppering solution before it is placed in the plating solution. A sulphate of copper, or any other acid, solution will not do. The process is too long to be detailed here in "Shop," but is fully described in my "Electro-platers' Handbook." (4) Some information on silvering jewellery has been given in WORK, Vol. III., p. 118. From this you may learn something. My "Electro-platers' Handbook" is a book of moderate price (the price is 3s.), and you can get it by ordering it of any bookseller. I do not know of any other at such a low price.—G. E. B.

Scene Painting.—R. R. S. (*London, N.W.*).—You may, if proficient, obtain employment by reading the "Wanted" columns of the *Era* theatrical paper, which appears every Saturday, and generally has one or more advertisements for assistant scenic artist. Go for a small salary first, to get a start, which is *most difficult;* but get it, and if you have any talent at all, you will soon rise. If I knew your abilities, I could tell what chance you had of success. One piece of advice I would give. Do not go too far away from home, as money is not always sure. In theatrical terms, "the ghost may not walk," and you would be in difficulties. You, having no references, must state that you have been very successful as an amateur, and accept any terms to get your first start. I wish you every success.—W. C.

Organ-Building Book.—W. W. (*Camberwell*). — Apply to Messrs. Crosby Lockwood & Co., Stationers' Hall Court, Ludgate Hill, London, E.C.

Brazing Tube.—T. W. S. (*Deptford*).—Presuming that you have a forge, or the use of one, to braze your stamping to a tube, proceed as follows: Carefully file out and clean the inside of the tube where the stamping is to fit; then fit your stamping to it. Let it fit very tightly. As to pinning it, I do not consider it necessary; if it is brazed well, the pin is a superfluity, and if it is brazed badly, the pin will not be of much use. Make up a clear fire of coke (broken small), and wind some small brass wire round and round the part to be brazed. Have by you some powdered borax and some spelter in some such receptacle as the lid of an old canister. Sprinkle a little borax over the spelter, and moisten it with water. Flatten out a piece of ⅛ in. rod at one end, and turn an eye at the other: this will do for putting on the spelter. Place the work on the fire when quite clear, and warm it a little. Have plenty of room, so that you can turn the affair (should it be a backhone). Place some of the mixed spelter and borax on the work, and commence to blow; when it gets to a dull red, throw a little borax on: this will help the metal to flow. Keep up a gentle blowing till you see the spelter run; then turn the work over carefully, and put a little more spelter on. Blow this until it has run down (assist it with borax), and rub off the superfluous metal; cease blowing, and, after a few seconds, lift it carefully off to examine, and to see if the spelter has gone all round; if not, you must go over it again, giving special attention to that part. I might say that, if you think it difficult to turn the work, you can work the spelter under it by means of the rod previously mentioned, which you must keep dipped in cold water, or it will pull the spelter off.—R. A.

Motors.—METAL.—Articles on Electric Motors appeared in WORK, Nos. 109 and 154.

Knotting, Splicing, and Working Cordage. —T. H. (*Huddersfield*).—Articles appeared in WORK, Nos. 105, 109, 113, 117, 120, 124, 127, 134, 139, 143, 147, and 150.

Scene Painting, etc.—E. C. (*Kirkdale*).—Articles on Scene Painting appeared in WORK, Nos. 92, 95, 97, 101, and 103; on Graining, in Nos. 55, 58, 62, 65, 69, 72, 76, 79, 85, 89, 93, 95, 98, 100, and 103; on Stage Carpentry, in Nos. 140, 144, 149, and 154.

Old Violin.—W. L. (*Hitchin*).—Bull, of Windmill Street, London, does not hold high rank amongst the English makers; but one frequently

finds a beautifully made violin from the hands of a maker who is not in great repute. If the violin is in a fair state of preservation, I should think it would be worth while to have it put into playing order; but without first seeing an instrument, it is impossible to give a correct estimate of its value.—B.

Improvements in the Steam Engine.—INVENTO.—To give our correspondent satisfactory information in reply to his query would require us to write a treatise on the history of the steam engine, which would demand more space than could be found in our pages to do so, seeing that the steam engine is applied to so many different purposes, in many of which great general improvements have been introduced to fit them for the required purposes. For example, there is the marine engine, with all its gradual developments and improvements which have produced the magnificent examples of the present day. Then there are the pumping engines, mill engines, electric light engines, and others for stationary use; the locomotive and its gradual and progressive development; the steam fire engine, the traction engine, and other applications of steam which have required special arrangements and developments to enable them to be applied to the various uses where the aid of steam is required, and each and all of these embody "general improvements on the first invented engine" of a more or less extended character. If our correspondent is within a reasonable distance of a scientific library he should read the various histories of, and treatises on, the steam engine which have been published, and are generally to be found in such. For example, Farey on the steam engine; Dr. Lardner, on the same subject; Dr. Clark's excellent works on the locomotive; Seaton's treatise on the marine engine—one of the best works on this subject; also J. G. Winton on the steam engine; Young's "Fires, Fire Engines, and Fire Brigades," which treats on steam fire engines; and many others, which embody more or less the "general improvements" in the use of steam since it was first known as a motive power some one hundred and twenty years or so B.C.—C. E.

On Testing Precious Stones.—LEARNER.—To test precious stones is a difficult and complicated matter. To be a good judge of precious stones, much study and a great deal of practice are necessary. That it is possible to use rough tests, which will be useful, is not questioned. Let me recommend a book, written by Professor A. H. Church; it is called "Precious Stones." If deeper knowledge is desired, then mineralogy should be studied, because that science is the one that deals with precious stones. Even in the elementary stage students are taught how to find the specific gravity of an article, and to apply other scientific tests as well. To draw an instance of what specific gravity can do: it can decide for us whether a stone is an Oriental—*i.e.*, a true—ruby or a spinel, a Siam ruby or a Cape. It will at once let us know if a topaz is an Oriental topaz, or a Brazilian or a Scotch topaz, the three being entirely different in specific gravity—and in value, too.—H. S. G.

Making Threefold Screen.—SCREEN.—As regards the woodwork of your projected screen, you will find useful directions, with diagrams, in Vol. II., page 618 (No. 91). For ornamental tops, see Vol. IV., page 206 (No. 169). As regards hinging, there are directions for doing this with webbing at the page first named; brass hinges will, however, work better, if you do not mind the cost, for they are rather expensive. They are made specially for the purpose to turn both ways. If your ironmonger has not got them in stock, he can probably show you lithographs of them and get them for you. From what you say of your design, I imagine you will do best to paint in ordinary tube oil colours, covering your frame with such canvas as is used for pictures; this you will buy by the yard, ready prepared, at any good artists' colour shop. Be sure that you stretch it tightly. A more æsthetic screen might undoubtedly be made by using "tapestry" colours on the special tapestry canvas. All materials for this "tapestry painting" may be got at Howell & James's, or at Lechertier, Barbe, & Co.'s, both of Regent Street, London, W.C. But the process is as much one of staining as of painting, and I doubt whether you could rely on succeeding in a first attempt.—S. W.

III.—QUESTIONS SUBMITTED TO READERS.

**** The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Cycle Wheel Repair.—A. M. (*Glasgow*) writes:—"Could any kind reader of WORK inform me the best way of repairing a buckled bicycle wheel? Would hollow rims be any advantage for hiring-out purposes?"

Tender Feet.—E. S. (*No Address*) writes:—"Can any reader of WORK give me information concerning a pneumatic inner sole for boots made of hollow indiarubber inflated with air? I am a great sufferer, having to stand for twelve hours each day on my feet."—[Try horse-hair sock.—ED.]

Polish.—WALNUT writes:—"Will someone kindly tell me what colour to mix with French polish when polishing walnut, as I want to get it darker than the natural wood is when polished."

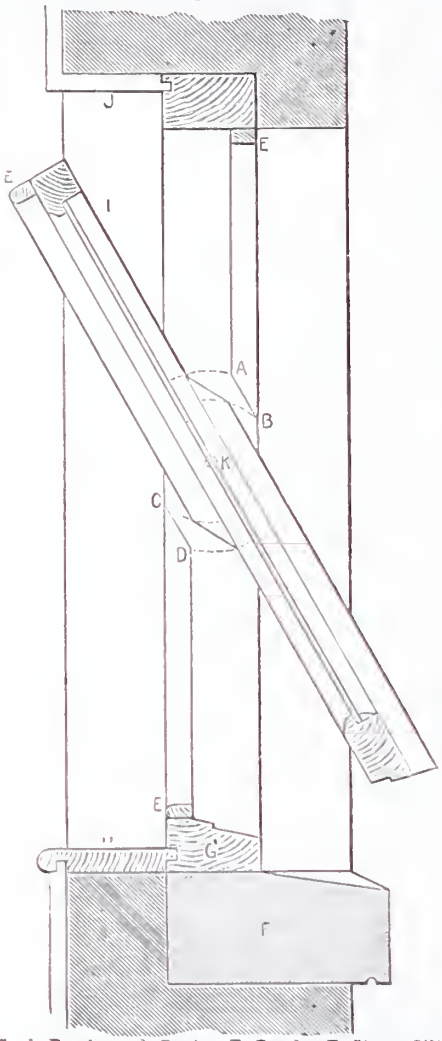
Couch.—C. R. (*Nottingham*) writes:—"I should very much thank anyone of my fellow-readers to give me a sketch, with the sizes, of a spindle-backed couch, the more elaborate the better?"

Gardener's Emblem.—GAEL writes:—"Could any reader give me a design for a gardener's emblem? I would like a floral design in fretwork about 10 in. by 8 in., introducing the letters B. O. A. F. G. Our Lodge is named the 'Bonnie Thistle.' Possibly the compass, set-square, and pruning-knife could be embodied."

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Model Screw Steamship.—M. (*Bishop Auckland*) writes to A. B. (*Leith*) (see No. 163, page 110):—"You will find a method of drawing the hull of a model steamer in No. 71, Vol. II., of WORK. I should not attempt more than two propellers on so small a model. Yellow pine, free from knots and strakes, will be a suitable wood."

Sash Beads.—PRACTICAL (*London*) writes, in answer to H. F. (*Ramsbury*) (see No. 171, page 238):—"The distance between the two lines, A B and C D, must be wide enough to let sash pass between and be fitted on to the pivot; which pivot should be slightly above centre of sash, so as to keep it closed by its own weight. The distance between



Sash Beads and Parts—E, Bead; F, Stone Sill; G, Oak Sill; H, Window Board; I, Frame; J, Head; K, Pivot.

A B and C D having been settled, all that remains is to strike out circles with the pivot as centre and distances to A, B, C, and D respectively as shown for the radii; where these cut the bead on sash gives the points of intersection; with scriber and rule join these points and cut as required. I think H. F. will find it clear from sketch."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—S. P. (*Whitechapel*); J. A. (*Thirsk*); J. W. G. (*Keighley*); T. J. B. (*Heywood*); S. S. (*Grantham*); A. B.; H. G. (*Coventry*); F. B. (*Greenwich*); A. M. A. T. (*Plaistow*); W. J. (*Buddington*); C. G. W. (*Knutsford*); MENDALL; BLACKPOOL; H. C. M. (*Liverpool*); A. F. (*Luton*); W. W. C. (*New Kent Road*); G. S. (*Windsor*); G. V. (*Stepney, E.*); V. D. (*Portsdown Road*); J. H. C. (*East Ham*); READER OF "WORK"; VELO; JACK PLANE; C. T. (*Edinburgh*); G. T. (*Leeds*); ANXIOUS ENGINEER; STEEL WIRE; W. V. (*Tavistock*); E. A. (*Treharris*); AMATEUR; G. F. H. (*Wandsworth*); OLD READER; E. W. C. (*Leicester*); W. E. (*Notting Hill*); H. B. (*Spring Hill*); J. C. (*Dundee*); W. J. Z. (*Winchester*); F. J. K. (*Tufnell Park, N.*); NEWBIGGIN FISHER LADDIE; F. D. (*Birmingham*); OLD SUBSCRIBER; J. E. (*Wolverhampton*); D. J. K. (*Roscommon*); FLY; A. R. T. (*Birmingham*); J. G., JUNR. (*Castle Rankin*); J. G. R. (*Ampthill*); ANGLO-AUSTRALIAN; G. F. D. (*York*); R. R. F. (*Frome*); H. S. (*London, N.E.*); WOODSPOILER; C. G. M. (*Finsbury*); IMPROVER; G. F. (*Middlesbro'*); J. T. J. (*Manchester*); FACTORIAN; S. F. G. (*Fenton*).

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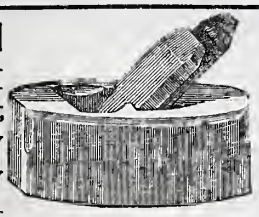

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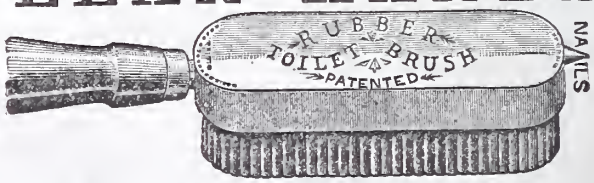

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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Vol. IV.—No. 183.] SATURDAY, SEPTEMBER 17, 1892. [Price One Penny.

WORK WORLD.

Aluminium is used for railroad carriage window frames in Switzerland.

* *

A small electric fan, for domestic use, is driven by a single dry cell.

* *

Screw propellers of the new Cunard liners are made of Parson's manganese bronze.

* *

The largest telephone switch-board in the world, at Berlin Exchange, has a connection of 7,000 wires.

* *

A farmer, sinking a well, has struck a rich lode of tin in the neighbourhood of Redruth, Cornwall. The yield is estimated at one hundredweight per ton of ore. A rich find!

* *

"It's an ill wind!" The cholera scare has sent up the price of bleach and other chemicals to a high rate in the North of England chemical factories.

* *

The largest American flag ever made will float from the lofty "Liberty pole" in front of the Administration Building at the World's Fair.

* *

Nottingham lace companies think that America is the place for the industry, and some are preparing to move their plant there. Nottingham mill lace machines are being shipped. Smart America!

* *

A treaty of commerce between Germany and the United States of Colombia will enable the Colombians to send tobacco, nuts, coffee, and sugar in exchange for all kinds of German manufactures.

* *

Some industrial establishments in the States are to fight the fifty-five-hour law. The Singer Company, employing over 4,000 operatives, has revolted, and after obeying the law for one week, resumed the old hours.

Slot machines for issuing railway tickets are used on the Berlin "belt railway." The machines can deliver tickets at the rate of forty-three per minute. Wanted—something of the kind on English excursion lines.

* *

Rhymers made with twisted or spiral flutes are handy for rhyming out the holes in small bosses where the keyways have been cut. This would be impossible with a straight, fluted rhymer. The twisted flutes will cross the keyway at an acute angle.

* *

Electric welding is fast becoming universal. The use of a flux is unnecessary. Electricity is now employed for making forgings, augers, railroad spikes, ball bearings, and many other articles hitherto made by hand.

* *

A new French explosive, Herculite, is a yellowish-grey powder, composed of sawdust, camphor, nitrate of potash, and several substances that are kept secret. It cannot be fired by sparks, flame, or detonation. At a trial, a half-pound charge of the compound displaced a block of stone of thirty tons.

* *

The Welsh tin-plate trade is depressed, and about sixty tin-plate works in South Wales are stopped. Large numbers of operatives have sailed for the United States of America, where new mills are being erected by Welsh proprietors. So much for the McKinley tariff.

* *

The Valorrette Falls, Switzerland, are to be utilised. 6,000 horse-power can be obtained. One establishment — an aluminium factory—is taking 1,000 horse-power. One turbine is connected to a dynamo, which gives 4,000 ampères at 500 volts.

* *

A new method of hardening plaster casts consists in tempering the plaster with a concentrated aqueous solution of dialysed silica, which causes the plaster to set rapidly. The work may be immersed, or receive several coats of the same solution, after which it is cooled by a solution of baryta heated to 60° centigrade.

A simple and ingenious device may soon be attachable to all bottles containing poisons. It consists of a mechanism so arranged that every time the bottle is lifted or moved it rings a little bell. This should prove useful, but where people *will* take poison, "Big Ben" or a whole peal of bells might prove useless.

* *

Californian wine cellars are overstocked, and grapes are sold for one-third of the price four years ago. San Francisco dealers have 12,000,000 gallons stored in their vaults, and it is estimated that the producers have from 50,000,000 to 60,000,000 gallons on hand, and are making from 20,000,000 to 25,000,000 gallons each year. $14,400,000 or so are locked up in the wine casks of California.

* *

Hitherto, the artistic skill of the Japanese has been turned to the production of beautiful ivories, bronzes and pottery, and daintily lacquered and painted fans, screens, and umbrellas. Now the "Japs" are taking contracts for swords and rifles, which need not surprise anyone, since the excellence of their work enables them to undertake the whole range of hardware, even to rifled guns, steel projectiles, and armour plates.

* *

A railroad fare of $1 to Chicago during the World's Fair for all working men in the United States living within 1,500 miles of Chicago is broached. The railroads can carry the business with a margin of profit. So also might the railway companies of this country do infinitely more for the British workman. Why should he, on a wage reduced to its very minimum, be forced to pay fares to and from the scene of his employment, which seriously hamper his efforts for those dependent upon him?

* *

The difficulty caused by leaky boiler tubes seems to have been overcome in the case of H.M.S. *Thunderer* by using malleable cast-iron ferrules entering the tube for a length equal to its diameter, but it only bears—with a driving fib—upon the tube for about half its length, *i.e.*, well inside the tube plate. The rest of the ferrule is turned down clear of the tube, and its outer end is made clear of the projecting end, and bears against the tube plate. The end of the tube is encased and protected.

ORIGINAL DINING-ROOM BUFFET.

BY F. JERMAN.

INTRODUCTION — SIZES — STYLE — ACCOMMODATION AND DESCRIPTION.

THE chief desiderata in a dining-room buffet are—fitness for the purpose for which it will be used, simplicity of construction, convenience of access to all the parts, and character or style which shall most reflect its use; and I think this design will be found to embrace all these points. Meaningless ornament and not-get-at-able cupboards I have eschewed, as they are entirely out of place in such an article. On plan, the best form it should take is a square; canted corners could be introduced, and would be very useful if the buffet is intended for a small room, but such an arrangement would entail more work in framing the different parts together, and there would be less room for side dishes and "removes." This latter accommodation is a great object to be desired in a buffet, and for the purpose of giving still more room, a cupboard front or the two sides are arranged in some examples to fall down, being supported on brackets or otherwise.

The size of this sideboard or buffet (please pronounce the word *buf-fay*) is 6 ft. long and 2 ft. 3 in. wide. Heights, 3 ft. 3 in. to the top, 4 ft. 6 in. to the shelf, and 5 ft. the total height. The space under the lower shelf is 9 in. There is a great advantage in fitting it at a good height above the floor, as in this example, because free access is allowed for the dusting brush, and the space below can be thus easily cleaned without lifting about the buffet, which will be found to be rather a lumpy article.

As regards style, I should say the design has a Jacobean feeling which is betrayed by the square massive appearance, the mouldings, and other details.

The framing is 3 in. by 3 in., and the turned posts and pendants are the same size. For details of the posts, see Fig. 3. Of course, the best wood to use is oak, the darker the better, rubbed down, when finished, with oil. The brackets can be made out of 2 in. stuff, and for shelves 1 in. will be sufficient.

A table-cloth drawer is provided in the buffet, with ornamental brackets below and a two-leaved cupboard or cellarette on each side. The method of giving the octagonal shape to the cupboard doors is to make the framing and panels up square in the usual way, and stick on triangular pieces in corners of the panels, making them level with the frame; then run moulds all round the octagon, carefully cut at the joints. In the framing of the back, instead of the three wood panels, bevelled mirrors might be introduced, and would have a very good effect. The top shelf is a handy stand for glass, and the small drawer in the middle is intended to accommodate cigars, etc. The two open spaces at the back of the shelf are filled in with spindles; they should be turned somewhat similar in style to the legs in Fig. 3, but reduced to about 1 in. or $\frac{3}{4}$ in. in diameter.

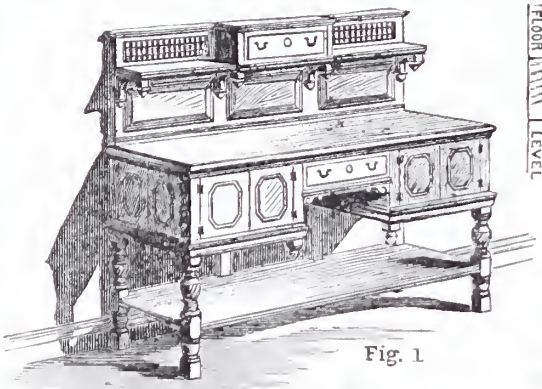


Fig. 1

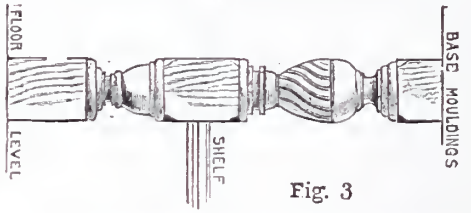


Fig. 3

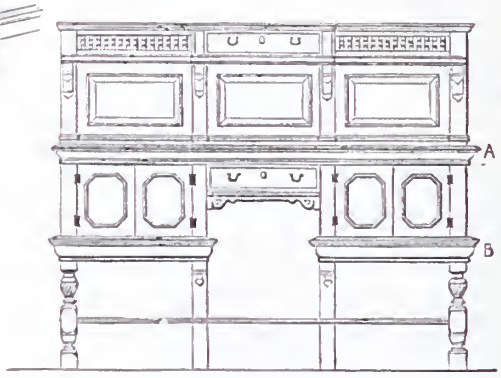


Fig. 2

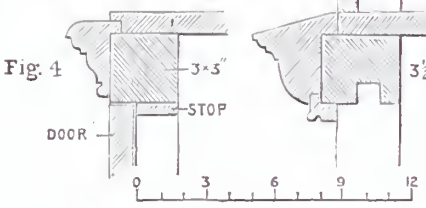


Fig. 4

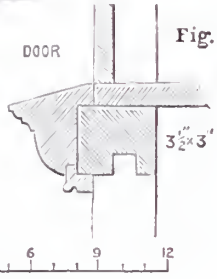


Fig. 5

Dining-Room Buffet. Fig. 1.—Perspective View. Fig. 2.—Front Elevation. Fig. 3.—Detail of Turned Legs. Fig. 4.—Detail at A. Fig. 5.—Detail at B.

TURNING AND THE TURNERS' COMPANY.

IN October the Worshipful Company of Turners propose holding their Twenty-third Annual Prize Competition, which it is to be hoped will be productive of a good collection of creditable turning. We draw special attention to this competition because among the tens of thousands who subscribe to WORK a very large number are lathe workers. What strikes us particularly in connection with this prize competition is the extreme poverty—for a City Company—of the prizes offered to journeymen and apprentices to induce them to exhibit. It is unreasonable, indeed, to expect that workers—whether professional turners or amateurs who use the lathe as a hobby—will be moved to great efforts or risk their handiwork in transit to and fro for rewards which would come out ridiculously mean if calculated at an amount per hour. A City Company should be able to rise superior to this kind of liberality, and offer inducements at any rate superior to those of the commercial man and private tradesman. If we mistake not, the Turners' Company do plead poverty, though on what grounds is not so clear to us. Surely the actual prize money indicated in the announcements of this approaching competition cannot be all that a great civic company—pledged to the interests of the turners' craft—would spend, annually, to conserve and advance the art with which they are so greatly concerned! If so, British workmen had better throw up the sponge. Another matter. This year we note the Competition Committee have cut out the amateur class altogether. This, we submit, is a very ill-advised step. It is true that the "Certificate" given in this class may have the value of 6d., or less. Nevertheless, amateurs particularly regret the disappearance of a section which, we unhesitatingly assert, always proves one of the most interesting features in any competitive exhibition. Much regret is expressed by amateurs on this point. One—an amateur turner of great ability and good position—writes to us:—

"I have attended these exhibitions some four years on prize day, but no speaker has ever alluded to the amateurs, though in 1889 the *Yorkshire Post* said, 'The show was only saved from absolute condemnation by some exquisitely beautiful work of an amateur.'

"The amateurs do more for turning than any other class, because having money, they try new schemes and inventions—most of which are failures, but a few are great advances.

"I know a manager of a large works who has taken up ornamental work as a hobby, and he is greatly disgusted that he cannot show multiple spirals cut out in separate strands upon an ordinary guide screw lathe—all the tools made by himself."

So much for the cause of the amateurs, who it seems a folly to neglect, seeing that the Company are anxious to get in touch with technical colleges and institutions! The amateur element is the backbone of these technical schools, wherein an apprentice joins classes not merely to qualify himself in his particular trade, but to enable him to gain an insight into some allied trade, which he should know, but to which he has not been indentured. Thus these two aspects of the forthcoming Turners' Competition clash with each other. For the sake of the professional element, however, who are invited to compete, we could have wished that the inducements had been on a more liberal monetary scale. As it is, we can only hope that the exhibition will prove a success; that the old grievances about preference for work done by particular lathes will not find vent again; and that the Company itself will have reason to be sufficiently moved to a fuller sense of the widespread interest it could, and should, arouse by more liberally stimulating these annual competitions. Hard cash is what a professional workman wants to pay his expenses and to buy tools for his lathe which he cannot otherwise get.

WATCH AND CLOCK CLEANING AND REPAIRING.

BY A PRACTICAL WATCHMAKER.

CLEANING A GENEVA WATCH.

THERE are two reasons why a watch should be cleaned: first, it may be dirty—that is, particles of dust, grit, fluff, etc., get in through the openings in the case, or are

introduced by the key, and clog up the pinions; or, secondly, it may be perfectly *clean*, by reason of the cases fitting well and good usage, but the oil with which it was oiled, say three years ago, has now all dried up, and got sticky; thus pivots stick in their holes, the coils of the spring stick together, and the watch refuses to work. It is well that it does so; for if it still went on after the oil had dried up, careless wearers would let it go till it "struck" and the pivots had worn completely off. They very soon do this if they run without oil.

The remedy for either is to take it all apart, as before described, and put the parts in a pot of pure benzine for a few moments. This dissolves off all the old oil, and loosens any dirt there may be. After taking the parts out of the benzine, they are dried. They soon dry if left upon the paper a minute or two.

I may here say that great care must be exercised in uncovering the benzine-pot *near a gas-jet:* a flash may ensue, and endanger, perhaps, the sight of the operator.

When dry, a soft watch-brush, charged with a little dry chalk (billiard chalk does capitally), is used to clean and polish up the plates, wheels, etc. The pieces are meanwhile held in the hand in a piece of tissue-paper, to prevent moisture from the hand soiling them. If the reader buys a *new brush* for this purpose, he had better scrape the hair well over the sharp edge of a knife, and charge it with chalk, and brush hard and continuously over a piece of burnt bone; then wash it in soap and water, and dry thoroughly. This will take the rough edges off the hair, and fit it for brushing delicate objects like scape-wheels, etc.

Now, taking the watch we have before us in pieces, put the plates, cocks, and wheels into the benzine; then, taking the barrel, pull out the mainspring. Put the barrel, cover, and arbor into the benzine with the first, and fold up a small piece of tissue-paper, and, holding this in the tweezers, thoroughly wipe the mainspring free from all grease. If it is very sticky, dip the paper in benzine and wipe as before. Take out the barrel, cover, and arbor from the benzine, brush them quite clean, and take one of the pieces of pegwood from the bundle. Sharpen this to a point, and with it clean out the holes in barrel and cover. This done, the spring must be replaced. It is very easy to put a mainspring into its barrel if it is set about the right way. It will be observed that inside the barrel is a hook, very shallow, but sufficient to hold the ring. Upon this hook place the outside end of mainspring, taking care that it is coiled round the right way—a moment's thought will decide this—then slowly coil the spring in, beginning with the outside coil, and pressing each one down as you go till it is all in.

This description applies only to a ¾-plate movement—the most common; but if a bar-watch is being cleaned, the barrel-work will be found altogether different. In this case the barrel, etc., comes away with the bar as if it were in one piece. Having unscrewed this from the plate, first remove the brass cap covering the ratchet at the top of the bar; then remove the stop-work underneath the barrel, prize off the cover with a screwdriver, and take out the spring. This done, grasp the winding-square in the jaws of the sliding-tongs, and take hold of the steel arbor inside the barrel by its *largest part* with a pair of pliers, taking care not to injure the hook, and, using some force, unscrew it from its centre. When off, the barrel, bar, and arbor all come apart easily. The large part of the arbor which was unscrewed locks the whole together. Occasionally this does not screw on, but is pinned through, in which case the pin must be pushed out with a steel point held in the pin-vice. Fig. 15 shows the arrangement of bar, barrel, arbor, etc.: A is the part that screws off and liberates the whole.

When apart, clean all as before, and put together again. To do this, hold the square in the sliding-tongs or a "Birch" watch-key, put a *small* quantity of watch oil (obtainable at watch material shops), by means of the oiler, upon the shoulders where the bar and barrel turn, put the latter in position, and screw on the arbor-nut once more, taking care it is the right way up. This can be ascertained by noticing the direction of the hook, and remembering that the pull of spring tends to screw up the arbor. This done, hook on the *inside* eye of mainspring, and wind it in with a key on the winding-square, guiding the outside coil of the spring into the barrel with the thumb of the left hand. When the spring is in, see that the outside eye is upon the barrel-hook. If so, all is right. Apply a considerable drop of oil to the top of the coils, another to the bottom of barrel inside, to lubricate the spring, place a little on shoulder, where the barrel-cover turns on arbor, and snap the cover on. For a guide to placing the cover on in the right position, a dot will be found on the edge of the barrel, outside, opposite which the opening in cover must go. If a ¾-plate watch, serve the spring the same as regards oil, put some on shoulders of arbor where barrel and cover turn, and snap cover on.

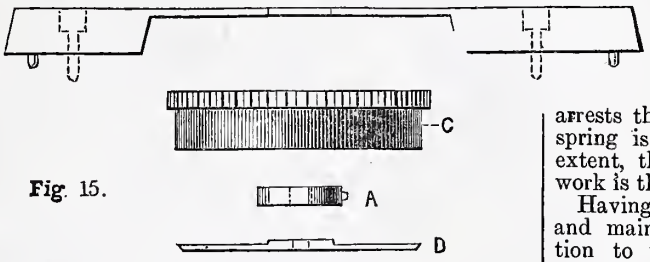


Fig. 15.

Fig. 15.—A, Screwing-off Part; B, Arbor; C, Barrel; D, Cover.

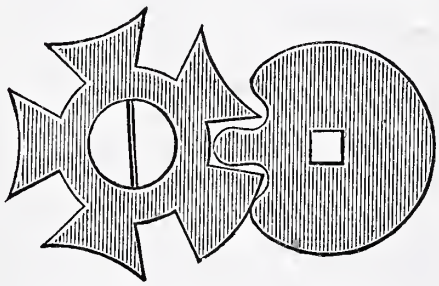


Fig. 16.

Fig. 16.—Stop-Work Arrangement.

We will now consider the stop-work, which is the same in both cases. Fig. 16 shows the arrangement. Without any stop-work the spring would make about five turns of the barrel, and when wound up would strain both the eye of spring and the barrel-hook. Therefore, for the purpose of utilising the middle four turns of the spring, and saving the strain when wound up full, stop-work is introduced. It will be seen to consist of two pieces: a star-wheel and a stop-finger. The star-wheel has five notches in it, and of the five solid pieces between, four are curved hollow and the fifth is left round, forming an abutment for one of the shoulders of the stop-finger. Now, if the winding-square is held firmly, and the barrel given half a revolution in the direction which winds up the spring, the star-wheel being placed in position on the cover—if, when like this, the stop-finger is placed upon its square on the barrel-arbor in the position shown in Fig. 16—it is evident the barrel cannot return. In other words, the mainspring will be permanently wound up, or "set up," half a turn. This is as it should be. Now, in this position it can be wound by means of the key or sliding-tongs (holding the barrel in the hand) *four turns*, at the completion of which the shoulder of stop-finger again comes into contact with the solid division of the star-wheel, and arrests the winding half a turn before the spring is actually wound up to its full extent, thus saving all strain. The stop-work is the same in all Geneva watches.

Having thoroughly cleaned the barrel and mainspring, we will turn our attention to the parts in the benzine—viz., plates, bars, and wheels—all, in fact, except the balance and accessories. Take these out one at a time, dry them, and brush clean, putting them aside carefully when done. All pivot-holes must be cleaned out with a fine-pointed peg. Pivots are dug hard into the pith to remove any traces of benzine. The spaces between the leaves of the steel pinions must be carefully cleaned out with a pointed peg. The 'scape-wheel needs especial care: it is so brittle and fragile, and its pinion so small, that great care is necessary in pegging it out clean.

Having cleaned all these parts, the movement may be put together again so far. Take the plate in a piece of tissue-paper in the left hand, and with the tweezers in the right, place the barrel in position, first oiling its pivots slightly. If a bar-watch, the process scarcely needs any directions, except that care must be taken to screw all bars *home*—not to force anything. The centre-wheel pivots must be oiled before putting the wheel in; the third, fourth, and 'scape-wheel pivots are oiled after the wheels are in.

If a ¾-plate watch, put in barrel and centre-wheel, oiling their pivots as before; also the third and fourth wheels. Then place the top plate carefully upon the pillars, and with the tweezers place the third and fourth wheel-pivots carefully in holes in top plate, and in no case use much pressure in pressing it down, or broken pivots will result. Screw it down, and see that all the wheels run quite smoothly and free. Each one should have perceptible "end-shake" between the plates—that is to say, they must lift slightly up and down. Then place the 'scape-wheel in position, and screw the cock down carefully. If it has no "end-shake," before screwing down the cock, place a minute piece of tissue-paper under the inside end, and screw down again. If it has too much (it should only be *just perceptible*), put the paper under outside end instead. See that this also runs free. Now push in the centre arbor, and, turning over the movement, push on the cannon-pinion, seeing that all goes well home. If a bar-watch, the winding-work will already be in position; but if a ¾-plate, put the steel ratchet-wheel on the winding-square,

polished side up, and the "click" in its place, and screw on the cover again, as before the watch was taken apart.

We now come to the balance—the heart and lungs of the watch—and more care than ever is needed in its treatment.

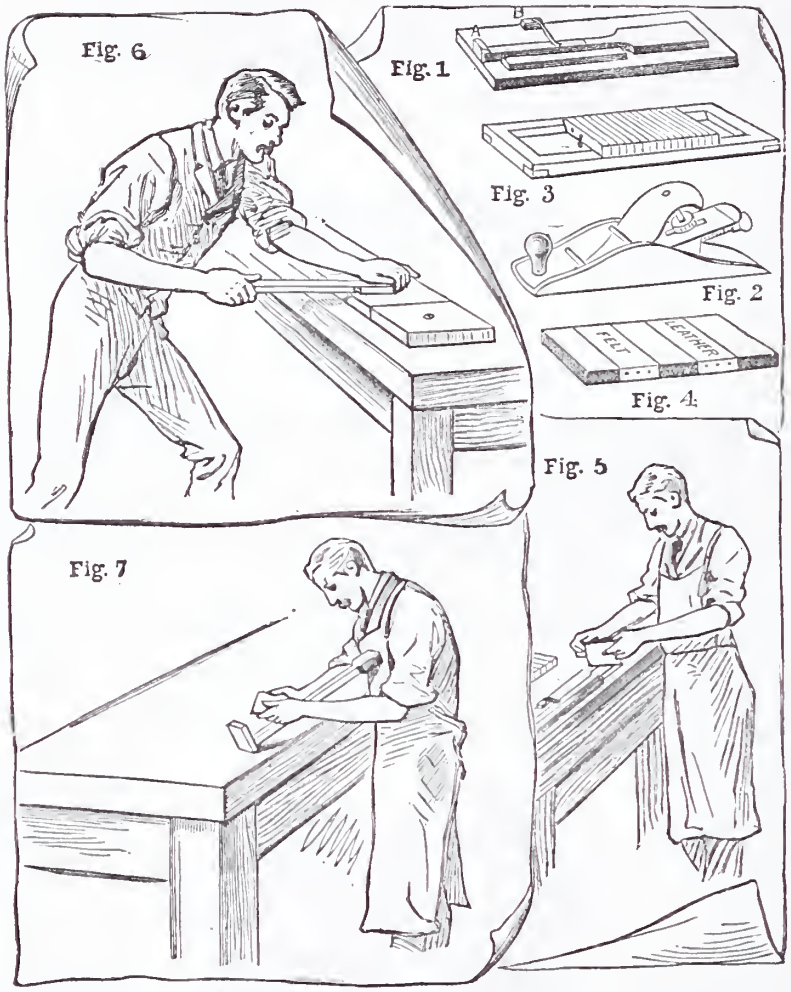
Before anything can be done in the way of cleaning it, we must disconnect the balance from the balance-cock. It will be seen that the outside end of the hairspring is passed through a hole in a brass stud affixed to the balance-cock, and kept there by a small pin. Do not disturb this, but detach the spring, stud and all, from the balance-cock. To do this, rest the edge of the brass, close against the stud, upon the end of the vice, and with the point of the tweezers push it through from the top. This done, the balance and hairspring will come apart from the balance-cock. The latter can be taken apart and cleaned with benzine, etc., as before, and screwed together again, the hole being pegged out carefully, and the "end-stone" wiped clean. The balance-pivots are cleaned with pith. The cylinder, its axis, is pegged out carefully, and very lightly brushed. The rim of the balance may be cleaned by resting it on a piece of cork in the vice and rubbing with pith. When done, place a minute droplet of oil in the top pivot-hole, and, laying the balance-cock flat upon the board, place the balance on it in position, and press the hairspring stud carefully home again. See that the hairspring plays freely between the two pins in the regulator.

Now take the movement, and apply oil in minute quantities to the bottom pivot-hole of the balance, a little to each tooth of the 'scape-wheel, to the 'scape-wheel top pivot, and the top pivots of the third and fourth wheels. The balance can now be very carefully put back in the watch and screwed down, care being taken to see that it is quite free and has correct end-shake. This can be obtained by means of tissue-paper, as before described. The watch can then be wound. If correct, it will at once start off.

If the watch in hand is keyless, the keyless wheels will have to be cleaned in the same way as the other wheels, and oil applied wherever there is friction in winding. Care must be taken to replace everything exactly as it was found. Any directions as to details of the keyless work would be quite useless, on account of the numerous varieties of keyless work in use. Hardly any two watches met with at random are alike. I will merely say that very often one of the large steel wheels upon the top plate or barrel bar, as the case may be, is fixed on by means of a *left-handed screw*. If this is borne in mind, it may save a lot of time and temper in trying to withdraw it as if it were a right-handed one.

Having put the entire going part of the watch together, it must be laid upon a clean part of the paper on the board, dial side up, and all the bottom pivots properly oiled. The motion-wheels can then be brushed and replaced, and the dial cleaned and put on again. If a pinned-on dial, and the pins are bad or deficient, file up fresh ones with the pin-vice, resting them on a piece of boxwood screwed in the vice. The boxwood has a shallow groove in it to accommodate pin. As the pin lies in the groove, the pin-vice is revolved in the left hand; while it is being filed down, taper to fit with the right hand. The hands can now be put on and the movement returned to the case, which is also to be thoroughly cleaned and freed from dust.

This is the whole process of cleaning a Geneva watch. Repairs will be dealt with in the next and following papers.



Keys of Musical Instruments. Fig. 1.—Block to hold the Keys for planing, scraping, and glass-papering. Fig. 2.—Suitable kind of Plane. Fig. 3.—Frame for Organ and Harmonium Keys. Fig. 4.—Polishing Board. Fig. 5.—Position on the Bench as regards Light and Method of holding the Scraper. Fig. 6.—Polishing Keys. Fig. 7.—Holding the Keys for scraping the Woodwork at the Back.

HOW TO IMPROVE THE KEYS OF MUSICAL INSTRUMENTS.

BY LIFEBOAT.

PLANING AND SCRAPING — POLISHING IVORY—POLISHING CELLULOID—FRONTS OF KEYS—CLEANING THE WOODWORK — ENAMELLING THE FRONTS—NOTES AND USEFUL HINTS.

Planing and Scraping.—To hold the keys, we shall require a block, as shown in Fig. 1. Take a piece of wood about 20 in. long, 4 in. wide, 1 in. thick. Screw this on the bench. Lay a key on about 1 in. away from the front edge and 2 in. from the left end. Now take two pieces of wood ½ in. thick, 1 in. wide, 6 in. long. Lay these on each side of the key, bringing the front ends against the shoulder of the key. Nail or screw them in position, so forming a groove.

It should be here noted that the keys at the extreme ends of the key-board are wider than the others. In fastening on these strips, use as a guide a G, A, or D key, which have shoulders on both sides. The end keys may be worked up separately.

Organ and harmonium keys may require a ⅝ in. hole bored through the board, to allow the regulating-screw or coupler-stud to pass, or the key will not bed level.

To keep the keys from jumping up when planing or scraping, it is advisable to put a grooved block at the tail end, as marked A in Fig. 1, though personally I prefer and use a spring, as marked B, for the purpose. An action or pedal spring is used, one screw only being used, so allowing the spring to turn on or off as required. The small American iron planes, as sold at about 1s. each, will be found a useful tool; but such a one as shown in Fig. 2, and sold at about 2s. 6d. each, is preferable, as by the milled nut at the top of the plane-iron they can be regulated to such a nicety. Should neither of these be available, a sharp, finely-set smoothing-plane will render good service, though I have seen scores of sets of keys done by the aid of a steel scraper and glass-paper. The plane, which must be sharp and finely set, is of use only in the case of ivory and bone. For celluloid it is useless: the scraper must be relied upon. From this it will be seen that, though a plane is useful, it is not absolutely necessary, since, in capable hands, the steel scraper will do all that is required. For instructions how to sharpen a scraper we refer our readers to an article by "Chopstick" in No. 134, page 474, Vol. III.

Having at hand a supply of No. 1 and No. 0 glass-paper (sheets cut in four), and a cork rubber about 3 in. long by 2½ in. wide, such as can be bought at most cork shops and tool dealers for 4d., put a key in the block, and, by the aid of plane or scraper, take a few shavings off, taking care not to go down lower on one side than the other. This done, take the rubber and a piece of No. 1 glass-paper, rub lengthways till it looks quite smooth and level, and finish with No. 0, taking it up from the block to set on the board again in the order in which it was taken up. Whilst still holding the key in the left hand, with the right hand take a piece of No. 0 paper, and take off all sharp edges previous to polishing.

Polishing Ivory.—As the bulk of our

readers will require to do only one or a few sets, it is needless to speak here of the machinery, such as revolving bobs, as used in the factories, especially for celluloid. For our purpose it is enough to procure a piece of board about 2 ft. long, 8 in. or 9 in. wide, 1 in. thick. Plane up one side and edges. To the top of this, on the left-hand side, must be affixed a piece of felt or cloth; on the right side a piece of chamois, buff, or wash-leather. This must be affixed so that no nails or tacks show themselves on the upper surface. This means that the felt, etc., must be long enough to allow it to be fastened on the front and back edges, as shown in Fig. 4. The board being screwed to the bench, and the felt or cloth well rubbed with clean whiting, and made fairly wet with methylated spirits, and the chamois sprinkled with dry whiting, or, better still, putty-powder, take the keys one at a time, turn face downwards, and rub the ivory to and fro on the felt, putting on pressure with the left hand, as shown in Fig. 6. With a clean piece of rag wipe off any surplus wet and whiting, and polish dry on the leather.

Polishing Celluloid.—It is better not to use the same board indiscriminately for both kinds of keys. For celluloid we require a similar board, but instead of whiting and spirits on the felt or cloth, we require either putty-powder and linseed oil, or very fine pumice-powder and benzoline, though I have found pumice-powder and Russian tallow answer the same purpose. These ingredients to some readers may seem so contrary in their composition; so is celluloid. In practice it will be found that one set will take a better polish than another, and some better with putty-powder than pumice. Personally, I prefer the latter, on the score of cheapness and cleanliness, as any oil on the wood will, unless scraped off, cause dirt to cling to it. If one plan does not give a satisfactory polish, try the other, or both in combination. In any case, finish off with dry putty-powder. Some remove any trace of greasiness that may be left by rubbing with the palm of the hand, first dipping it in flour.

Fronts of Keys.—We have so far only treated of the tops of the keys. If the fronts are covered with the same kind of covering as the tops, they will need the same treatment. Should they, however, be faced with wood, either moulded or plain, as will be found the case in the older class of instruments, a wonderful improvement will be gained if the fronts are enamelled to match the tops. But of this more anon.

Cleaning the Woodwork.—All the fronts and tops having been polished to our satisfaction, take the house bellows and dusting brush, and remove all the dust from the instrument—first taking out the black keys, and placing them on a separate board—taking care not to remove the cloth or paper washers, which will probably be found on the front key-pins. Before putting the keys back in their places, a still further improvement is gained if the woodwork part at the sides, from the front to the shoulder and the back, is cleaned. This is done by the scraper. The sides are done first, holding the scraper in the right hand, the key in the left. For the backs, however, we shall need a piece of wood, fastened on the bench, against which to press the end of the key, holding the scraper in both hands, as shown in Fig. 7, and finishing, if necessary, with glass-paper wrapped round a flat piece of wood.

Enamelling the Fronts.—If the fronts are left in wood and have turned brown with age, cleaning with methylated spirits and rag in the case of the moulded ones, and scraping in the case of the plain ones, then giving them a coat of white hard varnish, is an improvement. Should this not be deemed up to the mark, and it is decided to enamel them to match the tops, we must, *previous* to the scraping of the woodwork, put the keys back again in their places (white keys only). We then require a strip of wood 3 in. wide, ¼ in. thick, of a length that will reach the whole width of the key-board. This we insert under the whole of the keys, letting it rest on the front row of pins, and projecting forward about 1 in. Insert a piece of paper or cardboard at the extreme ends, between the last key and the key-block, to prevent the enamel getting thereon.

The enamel is made by mixing some "flake white" with white hard or transparent spirit varnish. Carefully strain before using. But it is far better and cheaper to buy a small tin ready prepared. I have found the Foochow brand (4½d. per tin) to be good. It should be carefully applied to the fronts with a camel-hair brush several times, till the desired result is gained. If the tops of the keys are not quite white, as in the case of ivory, it will be found that the enamel is *too* white. The required tinge to make them match properly can be gained by adding to the enamel a small quantity of ordinary brown polish or varnish.

Allow an interval of at least fifteen minutes to elapse between each coat. After the last coat, allow an interval of at least an hour to elapse before removing the strip of wood. Then let them stand overnight to thoroughly harden. Then take them up, and scrape off the surplus enamel, sides and backs, as previously advised.

Notes and Useful Hints.—This improvement of keys may from this appear to be a tedious affair. This is not so; for if the fronts are not enamelled, which necessarily takes time to harden, it is quite possible to do a set in four hours. It is desirable that all planing or scraping be done in daylight, with a good side light, as shown in Fig. 5. Keys, especially celluloid, may by artificial light appear quite white, whereas by daylight they appear quite yellow in places. Intending purchasers of musical instruments might do worse than take this fact to heart, and select their instruments by daylight. To keep the keys in good condition, keep them free from dust, and clean occasionally with a clean piece of rag just damp with methylated spirits, and on bright light days leave the keys exposed to the influence of sunshine.

The celluloid collars and cuffs now much worn may be effectually cleaned by this process of rubbing with fine pumice-powder and benzoline, and exposure to sunlight, the deep yellow stains being first removed by well rubbing with strong naphtha or naphtha spirit.

Brown Leather Boots.—To keep brown Russian leather boots and shoes a good colour, wash them with a damp sponge or a very soft brush. For the parts that are dirty, or dark through wear, use a little yellow soap. The water should be clean and cold. Then, when the leather is dry, give them a coat of brown cream (Propert's), and when this has nearly set, polish with a soft cloth.

HOW TO PUT ON A LOCK.

BY E. DICKER.

There are several things to be considered in putting on a lock successfully—that is, so that it works properly. It is, comparatively speaking, a very simple matter to *put on* a lock; the most important point to be borne in mind is, that it works nicely when it is on, also that it is the most suitable kind of lock for the purpose.

There are so many different sorts of locks, each adapted for its own particular use, that the first question which generally presents itself to the average amateur is: What sort of lock do I want? If he does not know, he asks an ironmonger, with the result that the ironmonger (whose business it is) sells him a lock: sometimes it is the right sort, but more often not; and even if it is the right sort of lock, it invariably happens that it is the wrong hand.

In ordering a lock for a door, it is a very good plan to make a rough sketch, showing how the door is hung, and on which side or hand you want the lock to be, and which way the latch-bolt is bevelled (if there is a *latch*-bolt). A lock is said to be "right hand" when it is on the right-hand edge of the door, viewed in all cases from the outside, and a "left-hand" when it is on the left-hand edge. It is assumed that a door opens inwards, or away from you when you stand outside.

If a door opens outwards, or toward you when standing outside, this order is reversed "in the case of a rim lock or latch," unless you want the lock to be on the inside, and in that case it is called a "reverse latch-bolt," either right- or left-hand, as described in the preceding paragraph.

This right- and left-hand business has always been a bone of contention between buyers and sellers of locks; in fact, so difficult is it to remember which hand a lock is, or to persuade the ironmonger that your version is the right one, that it saves a lot of trouble to take a little sketch as described above.

Nearly all mortise locks are now made with reversible bolts; so are rim locks, but in the case of rim locks you not only have the difficulty of "hands," but there comes the further complication of "reverse bolts," according to which side of a door the lock is fixed.

There are some very ingenious methods resorted to by some makers to get over the complexity of rim locks, but unless you want a number to keep in stock, they are rather too expensive for ordinary doors, and the little sketch serves every purpose.

Sometimes when a new key is wanted for a lock, the locksmith or ironmonger will tell you that it will be cheaper to buy a new lock; sometimes this is so, but, before buying a new one, see what it is he proposes to sell you in its place, and if it is not exactly a replica of the old one in every respect, have the old one repaired and a key cut to it, even if it costs you more than a new one would, because it is very often ever so much more trouble to make a new lock fit the place of an old one (unless it is exactly the same) than it is to put a lock on a place where there has not been one before. The keyhole is very often the seat of most of the trouble, then there are the screw-holes, the striking plate; and last, but not least, modern locks being more compact than the more ancient ones, they very often show a nasty-looking mark all round them on the door, drawer, etc., as the case may be, and very often this is most important; so do not be

persuaded by what the ironmonger says, see for yourself.

I give below sketches of some of the locks most frequently required, with their names.

Figs. 1 and 2 are rim locks; the way to fix these is to first let the projecting lip of the face-plate into the edge of the door, and then, holding the lock in its position, mark through the key and spindle-hole with a scribing tool, or small bradawl, on to the face of the door, remove the lock, and bore the keyhole top and bottom right through the door with a bit, that the shoulder of the key will pass comfortably through, and then finish keyhole with a keyhole-saw or small chisel, taking great care to only make the keyhole large enough to just allow the key to pass through comfortably, for if the keyhole is too large it does not guide the key exactly to the hole in the lock, but allows the key to strike the lock, and not go directly into the keyhole, and nothing is more annoying. Next bore the hole for the spindle exactly square with the face of the door. This should be done with the greatest nicety, for if the hole is not exactly square with the face of the door, you will find that when you come to screw up the knobs they "bind," and will not allow the latch-bolt to spring back freely when the knobs are turned. The lock should now be screwed on to its place; "round-headed" screws are mostly used for rim locks, and ordinary countersunk screws for the face-plate. Now put on the knobs and spindle, and the escutcheon, or keyhole plate; this plate is generally fixed with escutcheon pins.

The knobs and spindle, together with the escutcheons and finger-plates, are generally termed "lock furniture" in the trade; and always ask for rim or mortise lock furniture, as the case may be, as there is a distinct difference between the two. And I here take the opportunity of cautioning you against buying the old-fashioned knobs and spindle, where the knobs are simply secured to the spindle with a small screw, a most unsatisfactory arrangement, and one that is bound to give trouble at an early date. There are an innumerable number of "patent knobs" in the market, and some of the best of them, strangely enough, are the cheapest, and cost very little more than the old-fashioned sort.

The "box staple" is next screwed on to the door frame, adjusting it by letting it in a little way or packing it out a trifle if the door requires it, and just making the latch catch comfortable; if there is a moulding round the frame the "box staple" must be let into it, fitting it very carefully.

Fig. 3 is a night latch, and the fixing is somewhat similar to that described above, with the exceptions that after you have let in the lip of the face-plate you press the lock into its place, as it were, and the projecting pin in the centre of the keyhole makes an indent in the face of the door indicating where the keyhole is to be made. The escutcheon for a "night latch" is generally a little different from an ordinary one, and as the lock is constructed so as to be opened from the outside with a key only, knobs are not required, one being provided on the lock for the inside.

Figs. 4, 5, and 6 are "mortise locks." The fixing of these locks is rather beyond the scope of the average amateur, and requires special tools, etc., but I will describe their fixing in a separate paper later on.

Fig. 6A is called a "tubular mortise lock." Now *this* is a "mortise lock" that any person can readily fix if a certain amount of care is taken, and the direction and appliances for fixing are supplied with the lock. So much faith have I in this lock that I have no hesitancy in recommending it to my readers.

Fig. 6B is the template for marking the exact position of the key and spindle holes.

Fig. 6C is termed "the twist-bit guide," and all you have to do is to temporarily screw this on to the edge of the door, taking care that it stands exactly in a line with the face of the door, then pass the twist-bit through the "guide," and bore a hole the exact size of the lock. Now remove the guide and push the lock into its place, and by marking the centre of the screw holes in the face-plate on the edge of the door you get the exact centre for boring two more holes with the same twist-bit to take the face-plate of the lock; the same twist-bit bores the proper size sinking for letting in the striking plate. This brings the putting on of a mortise lock down to a mere matter of boring a series of holes perfectly true.

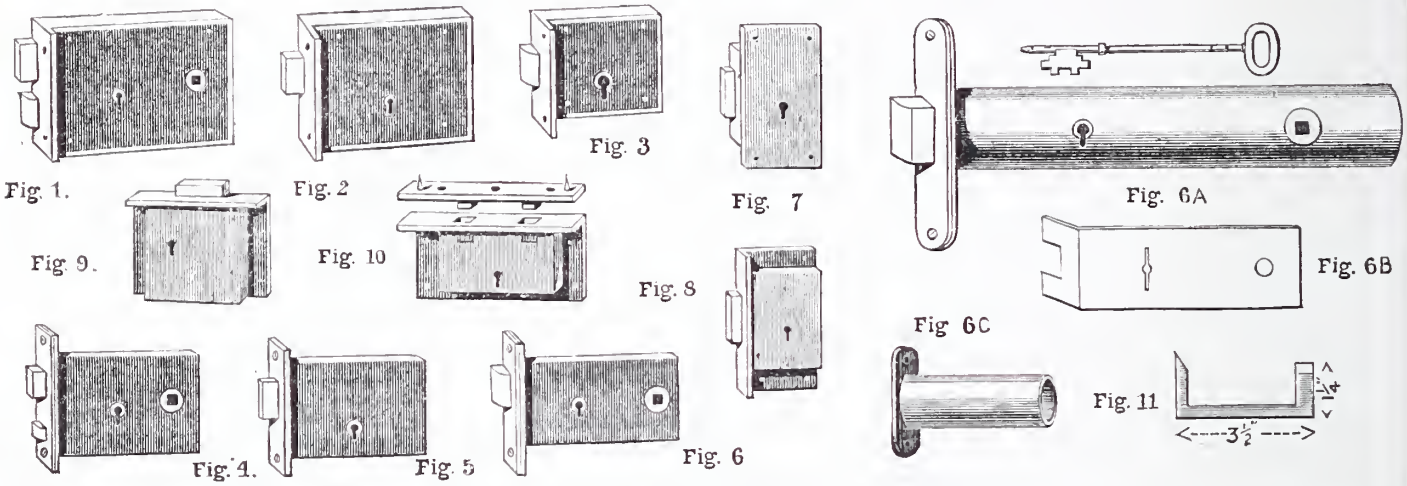
Fig. 7 is a "straight cupboard lock," the fixing of which is very simple, as it merely wants screwing flat on the door, the position of the keyhole being got by measurement and as the bolt shoots out on both sides it is both right- and left-hand, and this fact, combined with the facility of fixing, makes its use very general.

Fig. 8 is a "cut cupboard lock," and is intended to be let in flush in fixing; sometimes the back-plate is not let in, but as this class of lock is generally used for the sake of appearance in preference to Fig. 7, it should be let in, unless, as it sometimes happens, the peculiarities of the fixing of the striking plate prevent it. In fixing, the keyhole is bored first, and then get the keyhole of the lock and the hole in the door exactly opposite, and see that the face of the lock is exactly flush with the edge of the door; then mark with a pencil round the body of the lock and the length of the face-plate, and let these in until the back-plate lies on the back of the door (but not let in); this will enable you to try the key in the lock, and see that it enters readily before finally letting in the back-plate; and if the key does not enter exactly, you can shift the lock a trifle, and to do this after the lock has been let in entirely just spoils the job.

Fig. 9 is a till or drawer lock. In fixing, first find the centre of the width or length of the front of drawer, and measure the distance the keyhole is down from the face-plate of lock, and make the keyhole, and then hold the lock inside with the keyhole opposite the one made in the front of the drawer, and mark round the body, and proceed in the same manner as described for a "cut cupboard lock."

It is sometimes a very awkward job to make the hole for the bolt of the lock to shoot into. Fig. 11 shows a tool specially made to do this.

Fig. 10 is a box or chest lock. This is fixed in exactly the same manner as a drawer lock, but a little care is required to fix the link-plate. To do this, place the link-plate in the lock when it is fixed, and lock the lock, and then slam the lid of the box down sharply. Now unlock it, and the two pins will hold the link-plate in position on the lid, and by carefully opening the lid the link-plate will be found ready for marking round exactly over the place you want to let it in.



Names of Locks. Fig. 1.*—"Two-Bolt Rim": suitable for all ordinary Doors that are required to lock as well as latch. Fig. 2.*—"Rim Dead": for Doors that require to be locked one side only, such as Wine, Beer, and Coal Cellars, also large Cupboard Doors. Fig. 3.*—"Rim Night Latch": for external, and all Doors that require to be made secure on one side only. Fig. 4.*—"Two-Bolt Mortise": all Classes of Internal Doors, also other Doors where Fig. 1 would be an objection. Fig. 5.*—"Mortise Dead Lock": for Doors requiring to be locked both sides. Fig. 6.*—"One-Bolt Mortise": Lock and Latch in one Bolt. Fig. 6 A.—"Tubular Reversible Mortise Lock": used for same purpose as Figs. 1, 4, and 6, but more readily fixed. Fig. 7.—"Straight Cupboard Lock": for all ordinary Cupboard Doors. Fig. 8.*—"Cut Cupboard Lock": for better class of Cupboard Doors. Fig. 9.—"Drawer" or "Till" Lock: for Drawers of all Descriptions. Fig. 10.—"Box Lock": for Boxes and Chests; the same make of Lock, but with the Face-Plate bevelled to suit Slope, are called "Desk Locks." Fig. 11.—Drawer Bolt Chisel. Those marked with an asterisk are "Handed."

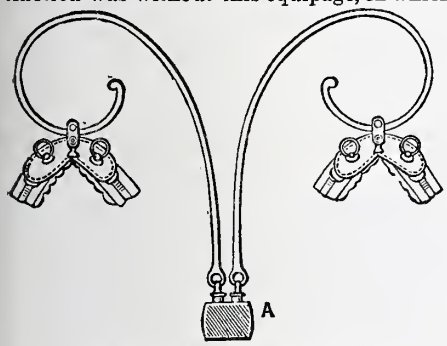
CURRICLE HARNESS.

BY H. C. KING.

Amongst the revivals in the carriage and harness trade in England, one of the most distinguished light pleasure carriages seems to have long waited its turn, and the wait seems, like many things else, to have been for the necessary essential scientific improvements that tend toward perfection, where imperfection before retarded advancement. The curricle has a distinguished ancestry from the currus of the racing contests of antiquity.

At the French Centennial Exposition, the perfect bronze remains of one of these curricles was built up with new woodwork. All the old metal parts were perfect, from the axle, wheels, nave, metallic "spoke"—the same as the modern "Sarven" hub "spoke-hoops"—to the whip-hook and floral ornaments that adorned the car body.

The modern curricle was conspicuous in England at the end of the last century and early part of this. No family of any distinction was without this equipage, in which



Curricle Harness—A, End Section of Pole.

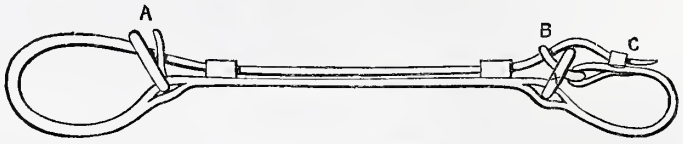
was used the finest horses, with the most stylish harness; but there was a drawback to its use. The mode of suspension to a pole, and its attachment to the harness, was by a yoke-bar of steel fitting across the backs of the horses, where the ends of the yoke-bar passed through a terret in each harness-pad, which allowed a certain degree of lateral motion to each horse. The yoke-bar had a strap-loop in the middle, by which it was held to another strap fixed to a flat spring under the pole; a girth chain from the girths of each horse passed over the pole to prevent it rising too much. With all this elaboration of fittings and fixings, the attachment of a pair of horses to a curricle was not safe from derangement. If one horse reared, the harness fittings were strained. If a horse fell, one or both terrets were torn out of the pads; then the equipage was useless: even one horse could not use it to draw it along a short distance. This was the reason for its disuse.

One who is of a family of curricle drivers has rectified the defects by simply using a separate attachment for each horse to the pole—a light steel whip-spring looped to an eye in a spring-plate on the pole, the whip-end of the spring being loosely looped to the roller swivel-terret in the harness-pad, so that a horse may rear or fall without affecting the other horse or his harness. These whip-springs take both up and down pressure on the horses' backs; no other attachment is required, and with the addition of swivel-terrets to pads, any harness suits. The gracefully curved steel springs above the backs of the horses have a bold, handsome appearance. The invention may do something to revive one of the old glories of road travelling in England.

RELEASING POLE-STRAPS.

BY J. C. KING.

How the shrewd workers of one craft have to scheme devices to compensate for the bungling or jobbery of another craft! Road-making, as it should not be, seems to be a paying game for the many engaged upon it. Formerly the study of road-makers was how to give horses good foothold and at the same time produce durable roads; now these two main factors are ignored by road-makers—if they deserve the name! Coachmen do not think so. The cruelty to horses on roads purposely made without foothold in wet weather is a disgrace to our municipal authorities. Over and over again have good systems of foothold wood-paving been brought to their notice, but the potent "tip" to the right man has not been given; so horses suffer, harness is wrecked, and shafts and poles are strained and broken.

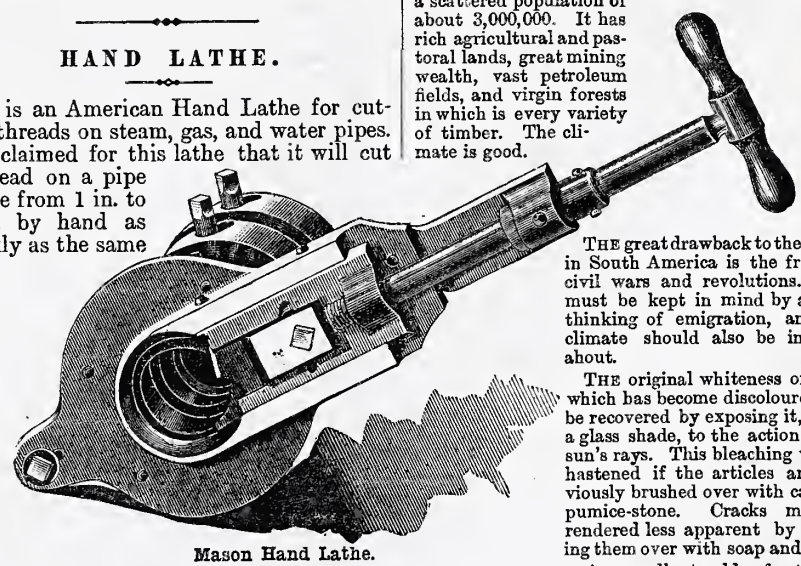


Releasing Pole-Strap.

To aid in quick release of fallen horses, the releasing pole-strap is designed. A is the usual buckle fastening; B is the releasing end, very simply effected by a bight-loop, B, which passes through a bar-frame. The bar is marked by a ×. The strap-point passes through the bight-loop, and is held tight in its place by the pull of the pole-strap loop, and fixed to the horse's hame-ring of collar. To release the strap, the point C is pushed out of its retaining loop and out of the bight-loop, and the strap is released automatically by the horse itself in pulling. It is quite easy to manipulate, and no dearer than ordinary pole-straps, which cannot be unbuckled when a horse's weight hangs on the buckle. This invention is brought out by Messrs. Whittingham & Wilkins.

HAND LATHE.

This is an American Hand Lathe for cutting threads on steam, gas, and water pipes. It is claimed for this lathe that it will cut a thread on a pipe in size from 1 in. to 6 in. by hand as quickly as the same could be cut by an engine lathe. It will cut the thread with the standard taper and will make a nipple of any length. This lathe has no dies to break, and there are no bushings to change in cutting different-sized pipes. The lathe is secured to the pipe by a universal chuck, and to change from a 2½-in. pipe to a 6-in. pipe requires but a minute's time. It is made in two sizes, cutting from 1 in. to 2 in. and from 2½ in. to 6 in. Another size, to cut from 6 to 12 in. inclusive, is now in course of preparation. All parts are made of the very best steel. The manufacturers state that it has given satisfaction wherever used.



Mason Hand Lathe.

We do not know that this is yet in the London markets, but Work tool advertisers should know. They keep most good things.

NOTES FOR WORKERS.

The Metropolitan Fire Brigade includes 55 land fire-engines, 4 river or floating stations, 215 fire-escapes, 706 firemen of all ranks, 25 men under instruction, 17 pilots, 73 coachmen, and 133 horses.

There are at present two hundred and six central electric lighting stations in operation in Europe.

Electric motive power is being applied to all the hand looms in St. Etienne, the French centre for producing silk ribbon. The 18,000 looms in use are in the houses of the workers, who will be charged 3½d. per day per loom for the power, but will be able, in consequence, to greatly increase their work.

It is intended that an additional 1,292 boys shall enter the Royal Navy during the present year, and in consequence the composite sloop, *Miranda*, 6,1,130 tons and 1,020 horse-power, will be fitted as another training-ship.

The London General Omnibus Co. have now sixty pocket electric lamps of 1 candle- or 2 candle-power, for the use of their ticket inspectors. They only weigh 2 lbs. each, and the cost is 8d. per lamp per week.

An electric crane is now at work on the Peterson Quay, in Hamburg, removing merchandise from the holds of vessels alongside the quay to waggons adjoining.

The highest central electric station is at Pontresina, Rhætia, 6,000 ft. above sea level. A waterfall of 430 ft. supplies 520 horse-power of energy, and every shepherd's hut has the electric light.

Peru covers about 500,000 square miles, and has a scattered population of about 3,000,000. It has rich agricultural and pastoral lands, great mining wealth, vast petroleum fields, and virgin forests in which is every variety of timber. The climate is good.

The great drawback to the States in South America is the frequent civil wars and revolutions. This must be kept in mind by anyone thinking of emigration, and the climate should also be inquired about.

The original whiteness of ivory which has become discoloured may be recovered by exposing it, under a glass shade, to the action of the sun's rays. This bleaching will be hastened if the articles are previously brushed over with calcined pumice-stone. Cracks may be rendered less apparent by brushing them over with soap and water.

An excellent solder for tinware can be made from the lining of tea-chests.

Eel-pie Island, in the Thames, is being transformed into a "charging station" for electric launches, which will be able to renew their charges here before going higher up the river.

Cocoa butter is made from cocoanut oil, the rancid flavour and colour of which are taken out by treatment with alcohol and animal charcoal.

"Brush" dynamos are to be used for the purpose of public lighting in the thoroughfares of the City of London.

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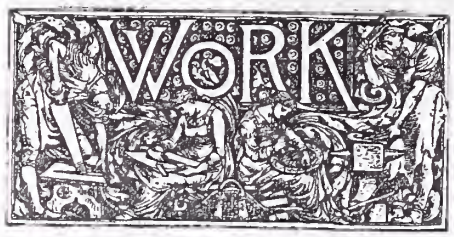

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*** All letters suggesting Articles, Designs, and MS. communications for insertion in this Journal will be welcomed, and should be addressed to the Editor of Work, Cassell and Company, Limited, London, E.C.

International Manufactures.—It is a common notion that the so-called "sweating system" is so rampant in foreign countries that foreign manufacturers are able thereby to produce goods so cheaply that, notwithstanding freightage and other expenses, they can sell these goods at a lower price than similar home-made goods can be sold at. This reveals a very crude notion of the principle that regulates international exchange. The price at which foreign commodities are sold in our markets has nothing to do with the cost of their production in the countries they come from. Indeed, commodities that are produced more cheaply here may be undersold by foreign commodities. Suppose that over some other country we have fourfold the advantage in the making of textile fabrics, while our advantage in the making of toys is only twofold; that other country, though it is put to twice the expense that we are in toy-making, will yet be able to undersell our toy-makers. The reason is obvious. One Englishman, by the supposition, can weave as great a quantity of textiles as four foreigners; in toy-making, however, he is equivalent to only two foreigners. The commerce between this country and the foreign country will consist of exchanges of woven stuff for toys, and the rate at which these commodities will be interchanged will be the produce of one English weaver for between two and four foreign toy-makers' produce. These foreign toys also will be sold at a price dependent not on what it costs the foreigner to produce them, but on what the textiles given for the toys cost us. This may be a complicated question and difficult to understand; yet the sooner it is understood the better it will be for this country, with the grave industrial problems, clamouring for solution, that are right before it; for the erroneous opinions that prevail respecting foreign commerce are simply obstructing clear views of the real cause of our difficulties.

The People's Food.—The returns of the cereal crops of the United Kingdom are not satisfactory reading. Summed up briefly, the whole of this year's wheat crop will not yield 8,000,000 qrs. of a second-rate quality, so that we shall have to import from 22,000,000 qrs. to 23,000,000 qrs. of wheat from abroad during the coming food year, which is reckoned from harvest to harvest. The land acreage for wheat is diminishing year by year; last year it was reduced from 2,388,147 acres to 2,150,000. Unfortunately some of the best wheat land has been laid down to grass at ruinous cost. The returns of wheat growth should show forty bushels per acre if the best land were used and the dressing by home-made manures. For indifferent land thirty-five bushels per acre should be a fair average in an ordinary season. Now it is anticipated that twenty-seven bushels per acre will be the average of good and bad land, or ten bushels per acre less than should result from free farming. By free farming is meant unrestricted methods of cropping by tenants, now hampered by conditions inimical to good farming by intelligent farmers. It has been said the more corn we have to import the better for manufactures, as we have to send them out to pay for the corn; by extending this theory to an extreme view, better save the labour on corn-land and import it all for the sake of sending out more manufactures to obtain it, which would be as absurd as it is to send the length of the kingdom for loaves of bread, instead of getting them in the next street; or as is done by the farmers, send to the Pacific Ocean 16,000 miles off for guano, when manure nearly as good could by proper arrangement of our sewage be had close to the crops to be manured. This dependence on a foreign supply of a necessary of life for two-thirds of the year is a national peril; and in view of the existence of 8,000,000 acres of wheat-growing land now lying waste and a million of able-bodied paupers wanting work, is a disgrace to the country and to an enlightened age.

Hardened Copper.—It is well known that in the earlier ages of the world—before furnaces capable of dealing with iron were constructed—copper was used for cutting instruments, and also for other tools which are now made of steel. This so-called copper has, by many metallurgists, been believed to be a kind of bronze—or we might say a copper—steel, in which the principal ingredient is copper. It now appears that a blacksmith of Quebec, Ferdinand Allard, has rediscovered the art of hardening copper. This material is stated to have been tested at the Government ranges, with the result that a bullet, fired from a distance of forty yards, flattened and split against a plate of hardened copper one-sixth of an inch thick. This material will now be tested in the English dockyards, and it is expected that its introduction will lead to alterations in our system of armour-plating. It is only recently, comparatively speaking, that the production of steels other than that formed by the association of a small quantity of carbon with iron has attracted that attention which it deserves; and there is no doubt that research in this direction, if it is properly followed up, will lead to results of great importance. Manganese steel, nickel steel, and mitis iron have already taken permanent places on the market, and phosphor bronze is largely used for castings of various descriptions. Although vast strides have been made in metallurgical science, much yet remains to be ascertained.

ABOUT BORDER ORNAMENT.

BY CHARLES KELSEY.

Anthemion Borders.

Introduction — Definition and Origin—Description of the Illustrations—Applying to Modern Work—As Objects of Study—Conclusion.

Introduction.—Amongst the many types of border ornament, probably not one has been used more frequently and by a larger variety of nationalities than the type chosen for illustration with this paper. The readiness with which it may be utilised, and the property it possesses in a high degree of lending itself to modification, may account for this extensive use. Its popularity remains undiminished at the present day.

Definition and Origin.—This type is variously known by the terms "Anthemion," "Honeysuckle," "Palmette," and "Flower and Knop" patterns. The first—perhaps the one most frequently used—is here adopted.

The earliest perfect specimens of this type are met with in Assyrian work. Examples discovered amongst the ruins of Nineveh are now exhibited in the British Museum.

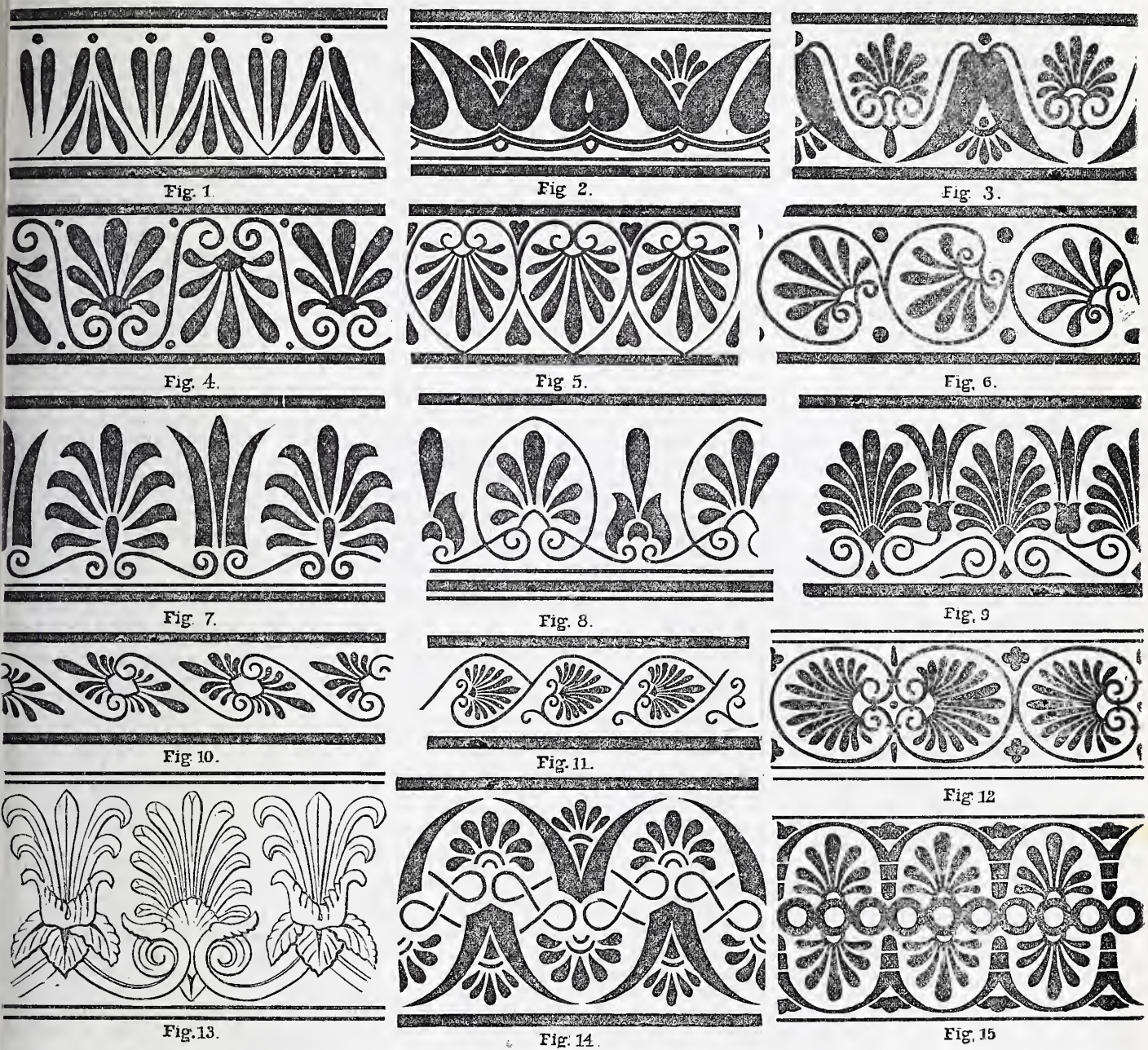
Many authorities have supposed that the Greeks acquired the type from this source; it appears in the Ionic order, which is generally supposed to have had an Asiatic origin. Others have urged the possibility of the Assyrians deriving it from textiles, etc., introduced from India, the common starting point of the Aryan races.

Modern nations unquestionably derived these patterns from Grecian sources; it is to Greek artists that we owe their development, and it is to their influence, through the example of their works, that they owe their wide and long-lived popularity.

By some authorities the Greek examples have been considered to be conventional renderings of the honeysuckle flower—hence that name; but, though partaking somewhat of that character, an examination of the examples upon Greek pottery does not confirm that view. There it is obviously a type of ornament which would, as it were, grow under the brush of the artist.

It is evidently "brush-work"; the individual lobes of the pattern are strokes or "flicks" of a brush or "pencil" fully charged with colour, broad at the point where it first touches the article, growing finer as it is gradually taken away by a downward motion of the wrist and hand. Similar forms are developed in work of those modern decorators who "set out" and execute their ornament with the aid of the brush alone, as may be seen in the better class hand-worked decoration upon papier-mâché and similar goods.

The impulse which led the Greek artist to combine these "flicks" in the particular form shown most likely was due alone to the appreciation of the decorative value of radiating forms, or possibly to the recollection of some ancient device, which may have been derived from Assyria or from



Anthemion Borders. Figs. 1-3.—Archaic Greek Painted Pottery. Figs. 4-8, 10, 11, 15.—Greek Painted Pottery. Figs. 9, 14.—Greek Painted Moulding Enrichment. Fig. 12.—Reversed Patterns. Fig. 13.—Greek Carved Stone.

some prehistoric stock common to both peoples.

The variations made whilst in Greek hands are so many, and of so great decorative value, that the present paper will be restricted to Greek examples, reserving the variations made by the workers of other nations for treatment in a separate paper.

Description of the Illustrations. — These patterns were very popular in ancient Greece. We find them used largely upon their pottery, a craft always one of the first to be practised by every nation. Hundreds of examples may be seen in the vase-rooms at the British Museum, from which source the pottery examples here given have been culled.

Figs. 1 to 3 are very early examples—evidently the archaic prototypes of the more perfect examples. The brush-work character is seen well in Fig. 1. Fig. 5 is a simple arrangement, possessing much simple beauty. Figs. 4 and 12 show reversed, and Figs. 6, 10, and 11 undulating, varieties. Figs. 7 and 8 are specimens with an intervening feature, which was elaborated and formed the most important portion in many later modifications of these patterns. Fig. 15 is a double variety, with a guilloche-like form in the centre. Many elaborate specimens of this type are exhibited.

Fig. 9 is an example met with both upon pottery and as a painted architectural ornament—a moulding enrichment. Fig. 14 is a double variety—a painted architectural enrichment. It is curiously like the archaic specimen (Fig. 3).

Fig. 13 is a carved example from the necking of the Ionic capital, now in the British Museum, which formed part of the temple known as the "Erechtheum," at Athens. It may interest Londoners to know that the Ionic Order used in St. Pancras' Church, in the Euston Road, is a faithful transcript of that in this famous temple. These patterns are also met with upon works executed in bronze and other metals, in ivory, bone, and various other materials.

Applying to Modern Work.—This group of examples should prove useful to WORK readers; they may be utilised by workers in every art and craft. Few articles there are that may not be beautified by the application of some of the varieties of these patterns; they will, perhaps, be most appropriate upon those articles which exhibit a simple beauty of form akin to Greek work, but they may be easily elaborated to harmonise with the most florid and complicated shapes. Truly of them it may be said that their beauty has proved a joy for ever; they seem possessed of a perennial youth, and look as well upon a modern article as they did when first applied twenty centuries ago.

As Objects of Study.—The decorative principles of radiation and repetition are those best exemplified by this type of patterns. These principles are of the highest decorative value, and are used extensively in all varieties of ornament.

The principle of radiation may be best explained by referring to the varieties of it seen in two well-known objects—the wheel and the fan. Both these objects possess a certain amount of beauty apparent to all; upon analysis it will be found to be due to this principle of radiation, present in varying forms in each. The wheel exhibits a variety of radiation formed by the straight-lined spokes radiating all round the central hub; this is the star or stellar variety, used both in the formation of individual ornamental forms—as in the rosette, the patera, etc.—and also in distributing a series of elements to form patterns, as seen in geometric tile and linoleum patterns. This is radiation of a simple nature—not of so high an order of beauty as that seen in the fan variety. This latter variety is exhibited in the form taken by the blades of a fully or partly opened fan. It is a beauty recognised by everyone, and is very similar to the variety seen in the central features of these patterns. This fan-like type of radiation is extensively used, and is of the highest decorative value in the composition of ornament.

Radiation is, perhaps, more beautiful in those instances where the individual radiating forms do not actually meet, but merely indicate such a meeting if they were continued. Most of these examples exhibit this, the individual lobes being in some instances stopped before they converge; in others they butt upon an arch-shaped form inserted at the base of the group.

Students should also notice the proportional decreasing of the lobes on either side of the central one, and the sensitive manner in which the lower ones conform to the shape of the supporting volute—both features which enhance the beauty of the composition and deserve study.

Note, again, how the upper edges of the lobes conform to an imaginary line which is parallel with the boundary curve, thus repeating its form and giving it a higher decorative value. In designing ornament the artist has many opportunities of suggesting beautiful lines by processes similar to this, and, if fully alive to the practice, can thus impart an additional charm to his work. Such beauties in ornament are none the less effectual because suggested rather than displayed. Work full of these concealed beauties should be aimed at. It is the highest art which conceals the art or means by which it is obtained.

It should be realised that ornament, like all other work, increases in value in proportion to the amount of brain-work expended in its production. Good work is not arrived at haphazard; it is not a matter of drawing a few idle scrawls, having no backbone or cohesion. The knowledge of these decorative principles is required, combined with the facility of using them to the best advantage.

The decorative value of repetition has been previously referred to. In these patterns it is well displayed in its simple form; also that variety of it got by the process of reversing an ornament on either side of a central line is seen to perfection. This expedient cannot be too highly valued, and should be utilised in designing patterns for those mechanical processes which lend themselves to this process. By its means elaborate and beautiful patterns are frequently produced, with a small expenditure of labour. The cards used in Jacquard weaving may be instanced as a case in point; they can readily be reversed in their action on the loom. For this reason this expedient is largely employed in weaving figured textiles, and the textile origin of many of the "turnover" patterns in use on other materials may thus be traced.

Conclusion. — The following paper will show some of the modifications which subsequent workers have evolved from these patterns, and will prove suggestive, to those modern workers who press them into their service, of further possible variations.

WORK fulfils an unique and valuable mission in steadily providing its readers with teaching and example respecting the great and ever-present matter of ornament.

CARPENTRY FOR BOYS.

BY McDONALD.

INTRODUCTION — TOOLS — TRESTLES AND THEIR USES—SAWING AND LINING TIMBER—CONSTRUCTION OF TRESTLES—MATERIAL—REMARKS ON TIMBER.

Introduction.—In starting anything in the carpentry and joinery line, the first things required, as everybody knows, are some tools, a bench to work upon, and a place to work in. Some of our youthful chips—as apprentices and others—are no doubt provided with these to begin with, and to them any remarks on the same may appear superfluous and monotonous. But all are not so fortunate. There are thousands of mechanically inclined youths who have neither one thing nor another, but yet are fully disposed to possess them. For their information, and by way of introduction, a short description of the rudimentary requisites of the craft becomes a necessity that cannot very well be here passed over; and for this reason, if for nothing else, perhaps the more advanced youth or amateur, as well as the professional reader, may not consider the same altogether valueless or uncalled for.

Tools.—In Fig. 1 some of the tools are shown, but it must be understood that these are not all that would be required to constitute a useful kit. In addition to the two planes shown, which are a jack-plane and a hand-plane, a trying-plane or half-long must be included. The chisels must be augmented to a set for paring, from $\frac{1}{8}$ in. to $1\frac{1}{4}$ in.; three or four mortise-irons, from $\frac{1}{4}$ in. to $\frac{3}{4}$ in.; and a few gouges, from $\frac{1}{4}$ in. to 1 in., or so. The brace must be accompanied by at least a dozen bits, from $\frac{1}{8}$ in. to 1 in., including centre-bits, shell-bits, auger-bits, and a countersink-bit or two. Besides the cross-cut saw shown, two more—a ripping saw and a tenon or sash saw—would be required; also three or four gimlets, from $\frac{1}{8}$ in. to $\frac{3}{4}$ in., and some half-dozen bradawls. Even with all this our kit is nothing like complete; but it should do very well for a boy or youth to commence with. Tools for special purposes, and which are but rarely used, will only be noticed as occasion arises. They may be procured at any time, just as they are needed; and it may be said that this is not a bad way to adopt with the most of them, for the best lesson in the use of any tool is actually to see the good of it or realise the want of it.

The prices of tools need not be detailed here, as they vary so much in different localities. The cost of a kit can easily be ascertained by getting price lists from one or two advertisers in WORK, and comparing quality and prices. Like other things, good tools, though a little dearer, are more satisfactory and cheaper in the end. When buying or selecting them, the novice would do well to take a practical man's advice if he can get it.

Trestles and their Uses.—Before constructing a bench, it may be as well for our beginner to make a pair of trestles. They need not be dressed, their function being chiefly to line off and cut wood upon, as may be seen from a glance at Fig. 2. Cutting across the grain or fibre, as at R, is cross-cutting; that at S, in the direction of the grain, is called ripping.

Sawing and Lining Timber. — Cross-cutting and ripping cannot be successfully performed by one saw. The cross-cut saw is used for the former; the ripping saw for the latter. The teeth in these are quite different in size and mode of sharpening; but it would not be advisable for the

beginner to attempt to sharpen his saws until he gets better acquainted with them and their uses. When they need this he should give them to a saw doctor; or, if one is not near at hand, a joiner or cabinet-maker may do it for him.

When working with a saw, he must take care not to force it through, but press it smoothly and regularly forward; neither must he allow it to bend or bulge to either side of the line: it should be kept straight in it, and as near as possible at right angles to the face of the plank.

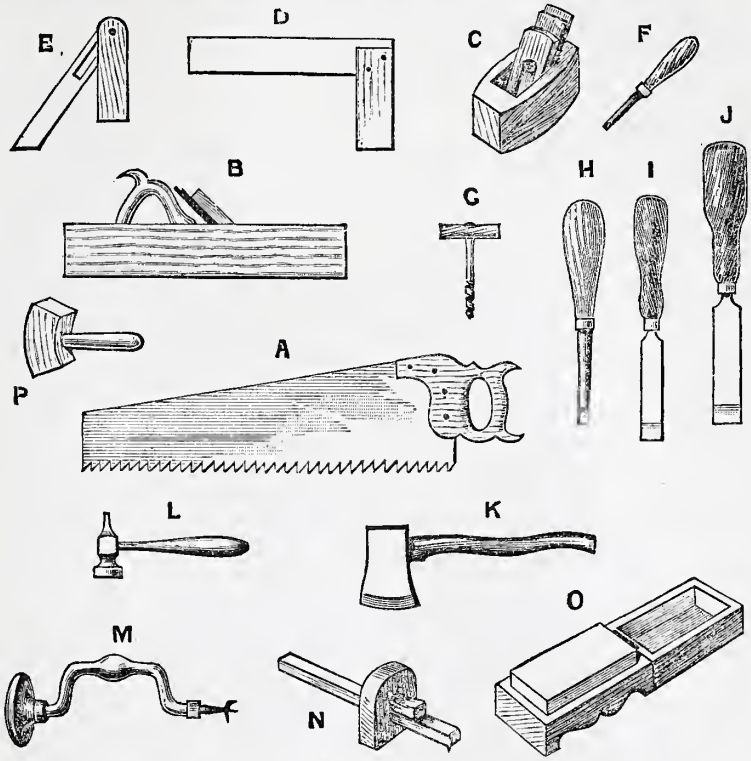
Lining off a plank or board for ripping, when rough on the edges, is commonly done with a straight-edge or chalk line. If square-edged it can be done as at x (Fig. 2), by the rule and pencil. The rule is held in the left hand, measuring off on the board the breadth to be ripped, and the forefinger placed against the edge to act as fence. The pencil is held in the right hand to the end of the rule on the board. Both hands are then moved simultaneously, and the required line is traced backward or forward, as may be desired. Lines for cross-cutting, when square across or at right angles to the edge, are readily obtained by the square, keeping its blade flat on the board or plank and its stock hard to the edge. For lines at an angle to the edge the bevel-stock is set and applied in the same way as the square. For this and similar purposes the young worker will perceive that this tool differs from the square only in having the blade movable, and capable of being adjusted at any desired angle with the stock by means of the screw attached.

Construction of Trestles.—The trestles here given as examples are extremely simple in construction. The tops and ends are merely cut square, and nailed together at the joints. The pieces on the bottoms of ends are also nailed to them. They are shaped as shown to give better stability to the trestles. The under hollows are taken out with a large paring chisel; the upper corners may be cut off by either that or the cross-cut saw. The stays or braces on the sides may be cut to the bevels before being nailed, or they may be nailed on first and cut flush with the tops and ends afterwards. When two or more pieces are said to be flush on a side, it is meant that each has a face in the plane of that side. Thus the top and ends of one of the trestles are flush on the edges, while an end and its bottom pieces are flush on both sides.

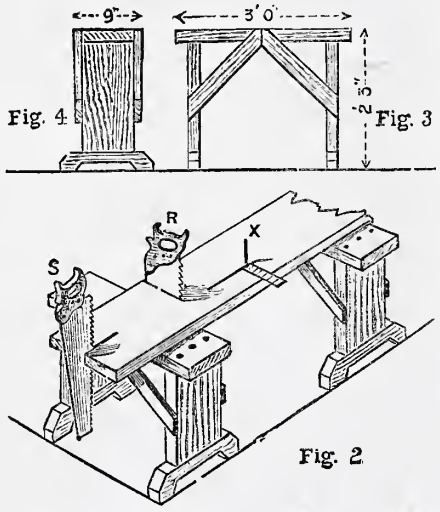
Material.—The material for these may be of the cheapest quality, as spruce or white pine or inferior yellow pine. The sizes of stuff can be easily obtained from the scale drawings (Figs. 3 and 4), which the learner might with advantage extend to full size at the outset, and work from, not only in this, but in all the examples given in this paper. For the purpose of deducing the scale, he will find the lines representing the principal dimensions all figured throughout. For a single trestle the sizes are: Top, 3 ft. × 9 in. × 1½ in.; ends, 1 ft. 9 in. × 9 in. × 1½ in. each; bottom pieces, 1 ft. 6 in. × 4½ in. × 1½ in. each; stays or braces, 2 ft. × 3 in. × 1 in. each.

Remarks on Timber.—The timber usually employed in ordinary carpentry is the pine species, as yellow, red, pitch, and white pine. The former is best for inside work, such as house finishings and articles of furniture to be painted, or in which beauty of grain and polish are not required. For the latter, pitch pine, polished or varnished, answers pretty well. Red pine is best for exposed work; and white pine, being inferior in quality and lower in value, is used for all purposes where cheapness is a consideration. Yellow pine is obtainable in logs or deals of 9 in. or 11 in. × 3 in. These can again be cut longitudinally to any size, as scantling or quartering, when used for framing purposes, or boarding when used for covering or panelling purposes. The other varieties are also to be got in the same way, while red and white are frequently sold in battens of 6½ in. × 2½ in., 6 in. × 2 in., 5 in. × 2 in., or 4 in. × 2 in.—this, of course, refers to what is usually kept in stock in sawmills and timber-yards; also flooring, 1⅛ in. thick; lining, ½ in., ⅝ in., or ⅞ in. thick; and rough sarking, from ⅝ in. to ⅞ in., of red or white pine, all commonly kept ready for use, the flooring and lining generally machine-dressed, and grooved and feathered.

These few hints may serve to give our youthful followers an idea of how to procure their timber, as it cannot be expected that they all have a stock of it beside them. If, however, circumstances would permit, to keep a few well-seasoned pieces and boards always to hand would be an advantage.



Carpentry for Boys. Fig. 1.—A, Saw; B, C, Planes; D, Square; E, Bevel-Stock; F, Bradawl; G, Gimlet; H, Screwdriver: I, J, Chisels; K, Axe; L, Hammer; M, Brace; N, Gauge; O, Sharpening Stone; P, Mallet.



Carpentry for Boys. Fig. 2.—Trestles—R, Cross-Cutting; S, Ripping; X, Lining with Rule and Pencil. Fig. 3.—Side Elevation of Trestle. Fig. 4.—End Elevation.

HOME INDUSTRIES AT A VILLAGE EXHIBITION.

The annual Cottagers' Horticultural and Industrial Show, which took place lately at Ascot, Berks, gave an opportunity for a display of some very good work.

The chief feature of the show every year is the bent-iron work. The East Berks Iron Works, entirely conducted by Miss Barnett, of Sunninghill, gives employment to the men and lads she teaches throughout the year, and supplies large London firms, besides executing many private orders.

The same good work which Miss Barnett has done for Sunninghill is accomplished in Ascot by the Rev. Herbert Wilson, whose stall attracted much attention by the artistic merit of the designs and the excellence of the work.

The first prize was awarded for a lantern to Joseph Longhurst, a pupil of Rev. H. Wilson's.

The table for carvings occupied a prominent place at the show, and among the competitors were two who won kindly notice at the Work Exhibition two years ago: John Abbott, a young carpenter, who, entering a carved alabaster panel, found his first opportunity of exhibiting at the Polytechnic; and Miss P. Clive Bayley sent the replica of a chip-carved pearwood box, which was shown on that occasion.

The best chip-carving work came from the boys taught by Rev. J. Lawson, of Sunningdale; and the work-boxes, frames, and tables found a ready sale. An example of a comparatively new handicraft was exhibited by Miss M. Clive Bayley, in the shape of a large chest done in poker-work; but the introduction of colour relieved the sameness of the burnt-wood work, and gave the effect of inlaying.

In the class for drawings some very good work was shown; but the first prize was awarded to Mr. Vine, a professional chimney-sweep, who employs his leisure in sketching, and who received a special notice from the judges. Other classes of interest were: the handwriting competition, the washing competition for girls, and the basket-making by boys. A plaid, made from the wool of the black-faced Highland sheep, by Mrs. Fowler, of Inverbroom, and some beautiful specimens of Swedish hand-weaving, were exhibited to show what is done in other places in the way of home industries. Village industries exhibitions should be all over the kingdom.

TRADE: PRESENT AND FUTURE.

*** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

STEEL TRADE.—Only an indifferent amount of business is being done in the steel trade, and prices of raw materials are falling slightly.

JEWELLERY TRADE.—In London this is extremely dull.

CHEMICAL TRADE.—There is a dispute at one of the St. Helen's chemical works as to the wheeling of cinders on Sundays. The men want terms paid at other works.

IRON TRADE.—An exceptional condition of quietude characterises the Lancashire iron trade, although prices for foundry qualities of pig iron are being well maintained. Naturally, the recent advances in prices have had the effect of checking business, and, except for immediate requirements, buyers are waiting for the anticipated lowering of the rates.

TAILORING TRADE.—There is no change in the tailors' dispute at Liverpool, though attempts are being made to bring about a conciliation. The men grumble at the work being sent to outsiders, who are mostly Jews working at their own homes.

ENGINEERING TRADE.—Although the improvement recently noticed in the condition of the Lancashire engineering trade is still maintained, there are, as yet, no signs of a marked revival of activity in any branch of the industry, and, generally speaking, the outlook is still very unsatisfactory. The chief feature is a number of inquiries for locomotives, chiefly for abroad. These orders are being very keenly competed for, and they will, in all probability, be taken at ridiculously low rates in order to keep works going. The leading machine tool makers are still fairly busy, and boiler makers also report an improvement in that branch, as there is a moderate amount of new work coming forward.

COTTON TRADE.—A deputation from the Federation of Master Cotton Spinners is attending meetings of master spinners in various districts, with a view to induce private spinners and limited companies to support a 5 per cent. reduction in wages. In the meantime, the condition of the trade is growing gradually worse, and in some cases mills are being closed without any prospect of reopening. In general, trade is in a bad state throughout the Rochdale district, though not so bad as in some of the surrounding towns.

FLANNEL TRADE.—This holds its own fairly well, though it cannot be said to be in a prosperous state.

BUILDING TRADE.—In Rochdale and district trade is getting very slack. The strike of plasterers is over, the masters having agreed to the demands of the men as to increase in wages and allowance for walking time.

TIMBER TRADE.—Deals and battens show an increase of 835 standards, and floorings and matchlinings a decrease of 743 standards. Floated timber has an increase of 135 loads. There has been a large addition to the stocks of spruce and pine in the Surrey Commercial Docks. On account of the "fever" scare, there has been a good demand for ⅝ in. matchlining, 1 in. tariff boards and scantlings, and prices for matchlining were firm; but at the sale ⅝ in. by 6½ in. fell to the ruinous price of 3s. 3d. per square. Reports from Cardiff, Sunderland, Bristol, and Liverpool show that the timber trade is fairly brisk. The mahogany sales at Liverpool realised an average price of about 5d., prices ranging from 3½d. to 1s. 3d., one log of 498 ft. fetching 10d., and a small log of exceptional richness sold for 5s. 6d. per foot.

CYCLE TRADE.—Auction rooms are busy. Solids, cushions, and pneumatics may be had as bargains. Riders prefer putting their mount away for sale rather than store it for the winter, trusting to be able to procure one of whatever type may be the fashion next season.

IRON AND STEEL TRADES.—Sheffield prices are unaltered, hematites being from 58s. to 60s. per ton.

COAL TRADE.—House coal in the vicinity of Sheffield has been advanced 6d. per ton.

SILVER TRADE.—Little doing beyond racing trophies. The Britannia metal trade is also slack. In the nickel silver plated department there is a demand for forks and spoons, and also for metal-handled steel table cutlery.

CUTLERY TRADE.—This is still depressed, with a demand only for champagne and sportsmen's knives.

EDGE TOOL TRADE.—Good trade is being done in nearly every line. There is little demand for shipbuilding tools.

FILE TRADE.—Short time is the order of the day. Complaints are still abroad as to the marking of machine-cut files as hand-cut.

SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

I.—LETTERS FROM CORRESPONDENTS.

Technical Education for the Army and Navy.—W. G. F. (*London, S.E.*) writes:—"This is, indeed, one of the most interesting of the many problems now under the consideration of the public, and it is to be regretted that the question of technical education in relation to the army and navy has not in the past been pushed more to the front than it has been. It is to be hoped, however, that readers of WORK will respond to the invitation on p. 344, and do all they can to suggest and promote some feasible scheme whereby the positions of our soldiers and sailors may be improved when their term of service has ended. This question affects soldiers even more than sailors; for whilst the former find the labour market on land is surfeited by those seeking employment, sailors, as a rule, do not find it so difficult to obtain a livelihood, as the seafaring life can only be successfully adopted by a class of men similar to themselves. The sailor who has served in the navy has, in some respects, at any rate, the advantage over a soldier who is left but badly equipped for the competition of labour when his period of service has expired. At the same time, it would be unjust to promote the interests of the latter while ignoring the claims of the former. Some plan such as the following might result in benefiting Tommy Atkins:—Every soldier shall compulsorily devote a certain portion of his time (to be determined according to his capabilities and length of service) to the learning of some handicraft or trade. Qualified teachers and workmen shall be employed to teach the recruits the theory and practice of the profession they may adopt; and at the end of their service, before being discharged, they shall be examined by experts, and certificates awarded them according to their merits and proficiency. Of course, this is only a crude idea, but the adoption of a similar plan would, at any rate, be a step in the right direction. Exception may possibly be taken to the compulsory aspect of the training, but such a question as this of handicraft training for soldiers must be handled firmly; and surely every man would see that the result of the apparent arbitrariness could not fail to act beneficially, since it would fully equip him for the inevitable struggle for work and wages when he returns to a civilian's life. Finally, whilst the public may desire to do good by discussing the problem, it must be remembered that nothing can be brought to a successful issue without the co-operation of the ruling military and naval powers; so that the sooner this question is more prominently placed before the authorities the better will it be for Jack Tar and Tommy Atkins."

Costly Cup.—H. S. G. (*London, S.W.*) writes:—"£8,000 has been paid for a cup, which can be seen in the British Museum. Whatever is it made of to be worth so much money? Well, it is of gold; but that will not account for more than about £200 of its cost. Its value is derived from the fact that it once formed part of the Royal Treasury of England, and it is mentioned in the inventories of Henry VIII. and Elizabeth. It is supposed to have been brought from France by Henry V., and to have belonged to Charles V. The historical interest is, therefore, great, and it is chiefly on that account that the Treasury, the Goldsmiths' Company, and three or four rich connoisseurs have subscribed the necessary amount for its purchase for the nation. It has artistic as well as historical value—chiefly on account of the wonderful richness of its enamelling. There is much more to be said about it, but this will suffice for the present, as we shall be shortly giving an illustration and a description of its enamel work. It is in the Gold Ornament Room, to gain admittance to which a bell has to be rung."

Hobbyists' Emporium.—E. D. (*London, W.*) writes:—"It is hardly worth while replying to THOMASO, who writes in No. 177, the more so as he apparently has no personal interest whatever in the object in view—his hobby and excess energy appearing to be that of reading (in a very superficial manner and with a pre-disposition to antagonism and insult) the *primary* suggestions of others, and therefrom forming his own conclusions, which are, in many respects, totally wide of the intentions and ideas of the writers. At the same time, he is unable or, at any rate, unwilling, to offer the crudest suggestions himself; but, commencing with a spiteful classification of amateur workers in general, he descends to the marine store, and concludes his pessimistic wanderings in a manner totally uncalled for, and fortunately foreign to the usual kindly and courteous columns of 'Shop.'"

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Ship Carpenter.—LOVER OF THE SEA.—Our correspondent has a good foundation to work upon, but appears to have had no experience in the very matter he seems to wish to follow. His best course would be to get employment in a shipbuilder's yard, where he would be able to gain some insight into the kind of work he would have to do with, and when he felt himself capable of tackling it, should then get an engagement in a ship making short voyages, so as to get accustomed to the sea, to the routine, and the duties required of him; and when he feels he can undertake the duties, he might then apply to a marine superintendent of some line, where he might get taken on if there happens to be a vacancy. He will find it rather difficult, we fear, to obtain what he desires on the old-established lines, as fathers and sons, uncles and nephews, brothers and cousins—of whom there are always plenty in such places—generally secure such berths as are vacant; still, it is worth trying, and it might happen by a chance he may succeed. At any rate, try, and again try! We should think that at Goole, Middlesboro', Hull, or Grimsby he might find employment at some of the shipyards, or even on the Tyne, the Wear, or the Tees.—C. E.

Patents.—A FITTER.—In reply to our correspondent's queries, no doubt a cheap, efficient, and simple article of the kind he names would go down with those who require to use them, but it would be an act of extreme folly to put the plan before any manufacturer without his right to it being secured. We do not think he could secure his right, either by registering or by a trade-mark, it appearing to us that it is not a fit subject for either. As we have not seen it, we cannot decide this point; but it seems to us to be the proper subject for a patent, which would cover various modifications of the principle, whilst registration would only cover the precise thing shown, and a trade-mark would only cover the goods he might make or sell, but *not* the principle on which they are made. No article registered or trade-marked, and exposed to the public, can be patented afterwards. One of the most essential features required in a patent is *novelty*—that is, it must not have been known to the public prior to making application for the grant; therefore our correspondent must be very careful in his proceedings before he applies for his patent. We do not know of any makers of such articles; but a reference to a Birmingham directory would, no doubt, enable him to select a suitable firm to apply to, to ascertain if they would be disposed to take it up.—C. E.

Corrugated Carbon Cell.—OBLONG.—The cell inquired about, and of which you send a sketch, is the corrugated carbon cell invented by Mr. R. Applegarth, and sold by him to Judson & Sons, who are now, I believe, the proprietors of the patent. The cells are made of powdered carbon compressed by machinery into a mould fitted with a corrugated core. This leaves the insides of each cell ribbed or corrugated, hence its name. The outsides of the cells are coated with a waterproof varnish. Apart from this peculiarity, the cell may be regarded as one of the Leclanché type without a porous cell. At the bottom of each cell is placed some peroxide of manganese. A rod of zinc is suspended above this to a porcelain cover, and the zinc is enveloped in cotton-wool wetted with a saturated solution of sal-ammoniac. The carbon cell itself is the negative element, and to this is fixed a binding screw for connections. To repair this cell when exhausted, empty it of all its contents, well soak the interior in several changes of warm water, then put in a few ounces of broken peroxide of manganese, clean the zinc, and envelop it anew in cotton-wool soaked in a saturated solution of sal-ammoniac, and replace it in the cell. The cotton-wool must be well wetted, and pressed in tight around the zinc. This cell has been used for electric bell ringing, but is not in great favour, because of its high internal resistance. I do not think you could make the cell, even if the patent rights were expired.—G. E. B.

WORK to Natal.—G. H. (*Pietermaritzburg*).—Twelve months' subscription to WORK, forwarded by post to Natal, weekly, as published, is 6s. 6d., payable in advance.

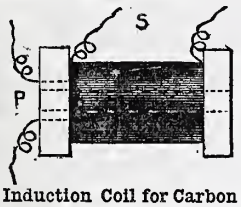
Vertical Boiler.—MOTOR.—You can see drawings of the nozzle you require in *Engineering* for February 8 and February 15, 1889. The subject is hardly of sufficient general interest to warrant us in going to the expense of preparing wood blocks necessary for illustration.—J.

Incubator.—L. S. (*Ripley*).—If your regulator does not open the damper soon enough, the remedy is easily found. Use a longer rod or more mercury in the tube.—LEGHORN.

Patents.—N. N. (*South Stockton-on-Tees*).—By the Patent Convention which now exists between this and several other foreign countries and colonies, it is provided that any person taking a patent in any one of them has the right of priority with that patent over any other person in all the others for the term of *seven months* from the date of his application, during and before the expiry of which term his application must be recorded in the country he intends to apply in. Of course, he can apply after the term is up, but then he must do so before he files his complete specification, supposing he has applied in England first, and he encounters the risk of someone having applied before him for the same thing. In the United States, America, he may apply at any time within two years of his first application elsewhere, but he will have no priority

of right over anyone who may have applied at the expiry of the seven months, during which time he had the right of priority. Not knowing the nature of the invention of our correspondent, we are unable to advise him as to the best course for him to follow; but we give him the particulars of how the matter stands in regard to foreign patents, so that he may see his way in considering what he should do.—C. E.

Coil for Transmitter.—INDUCTION.—This instrument, which is only necessary for long lines, may be made as follows: Two pieces of hard wood, such as walnut, for ends, 1¼ in. square and about ¼ in. thick. These are joined together by a bundle of soft iron wire, which constitute the core, this bundle being about $\frac{5}{16}$ in. The primary coil is wound with No. 22 B. W. G. double silk-covered copper wire, about 1¼ oz. being sufficient. The secondary coil is wound with No. 40 B. W. G. double silk-covered—2 oz. will be necessary. Before winding on the primary, a layer or two of paraffined paper should be wrapped round the iron core, and another layer should be wound between the primary and secondary coils. It will be well also to steep the whole when finished in melted paraffin wax, and after having allowed it to dry in the heat, cover it with a piece of velvet or cloth of some kind. The sketch given above shows it full size. Of course, two will be required, one for each instrument. The method of connecting is very simple—the primary coil is connected directly to the microphone, and the secondary to the distant receiver.—W. D.



Induction Coil for Carbon Transmitter.

Cracks in Floor.—H. J. G. (*Hastings*).—There is no known composition for stopping up the cracks between your floor-boards that is equal to the insertion of wedge-shaped strips of wood, well glued, and driven home by a mallet or hammer. If this is done, and allowed to stand all night previous to planing down level, and the smaller interstices and nail-holes filled up with putty coloured to match, you would have a floor far more satisfactory and cheaper to yourself than the use of any composition worthy of the name could possibly give. Should you adopt this plan—which I strongly advise—it will be well to remind you to punch all nails below the level of the boards. These holes and the smaller cracks must be filled up with putty coloured to match the floor as intended to be finished, and must be used *after* the staining is done and is perfectly dry. If done before, or if plain putty is used, its oily nature will prevent the stain striking in so deeply as in the parts untouched, so giving a patchy appearance. I have seen several jobs spoilt by the want of this precaution. I have presumed that your floor is one of the common ones of deal. Should it, however, be of the better class, you will find many useful hints on referring to "Making the Best of a Bad House," in No. 145 of WORK, p. 649. If it is one of this class of floor you have in hand, and the cracks are not so wide as to allow the composition to run through, you might use equal parts of resin and beeswax, or, for a harder composition, refer to and use hard-stopping, as advised in No. 150, p. 726.—LIFEBOAT.

Curing Mole Skins.—MORGANWG.—It is not usual to cure the skins of small animals either by tawing or tanning—alum is the usual dressing. This alone will suffice, either in powder or as a solution. Some add saltpetre or hay-salt, and some corrosive sublimate. In Vol. II., pp. 294, 718 (Nos. 70, 96), are recipes for such compound dressings. Some tack the skin to a board for the few days during which it needs attention, then dress two skins, lay them flesh sides together, and roll them up. When dried, the skins are made pliant by rubbing.—M. M.

What makes an Electric Bell Ring?—H. C. (*London, W.C.*).—As there may be other readers circumstanced like yourself, by being blessed with little boys who ask such difficult questions, I will try to give an explicit reply. You say it is not enough to tell him that the electricity travels through the wire from the battery to the bell, and rings it. Well, then, take off the little box covering the works, and you will see two reels filled with green silk-covered wire fitted on two cores of soft iron. Now, soft iron is non-magnetic—that is, it will not attract to itself another piece of iron, as a magnet does. But electricians know how to make soft iron magnetic or otherwise at will. When a rod of soft iron is enveloped in several turns of silk-covered copper wire, and a current of electricity is sent through the turns of wire, the soft iron becomes converted into a magnet, and will attract other pieces of iron as long as the electric current is passing through the coils of wire wound around the core. When, however, the continuity of the current is broken, the iron loses its magnetism. In the works of the bell you will see a strip of iron attached to a spring, and placed across the iron cores above mentioned. The hammer shaft is connected to this iron armature. When the push is pressed, the current from the battery passes through the wire wound over the cores, converts them into magnets, and, attracting the armature, causes the hammer to strike the bell. At this instant the continuity of the current is broken, and the spring pulls the armature back. As this closes the circuit, the iron is again attracted, and it is this to and fro movement, rapidly repeated, which rings the bell.—G. E. B.

Repairing Shocking Coil.—A. B. (*Westminster*).—Thanks for your sketch of coil. From it, I see that you have an old style form of medical or shocking coil, with a separate rheotome or contact breaker. The two fine wires are the ends of the secondary coil. Solder two lengths of copper wire—any size—to these, pass them along beneath the stand to the studs attached to the handles, and secure the bare cleaned ends to the tangs of the cleaned studs. The wire from one of the battery studs should go around the electro-magnet of the break, and then to the coil. This is the primary wire. A pint bichromate of potash battery cell will work this coil, but I prefer one of the dry battery cells, such as the E. S., the E. C. C., or the Hellesen dry cells. These are always clean, give no trouble nor fumes, and are ready for work at any time.—G. E. B.

A Profitable "Idea."—C. E. (*Finsbury*).—Our correspondent, having an "idea," but not having developed it to ascertain whether it is practicable, or how it is to be carried out in reality, does not possess anything that can be turned to a practical account, or be "profitably disposed of." A man may have an "idea" that a balloon may be steered or controlled as to its course, but unless he can show *how* it is to be done, has nothing at all of any use to anyone, or anything he can sell or turn to a profitable account. The only thing that can be successfully dealt with is a manner, method, or mode of achieving a given result, which is novel, useful, and not in use, or described, at the time he makes the discovery. A man with an "idea" is anything but a useful member of society, and such may be found by thousands; but if they get no further than the mere "idea," of what use are they, either to themselves or the world? A visit to Banwell or Colney Hatch will soon satisfy anyone that there is no want of men with "ideas." What the world wants is men who can start good, sound, and useful ideas, and then bring them into such a shape as shall be of public benefit, and unless they can do this, the fewer there are of the kind the better. Until our correspondent has tested the feasibility of his "idea," and ascertained how it is to be done or carried out, he has nothing whatever of any commercial value, and nothing, consequently, that he can negotiate for or with. Under the circumstances named, we cannot see how to advise our correspondent, nor what would be the course he should pursue, especially as to the "profitable disposal of the idea."—C. E.

Water Motor.—W. C. (*Wallington*).—The address cannot be given in "Shop." If you send stamped addressed envelope to the Editor, the address will be sent.—M.

Tool-Heating Gas Burner.—J. H. A. (*Southwark*).—These burners are introduced to the trade by Mr. W. H. Bishop, of Walsall. The three small

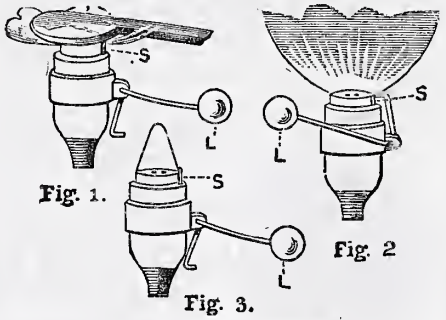


Fig. 1. Fig. 2 Fig. 3.
Tool-Heating Gas Burner.

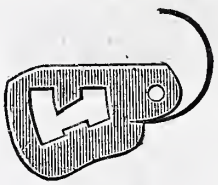
diagrams show their principle very clearly. Fig. 1 shows the burner in action with the tool on; Fig. 2 in ordinary use as a lighting burner; Fig. 3, as it appears when the tool is removed.—R. A.

Burglar and Time Alarum.—C. E. M. (*Finsbury*).—As you are a new reader, and space in "Shop" is too precious to allow a lengthy quotation from previous numbers, will you kindly get Nos. 12, 18, 20, 27, 31, and 33 of Vol. I. of WORK? These can be obtained through any bookseller, or direct from the office. From them you will learn how to make, fix, and arrange a system of electric burglar alarums to protect all your doors and windows. If to these you add No. 32, Vol. I., of WORK, you will learn how to construct an electric time alarum, or fix such an alarum to your clock. Following on this article, there are several suggestions in the same volume for fitting up clocks of different styles with electric alarms. Nearly all of these are illustrated, and form a very good collection on the subject.—G. E. B.

Plumbers' Work.—A. R. F. (*Falkirk*).—There are a great many works on the above subject. A very good one is by Hellyer, published by Batsford; another, entitled "Plumbing: a Text-Book to the Practice of the Art or Craft of the Plumber," by W. P. Bucan, published by Crosby Lockwood & Co. Watch for papers in WORK.—E. D.

Steam Engine.—D. W. S. (*Liverpool*).—In answer to your query, I should advise you to write to Cassell's for, or obtain through a newsagent, the following numbers of WORK: 106, 110, 121, 125, 131, 136, 141, 145, 149, in which you will find a series of articles entitled "How to Make a Quarter Horse-power Steam Engine," and which, with letterpress and working drawings combined, explain thoroughly how to build an engine of the size mentioned, the bed-plate being some 2 ft. long. No. 110 specially treats of the parts and arrangement of the valve. You say that you want the engine to drive a sawing machine, but do not say what size the machine is, and as I have no idea, I must leave you to judge the size of engine required to drive the same, unless you write again, giving more particulars of it. Should you, in your judgment, require a smaller or larger engine than the one shown in the drawings, you must reduce or enlarge every dimension in the same proportion as you lessen or increase the diameter of the cylinder.—P. B. H.

Lever Lock Spring.—C. M. (*London, N.*).—Drive out the broken spring with a fine bradawl, and fix the new spring in the same slot that held the old one, bending the spring into the shape shown in sketch.—T. W.


Lever Spring.

Oak Polish.—SUBSCRIBER TO "WORK."—Oak may be polished by means of wax polish, egg shell or antique, or French polish. The first is suitable for, and generally used on, floors, rendering them fit for dancing purposes, though it is often used for dados and panelling round rooms, etc. Its simplicity in using renders it of service to those who have had no experience in French polishing. For this purpose we require beeswax dissolved by heat; then add turpentine in proportion of one pint to one pound of wax. This is applied to the woodwork by means of a brush or flannel; elbow grease does the rest, of which any amount may be laid on, the more the better. Egg shell or antique is used, as its name implies, on old furniture, giving to the work thus treated a gloss instead of a shine. For this purpose the foundation is worked up as for polishing—*i.e.*, it is "oiled," "filled in," and "bodied up." Then after standing overnight for the polish to harden, it is rubbed down with a felt rubber and fine pumice-powder till sufficiently dull, then finished by "wax polishing," of which you will find fuller particulars in No. 52 of WORK, page 826. French polishing requires more experience and tact than the former processes. It has been fully described in Vol. III. of WORK, both in papers and "Shop" (see index). Briefly, it may be said to be as follows: See that the work is free from dust; then, assuming that it requires no staining, wipe over with raw linseed-oil; then fill up the pores of the wood as much as possible with a mixture of dry finely crushed whiting, coloured to match your wood by the addition of a little dry yellow ochre. Mix into a paste the consistency of thick paint with turpentine. Apply with rag, rub well in crossways of the grain, and wipe off clean; it is then ready to polish. Prepare a rubber of white wadding, in size according to the job you have in hand—a piece 6 in. square will make a useful workable size—and wet it with polish. Cover the rubber with a piece of clean soft rag, and twist the ends together, bringing it tight over the face of the rubber, which, in shape, should now resemble a pear cut in half; then proceed to rub over your job in a circular motion; glide on, glide off, and keep constantly on the move. When dry, wet again with polish, this time putting a spot or two of oil on the face to prevent it from sticking. Thus continue to work till you have a sufficient body of polish on; then set aside for at least a few hours to allow for sinking. Take up the work again, and proceed as before, till the grain appears quite full, and all appears perfectly level; then gradually thin out the polish in your rubber by using more spirits and less polish, till the work looks semi-lustrous or cloudy with oil, to remove which we require a rubber of clean wadding prepared as for polishing; and on the use of this depends whether our work can be classed good, bad, or indifferent. Its object is to remove the oil and increase the lustre. Make the rubber fairly damp (not wet) with methylated spirits, and apply gently to your work, rubbing lengthwise, using pressure as it gets drier. Repeat till satisfaction is gained. I need hardly remind you that no oil is used in finishing, and that all polishing should be done in a good light, and a clean and warm room. The polish can be made by dissolving about 6 oz. of best orange shellac in one pint of methylated spirits, or rectified naphtha: some prefer the former, as it works slower, and is more agreeable to use. The more experienced, or, rather, those who wish to get over their work more quickly, prefer naphtha. In conclusion, I would say *Nil desperandum*.—LIFEBOAT.

Sewing-Machine for Fret Cutting.—H. W. (*Halifax*).—As you can cut the frets fairly well by hand, and desire to cut them more quickly, the policy of buying a sewing-machine to convert into a fret-machine is not one of the happiest. You would find yourself handicapped in many ways, unless you are a skilled mechanic; and to call in any such help would add greatly to the cost. Far better, to my mind, to go on cutting by hand till such time as you can afford a machine made specially for the purpose, which can now be done very cheaply.

Write to the firms who advertise in WORK for catalogues, not forgetting the Britannia Company, who often have, I believe, some second-hand ones on sale. You might also write to E. Preston, tool merchant, Snow Hill, Birmingham; also Paul Metz, Bull Ring, Birmingham. The latter firm can supply a German-made machine that can be affixed to any table or bench, and works by means of a wheel somewhat similar to a sewing-machine, only that the wheel is more conveniently situated, or he sells same machine with an adjustable treadle attachment. Had you already got in your possession a stand and machine the case would be different, then I should advise you to obtain No. 138 of WORK, November 7th, 1891, and turn to page 540, where you will find an illustrated reply in "Shop" to a query similar to yours. For further particulars on fret-machines, refer to No. 114, page 155, and No. 133, page 461.—LIFEBOAT.

Weights and Measures.—I. H. K. (*No Address*).—I think the book entitled "Weighing and Measuring, The Science of, and the Standards of Measure and Weight," by H. W. Chisholm, Warden of the Standards, price 4s. 6d., is the one that would suit you best. I do not know the publishers, but you could obtain it through the Britannia Co., Colchester.—E. D.

Telephone.—D. B. (*Glasgow*).—You ask for instructions for making a mechanical telephone, and, in your letter, go on to describe what you have done, which seems to cover the whole ground. I would advise you to stick to the ferrotype for the diaphragm, and use two rings of indiarubber back and front to insulate the sound. Be sure that the diaphragm is flat and taut like a drumhead, and that the conducting wire is straight out from the centre of the plate. It is not necessary to rivet the wire to the plate; you could use a small brass nut. It does not matter whether the wire has to go straight or turn corners. It must, however, be strained very tight, and at corners an insulator of rubber must be used to pass the wire through. The great point is to keep the line from touching any object whatever, except the insulators. There is a special wire sold for the purpose. The usual method of calling attention is by tapping with a wooden instrument upon the nut or button of the diaphragm. I shall be pleased to help you further if you are not successful. There is no need of a sketch, as a box of any shape, with an opening in front to serve as mouthpiece, is all that is required.—W. D.

Optical Lantern.—A. J. S. (*Canterbury*).—Your question is not very definite, and I am in doubt as to whether you intend to purchase the condensers and objective ready mounted, or desire to mount the lenses yourself. In the former case, you will need a 4 in. compound condenser mounted in a brass cell; also an objective having a focus suitable to your requirements. The condenser is simply made to slide into the collar of the stage plate (Fig. 21, page 624, Vol. II.), to which it is secured by means of a bayonet catch, so that it is removable at will. The objective mount is made to screw into a flange or collar brazed on to the outer end of the draw-tube of the stage front in the manner shown by Fig. 2, page 205, Vol. III. This draw-tube is a 5 in. length of tubing made to slide over the tube of the outer stage plate (see Fig. 24, page 624, Vol. II.). Should you desire to mount the lenses yourself, you can mount the condenser in the manner described in answer to J. H. J. J., page 413, Vol. I. The lenses shown in Fig. 1 on the above-named page should be placed about ⅛ in. apart. For the objective, you can employ a pair of plano-convex lenses, placed about ½ in. apart, as shown in Fig. 2 on the above-named page. You will find much additional information respecting better class of objectives in the reply to F. J. D., page 219, Vol. II.; and Fig. 44, page 776, shows clearly the disposition of the various portions of the lantern body.—C. A. P.

Tower Bridge.—W. R. (*London*).—The only certain method of obtaining a fully dimensioned set of drawings for the purpose of making a cardboard model, correct in every detail, would be to gain the engineer's consent to your preparing tracings or copies of the working drawings; but, should this be granted, you will find it a long job, as there is a great deal of machinery in connection with this structure.—F. C.

Hydraulic Power Machine.—NOVICE.—The reason why screwing down the inlet-valve does not reduce the *quantity* of water used is that the cylinder must be filled at each stroke, and water being practically inelastic, the quantity will be the same for each complete stroke. The effect of screwing down the inlet-valve is to reduce the *speed* of the machine.—F. C.

III.—QUESTIONS SUBMITTED TO READERS.

*** *The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Razor Grinding.—SHAVER writes:—"I would be much obliged for any information as to rigging up an appliance, wheels, etc., for razor grinding."

Fret Machine.—A. B. D. (*South Shields*) writes:—"Will any reader kindly give me the necessary information to make a fret machine of wood with small lathe attachment?"

Foot Lathe.—CONSTANT READER OF "WORK" writes:—"Would any kind reader give me a sketch of a foot lathe, as I should like to make one myself?"

Catching House-Flies.—W. W. (*Wembley*) writes:—"I shall be glad to know how to make the sticky solution that is put on those papers called the 'Fly Cemetery'; also to know where they breed and when, and if there is any really effectual way of keeping them down."

Sofa or Couch.—G. H. (*Ashford*) writes:—"Will some kind reader of WORK give me a rough sketch of an easily constructed sofa or couch, to be about 5 ft. 6 in. long, and constructed from teak?"

Crane.—J. W. (*Askam-in-Furness*) writes:—"Will some reader give me particulars as to how to fit up a jib-crane with rack, for a foundry 40 ft. long and 30 ft. wide, the crane to lift about 3 tons; also the best means to adopt in making kitchen ranges, etc.?"

Pyrotechny.—C. A. J. (*Manchester*) writes:—"As a subscriber I ask if some reader could kindly inform me of a good book on the science of pyrotechny and pyrotechnic chemicals?"

Minor Industries.—TERRANOVA (*Newfoundland*) writes:—"I want to establish some minor industries here, such as album-making, toys, brass photo frames, purses. I wish to know whether I can get books which describe the manufacture of these articles."

Indiarubber.—S. H. S. (*Barnsbury*) writes:—"Could any reader of WORK kindly inform me how to dissolve indiarubber and cast figures, also the kind of mould used?"

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Monogram "S. W." for Painting.—C. K. (*Stratford*) writes:—"In WORK, No. 160, page 62, S. W. (*Chesham*) asks for a monogram. I trust this one may suit him."

"S. W." Monogram.

Newtonian Telescope.—O. K. (*No Address*) writes to H. W. (*Byfield*):—"If H. W. applies to Messrs. Holland & Son, 42, Newington Green, London, N., he will be able to obtain speculum and flats that he requires."—[Surely, too, Caplatzi, who advertises in WORK, keeps these in stock!—ED.]

Small Power Engine.—E. C. W. (*Clapham*) writes, in answer to HALIFAX (see No. 166, page 158):—"Your exhaust port in your cylinders should not be less than ⅝ in. by 1¼ in.: by having these too small you incur back-pressure; also your crank shaft should not be less than 3 in. diameter. Piston-rods should be ⅝ in. diameter *steel*, and the supply pipe for both cylinders 1¾ in. diameter. You might use the same size—viz., 1¾ in.—for exhaust of each engine. Your fly-wheel should be about 4 ft. diameter, and not weigh less than 4 cwt. If you are not going to drive off this wheel, you may have one as large as 5 ft. or 5 ft. 6 in. In this case it would be as well to have a bearing each side of wheel. Your engine, if at all suited for coupling, should give better results when coupled than separated. With cylinders 4 in. bore and 8 in. stroke, and boiler pressure at 50 lb., your engine would be about equal to four-horse power."

"W.H.R." Monogram.—F. J. K. (*Tufnell Park*) writes:—"I shall be pleased if this monogram will suit W. H. R. (*Commercial Road*) (see No. 168, page 190)."

"W. H. R." Monogram.

Mail-Cart Design.—M. (*Bishop Auckland*) writes to POOR FATHER (see No. 176, page 318):—Designs for three different mail-carts are given in Vol. I., No. 30, of WORK."

Asphalte Paths.—M. (*Bishop Auckland*) writes to W. R. (*St. Albans*) (see No. 176, page 318):—"Prepare some broken stones about 1 in. or 1½ in. mesh. Then boil the tar and pitch, and cover the stones with it, turning them over till all are coated. The stones should be perfectly dry, and should be mixed under cover. Lay a foundation 3 in. thick of broken stones, and lay the tarred stones 1½ in. thick and roll with a heavy roller. Then cover with fine chippings or gravel about ⅜ in. mesh, and roll till level. Paths made in this manner will last many years."

Lathe Change Wheels.—M. (*Bishop Auckland*) writes to TURNER (see No. 177, page 334):—"You can procure these from Richard Lloyd & Co., 135 and 136, Steelhouse Lane, Birmingham."

Firewood Splitting Machine.—M. (*Bishop Auckland*) writes to MERCHANT (see No. 177, page 334):—"You can procure splitting and bundling machines for firewood from M. Glover & Co., Pottersdale Works, Leeds."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—F. F. A. (*Lewisham*); W. E. J. (*Blackburn*); A CONSTANT READER; S. C. S.; A. B. (*Burslem*); A. W. (*Liverpool*); W. E. E. (*Manchester*); WORKER; G. M. T. (*Lambeth, S.E.*); C. H. C. (*Pimlico*); MARINE ENGINEER; H. T. H. (*Merthyr*); LATHE; CAM; W. A. (*Edinburgh*); GUNMAN; A WORKER; F. W. (*Walsall*); H. B. J. (*Hailsham*); J. B. (*Accrington*); A. F. (*Bow*); A. J. (*Leytonstone*); F. S. (*Manchester*); J. S. (*Glasgow*); H. C. G. (*Islington*); G. W. E. (*Leeds*); AGATE.

"WORK" PRIZE SCHEME.

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"Tourists' Road, Water, or Rail, Travelling Requisite" Competition.

To give zest to, and widen the field of original research, such an outfit might, for instance, combine with it some useful appliance to be used in case of emergency—such as life-saving, or in pleasure hunting while holiday bent. This we must leave to our readers' judgment, and feel sure that anything to make travel more enjoyable will be welcomed by the public and the readers of WORK who have to travel. By the time this announcement is made most of us will have had some experience of holidays and the pleasures (?) of luggage. For the three best suggestions for an "Improved Tourists' Travelling Requisite," the following prizes will be awarded—

First Prize, £3;

Second Prize, £2;

Third Prize, £1.

CONDITIONS AND RULES OF THE "TOURISTS' TRAVELLING REQUISITE" COMPETITION

will be found in No. 181 and subsequent issues.

All manuscripts intended for the "Tourists' Travelling Requisite" Competition must be addressed to the Editor of WORK, c/o Cassell and Company, Ltd., Ludgate Hill, London, E.C. They must reach him on or before SATURDAY, OCTOBER 29, endorsed, "Tourists' Travelling Requisite" Competition.

"WORK" WEEKLY CONTENTS.

SEVERAL subscribers have kindly made the suggestion to exhibit a weekly contents bill of WORK in their workshops and elsewhere, for the benefit of fellow-workmen not already subscribers.

Doubtless many others who write expressing their indebtedness to WORK may be similarly disposed. If so, and they will furnish their names and addresses to the Editor, such a bill for exhibition will be sent to them by Messrs. Cassell & Co.

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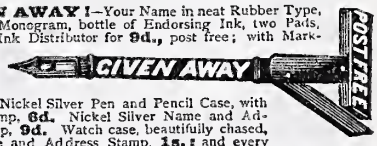

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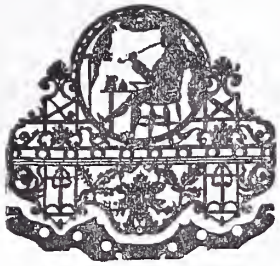

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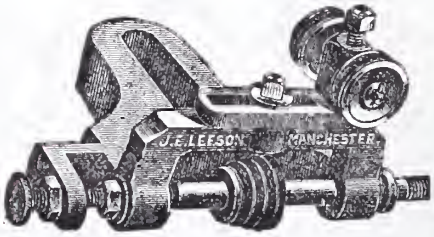

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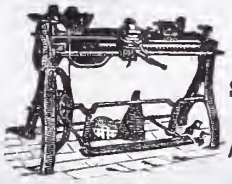

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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Vol. IV.—No. 184.] SATURDAY, SEPTEMBER 24, 1892. [Price One Penny.

WORK WORLD.

Cancer can be arrested by an injection of one of the coal-tar derivatives—methyl violet. What say the medical profession?

* *

The Jewish colonies planted in Argentina by Baron Hirsch are in a deplorable condition. Money is not necessarily amelioration.

* *

The efficiency of the electric motors—of 100 horse-power—on the City and South London Railway averages 92 per cent.

* *

The Singer, Elswick, and Hadley cycles are in repute among Russian cyclists, as the result of the Moscow Cycle Exhibition. *Not* "made in Germany"!

* *

Recent experiments suggest that asbestos paper is not only of no advantage in a floor as a protection against fire, but it probably aids the conflagration. How?

* *

A Frenchman has succeeded in making pearls by boring holes in pearl oysters, dropping in minute glass beads, and then hermetically sealing the holes. No samples have reached us.

* *

A canvass of the operatives throughout the Rochdale cotton district on the eight-hours question, shows a great majority in favour of a compulsory eight-hours day.

* *

The Coventry Machinists Company have decided to commence manufacturing their machines in America to avoid the heavy import duty. The McKinley tariff again!

* *

Fire-proof paper at last! A mineral resembling asbestos in its properties has been discovered in immense deposits in Columbia. It is the colour of amber, perfectly transparent, and incombustible.

* *

The box shape of harmoniums is fast giving way to more artistic and decorative cases made up in the form of davenports, bookcases, and sideboards with bevelled glass panels and shelves for bric-à-brac, etc. Well this is so, for there is ample room.

* *

A new pneumatic tire for carriages of all descriptions is made in such a manner that it is impossible to puncture or burst it. An unpuncturable and unburstable pneumatic tire for cycles would make every cyclist's heart rejoice.

* *

Three hundred and ninety-three wood-laden vessels, with a tonnage of 291,844, have entered Surrey Commercial Docks; this, as against 300 vessels, of 216,342 tonnage, last year, and 96 firewood ships, as compared with 70 for the same period.

* *

A paper church! One has been built at Bergen. The pulp was compressed by powerful machinery, and rendered waterproof with a solution, one of the principal constituents of which is lime. Fiery discourses might be dangerous here.

* *

The largest ærolite ever known to have fallen is lying in the Caspian Sea. It made a terrific noise as it rushed through the air, and the white-hot mass illuminated the surrounding sea and country. On its striking the water immense clouds of steam rose, and volumes of water were thrown up.

* *

Soap- and candle-making machinery and brick and cement machines are wanted in Alexandria. In Paraguay, cotton-gins and presses; stills for distilling sugar cane and orange leaves; also decorticating machines, and agricultural machinery generally is required. Makers—why not look this market up?

* *

Peat compares unfavourably with coal as a fuel. In its ordinary condition it is five times more bulky, while it contains from 15 per cent. to 25 per cent. of water, and seldom less than 10 per cent of ash. Two and a half tons of ordinary peat only do the same work as one ton of average Staffordshire coal.

* *

An electric banquet, with a menu wholly cooked by electricity, has been given at Ottawa. This is the first instance in the history of the world of an entire meal being cooked by electricity. Soup, fish, boiled, roast, *entrées*, vegetables, pudding, pastry, fruits, were all there. Bravo, Messrs. Ahearn and Soper, who have solved the electric cooking problem!

* *

Sailors' wages in Southern-going steamers were £2 10s.; and firemen, £2 15s. per month, four years ago; and Western-going traders paid sailors, £3 10s.; and firemen, £4. The Union was formed, and wages rose to what they now are for Southern vessels, £4 to sailors, and £4 10s. to firemen; on Western vessels, sailors, £4 10s.; and firemen, £5.

* *

While many improvements have been effected in the interior of pianos, the exterior case remains with us as of old. True, the silk and fret have given place to panels incised, and marqueterie and screw in legs have made way for bracket trusses, but beyond this variation there is a striking similarity of design amongst all makers. There is ample scope in the piano case for inventive genius and design. What is needed is something that will harmonise better with its surroundings and capabilities.

* *

An automatic letter distributor is at work in Geneva. In the lofty buildings a common letter-box is fitted with compartments corresponding with each storey. When the postman puts the letters into this, an electric circuit is closed, and an electro-magnet opens a valve whence water flows into a cylinder connected by a chain with the letter-box. As this ascends it discharges its letters at the proper flats, and on reaching the highest floor the water is discharged and the letter-box returns to the ground floor.

* *

The largest vessel in the world—the *Campania*—is expected to cross the Atlantic in five days and a quarter. Her length is 600 ft., being only 92 ft. shorter than the ill-fated *Great Eastern*. Her machinery consists of twin screws of phosphor-bronze, driven by two pairs of triple-expansion engines, each of 15,000 indicated horse-power. With the exception of the rudder, which had to be made at Krupp's works, the whole of the vessel is of British construction. Why not the rudder?

COMBINATION INKSTAND AND PEN-RACK.

BY THE OFFICE BOY.

THE want of a compact inkstand and pen and paper rack for office use, to replace an old-fashioned affair of some years' standing (a "treasure of the guv'nor's"), without expending, from a not overflowing exchequer, the required 20s. or 30s. necessary to purchase such an article, as well as for the pleasure experienced in executing little jobs like this (and at which he is better suited than in describing "how to do it"), set the writer considering what could be done in the amateur's workshop. Result, the successful production of a handy little piece of office-table furniture, if we may so call it, which cost at the utmost limit 3s., requiring no other than ordinary joiners' tools in the making thereof; although if the reader is the happy possessor of a lathe—to which a small circular saw arrangement is added—a deal of labour is saved in cutting the necessary rabbets, grooving, etc.

The material is $\frac{1}{4}$ in. mahogany, of which from a local boat-builder the writer obtained a quantity of odd pieces—as much as he could conveniently carry away—for the sum of 1s. 3d., and which was of just the right thickness for the job. Take care to pick up the pieces in which the grain runs straight; this will probably save a lot of unparliamentary language in subsequent manipulation. Three glass (or porcelain) inkpots are required, which can be bought at most stationers (cost, glass ones—four for 6d.; a spare one is handy in case of accidents); also two small drawer knobs (glass ones look well, cost—3d. each), and three small brass knobs for the slides to inkpots (cost—1d. each at any shop where fret material is kept).

Now to commence. First cut two side pieces of the shape and size shown (A, A, A, A, Fig. 2*b*), and which must be of rather thicker stuff than the other parts, viz., $\frac{5}{16}$ in. when planed up (remember this when visiting the boat-builder's yard). Carefully square these pieces up, just slightly rounding off the edge at A×, finishing off with sand-paper.

Cut a groove in each piece, as shown at E, $\frac{1}{4}$ in. wide by $\frac{1}{8}$ in. deep, and also one in each piece as shown at F for partition (this is where the circular saw with adjustable table comes in very handy, but of course it can be done with an ordinary rabbet-plane).

Next prepare two rabbet pieces, 5 in. long, of the section shown at Fig. 1, H, and two pieces like J, Fig. 1. These can be either cut with rabbet-plane or the circular saw; in the latter case the top piece, *n j*, must be glued and nailed on with pin brads. Fix the piece J on sides as shown at Fig. 2*b*, and nail on a short ledger piece below at K, same width as the rabbet.

Prepare a piece for the bottom 6 in. wide by 9 in. long (L), rounding off the edges with the plane and finishing off with glass-paper; also a piece (M) for back, $8\frac{1}{2}$ in. long by 3 in. wide, and a wider piece (N) for same, $8\frac{1}{2}$ in. long by $5\frac{1}{2}$ in. wide ($\frac{1}{4}$ in. thick when planed). Carefully plane up, and with a fret-saw cut the ornamental part "to taste"—as the cookery books say—in fact, here is an opportunity for a little display of fretwork.

Cut out a piece in right-hand side-piece for the side drawer, $2\frac{1}{4}$ in. long by $1\frac{3}{8}$ in. wide, as shown in dotted lines in Fig. 2*b* (this should be carefully done with a fine fret-saw), and a commencement can now be made to build up. Nail or screw (small brass screws are best—No. 8) side-pieces to bottom and carefully fix on the two back-pieces M and N, seeing that all is nice and square. Cut out a piece (P) for the inkpots, $2\frac{3}{4}$ in. wide and just thick enough to fit on the ledgers at K. Cut out the holes either with a large centre-bit or fret-saw, so that the pots fit in comfortably, and do not shake about. Fix a narrow ledger along the bottom at the back end to form runner for side drawer (R), also one at *r*, Fig. 2.

Next get out a piece $\frac{1}{4}$ in. thick for the front (S), cut it down $\frac{7}{8}$ in. from bottom edge to form front of bottom drawer (T), and screw on the top piece to sides with four brass screws. The two middle rabbet pieces (H *n*) can now be fitted across and glued or nailed to the piece P, which carries the pots, care being taken to get them quite parallel. Unscrew the front (S) again and fit in the three covers, size of which is $2\frac{3}{8}$ in. by $2\frac{3}{4}$ in. by $\frac{3}{16}$ in., which should be made to work easily in the grooves.

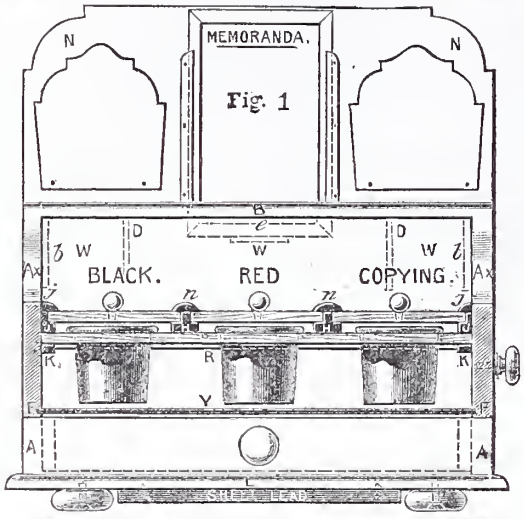
Next fit in a piece for the front (W), into the grooves previously cut in sides A, cutting notches in the rabbet pieces, so that this front comes down on to the covers, of course, just leaving space for the covers to work freely. Three strips should be fixed in front as at ×, so that the covers do not come up to the front by this much. A slight "bead" should be cut in front end of cover to make a finish. Finish off and sand-paper the covers, and screw on the front again—just rounding off the top of same—previously to which, however, the partition (Y) must be fitted in the grooves made in side-pieces. This can either be made by planing down a $\frac{1}{4}$ in. board, or a piece of common fretwood $\frac{1}{8}$ in. thick can be used. The front drawer should now be fitted together, for the bottom of which use a piece of the aforesaid fretwood. Nail on the pieces × to the front with four fine brads, brad-punch them in, and fill up with putty.

Next we can proceed to make the side drawer, for which no description is necessary, except that it should be made of the aforesaid $\frac{1}{8}$ in. fretwood, so as to economise space.

It will be seen that the bottom and sides are let into the end pieces as at o_2 (Fig. 3); also that two narrow strips are fixed on each side to form runners o_3, o_4; the bottom pieces o_4 need not be more than 2 in. or 3 in. long, and fixed at the *back* end of drawer to form guides to prevent wobbling about. Prepare a piece of stuff for the lid B $8\frac{1}{2}$ in. by 2 in., and a piece (C) which is fixed across and on the top of side pieces, and to which the lid is attached with a couple of fancy hinges.

This lid is made to form a pen-rack by the aid of the two little brass fittings (D, D), which are cut out of stout sheet brass with fret saw (shown in detail at Fig. 2*a*). The supports are soldered or sweated on and fixed to lid with two fine brass screws. Two pieces of stuff $\frac{1}{8}$ in. thick are cut to shape (*b b*) and fixed on lid flush with sides A, to form guides and also to keep the pens in their places. Some sort of a stop must be fixed on bottom of these to prevent the lid being opened further than just upright.

The two letter-racks can be cut out to taste—in fact, here is another opportunity for a little fancy fretwork which would look very effective.



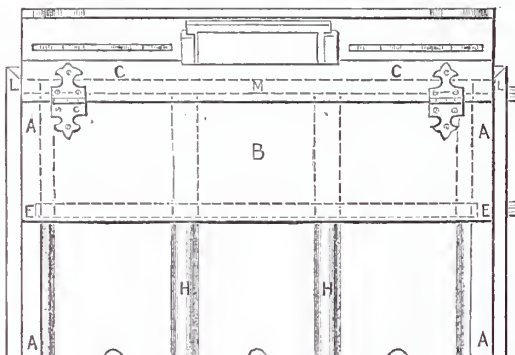


Fig. 3.

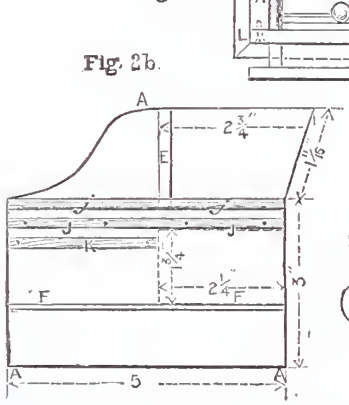


Fig. 2b.

Fig. 2a

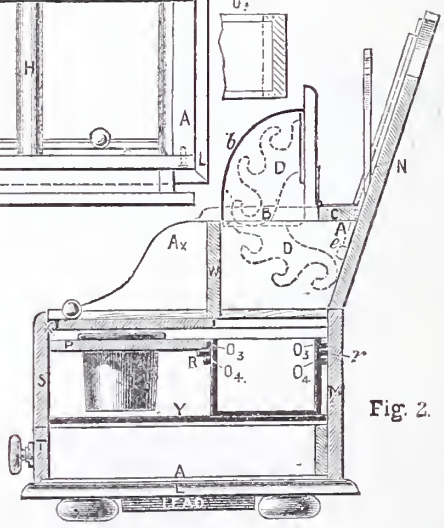


Fig. 2.

Combination Inkstand and Pen-Rack. Fig. 1.—Front View, with Front Piece (S) removed. Fig. 2.—Side View, with Side Piece (A) removed. Fig. 2 a.—Brass Pen-Rack Fittings. Fig. 2 b.—Side showing Rabbet, Ledger Pieces, etc. Fig. 3.—Plan.

The memorandum tablet is a piece of opal plate (if the reader is an amateur photographer he will no doubt have a "waster" to cut up for this) cut to size ($2\frac{5}{8}$ in. by 4 in.), the edges bound with a piece of bookbinders' cloth and finished off with a tag of same material at the top. This tablet can be let into top as shown at *e*, so as to get as much writing surface as possible, and with a soft blacklead pencil can be written upon both sides.

Four wood knobs are turned up for the feet, of sufficient thickness to allow a good stout piece of sheet-lead being screwed on bottom of stand. This will prevent our "imposing edifice" from being accidentally overthrown during the matutinal process of being dusted by a too energetic "domestic." This will bring us to about the finish of our job, and a vigorous scrubbing with sand-paper, followed by the application of two or three coats of good varnish, should "complete the contract."

If any further information is required, the writer will be pleased to furnish it to any who may ask for it through "Shop."

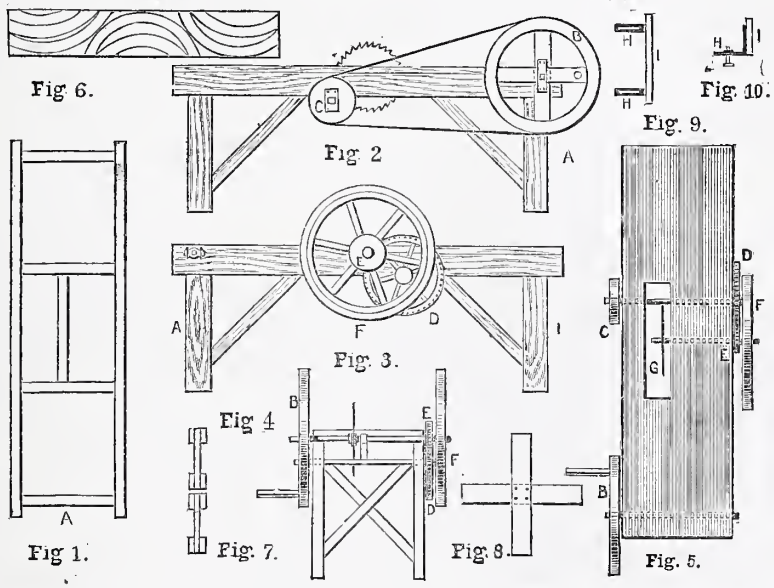
HOW TO MAKE A HAND-POWER CIRCULAR-SAW BENCH.

BY "CHOPSTICK."

INTRODUCTION—SIZE OF BENCH—DESCRIPTION OF DRAWINGS—EXPLANATION OF MECHANISM BY WHICH THE MAXIMUM OF SPEED AND POWER IS OBTAINED BY THE EXPENDITURE OF THE MINIMUM OF STRENGTH—WHERE TO OBTAIN THE IRON WHEELS REQUIRED — THE DRIVING WHEEL — ALTERNATIVE METHOD OF DRIVING WITHOUT COG-WHEELS—THE TABLE OR TOP — THE FENCE—CONCLUSION.

THIS short paper is written in reply to a correspondent who requested me to give a description of a saw-bench which could be worked by hand in the "Shop" columns; but as I felt that I could neither do myself credit, nor give my correspondent satisfaction, in the necessarily short description which I should be able to crowd into the already overflowing columns of "Shop," I promised to write an article on the subject at my first opportunity; and accordingly I am now about to fulfil that promise, and I trust that not only the reader who asked for the information, but a good number of others, will be benefited by the same.

As it is very unlikely that anyone would be likely to attempt to make such a machine who was not able to understand the framing, etc., of the bench without instructions, I shall not waste time and space in minutely describing the method of setting out and cutting every mortise and tenon; but shall content myself with giving general directions only, leaving it to each individual reader to use his own ability in construction, as it really matters very little in what way the frame is made, so as it is firm and strong, and likely to keep so, which will be secured by using good, well-seasoned timber, and fitting it well together. The size of the bench must be regulated according to the kind of work which it is required for; a useful size for a joiner's shop would be about 6 ft. long by 2 ft. 6 in. wide, and I consider the height should be about 3 ft. The drawings are not drawn to scale, but they are supposed to be for a bench 8 ft. long and 2 ft. 6 in. wide, but the makers will be able to get their measurements from them easily enough. And now for the frame first. Fig. 1 shows plan of top of frame. Fig. 2 the elevation of left-hand side when standing at end A. Fig. 3, elevation of right-hand side. Fig. 4, elevation of end A (Figs. 1, 2, and 3), and Fig. 5 shows plan of top after table is on and bench complete. I think the drawings are sufficiently self-explanatory as far as the framework is concerned, but as to the wheels and driving apparatus, perhaps it will not be so. As will be seen at once, this is quite different from any saw-bench in the market, and I will give my reasons for making it so. It is usual in hand-saw benches for the handle for turning the saw to be on the fly-wheel, off which a strap leads to a small rigger on the saw-spindle. Now by this method the fly-wheel is never going fast enough to act as it is intended to do, unless the man who turns it does so at a terrific rate, and such a rate will soon knock up any man; and this, I think, is the reason why the hand circular saws are not more used than they are. Now look at the method which I recommend, and see which looks best.



Hand-Power Circular-Saw Bench. Fig. 1.—Plan of Top of Frame. Fig. 2.—Elevation of Left-hand Side. Fig. 3.—Elevation of Right-hand Side. Fig. 4.—Elevation of End. Fig. 5.—Plan of Top, showing Position of Wheels, Spindles, and Saw. Fig. 6.—Method of cutting Circles out of Straight Board. Fig. 7.—Section of Driving Wheel. Fig. 8.—Elevation of Centre Part of ditto. Fig. 9.—Plan of Fence. Fig. 10.—End Elevation of ditto.

The man turns a light wooden wheel (B) (the same letters apply to all the figures); off this a strap leads to a small wheel (C), the spindle of which runs through the bench and carries a large cog-wheel (D), and this engages with a small pinion (E), which is mounted on the saw-spindle, and which spindle is continued beyond the pinion so as to carry the fly-wheel (F). Now if the driving wheel (B) is 3 ft. in diameter, and the small wheel (C) 1 ft., and this in turn carries a cog-wheel 1 ft. 9 in., and this drives a pinion $4\frac{1}{2}$ in. in diameter, we are sending round the fly-wheel at the rate of about thirteen times to one turn of the driving wheel, as against once in the ordinary way; and this will give a great deal more power, without a corresponding amount of hard work, though of course there will be a certain amount of friction to get over, but if the bearings are well fitted, this will not be much; at any rate, it is nothing compared with the advantages to be gained.

One objection which will be made to this method will, no doubt, be the cost of the wheels required. This can be got over by using wooden wheels for the driving wheels (B and C), a method of making which I will describe before I close the paper; and anyone who is living in either an agricultural or in a manufacturing district will be able to get the cog-wheels and also the fly-wheel cheaply second-hand, and may also be able to get the necessary spindles and bearings as well; but if this is done, the whole must be obtained before the frame is made, so that the bearings, etc., can be placed at exactly the proper places. It is for this reason that I did not make my drawings to scale, so as not to confine anyone to any size. It will be as well to bear one thing in mind: that the heavier the fly-wheel the easier it will run, and, at the same time, the stronger the frame of the bench must be. The drawings show the position of every bearing, so I will not trouble to explain them any further, but will describe the method of making the wooden wheels. First the 3 ft. driving wheel. For this take some 1 in. elm or oak and make a cross as in Fig. 8, halved together in the centre so as to be flush both sides; then strike out some pieces to a 3 ft. circle (1 ft. 6 in. radius), enough to reach round the wheel three times (Fig. 6 shows the best way to do this without wasting the board); then take four of the longest pieces and screw them to the cross already made, fitting them together in between the arms, or perhaps I should say spokes; then turn the wheel over and fit a short piece between each of the spokes, crossing the joints of the other circling pieces, and screwing them firmly to them; then screw another circle all round, again crossing the joints; now screw a piece on each side in the centre, and the wheel is done. A section of it is shown in Fig. 7. An iron plate can be screwed on each side in the centre to take the spindle, or the wheel will soon run out of truth. We have now a wheel 3 in. thick, on which a strap will bite as well or even better than on an iron wheel. The small rigger (C) will be made in the same way, only of course it will be made solid in width, not thickness, and it had better have an iron plate as well on each side, to take the spindle.

If the cog-wheels are difficult to obtain, they can be dispensed with by placing the wheel C at the extreme end of bench, and having another wooden wheel on the other end of spindle, and a smaller one on saw-spindle, and connecting the two with another strap; and even the fly-wheel could be made of wood, and weighted at the rim, by nailing sheet lead round. But I do not recommend this way, only it may be useful for those whose pockets are light, and who may have time on their hands.

All the wheels, etc., in their places, the top can be put on. This should not be less

than $1\frac{1}{2}$ in. thick, and should be planed off smooth and true, and a piece should be made to lift for the purpose of changing the saw when required. This piece is shown at G (Fig. 5). A simple form of fence is shown in Figs. 9 and 10. H, H are iron brackets which are slotted on one arm, and a bolt passing through the slot and through top of bench fixes them in any position. I is a piece of wood about 2 ft. 6 in. long, which forms the fence. The bench can be used for grooving, rabbeting, tenoning, etc., by having pieces of wood of different thicknesses to fix on bench, so as to regulate depth of saw-cut. I could go on for some time longer, but as it is my desire to be brief, I will not take up any more space; at the same time, if I have passed any detail over too lightly, I shall be pleased to explain fully in "Shop" to anyone who wishes for explanation. I trust I shall have no mere carping critics ready to find fault with my proposal before endeavouring to make the article and give it a trial. I hope, too, that no one will be deterred from asking for information, as I shall be very happy to give any in my power, and I am sure all those who follow my advice will never regret the day when they cast aside the old rip saw and made a hand-saw bench.

BENT IRON WORK, AND HOW TO DO IT.

BY J. H.

Bowl and Lamps.

Suspended Bowl—The Supporting Bracket—The Supporting Link—The Bowl—The Bottom of the Bowl—Suspension Lamp—The Supporting Link—The Copper Flowers—The Disc—The Suspension Chains—Bracket, or Wall Lamp—The Back—The Main Scrolls on the Horizontal Bar—The Main Scrolls that Support the Lamp Bowl — The Minor Curves — Suggested Modifications.

Suspended Bowl.—Fig. 43 shows a suspended vessel for the reception of ferns, flowers, grasses, etc. It is supported with brass chains; above is a star-like ornament, and a bracket sustains the whole. The only portions which are not made in bent iron are the chains, which are bought of an ironmonger or gas-fitter.

The Supporting Bracket.—Beginning with the bracket:—The outer framing (A) is made of bar, having a cross section of about $\frac{3}{8}$ in. by $\frac{1}{4}$ in. It is bent round and riveted, or brazed, by methods previously described. The sides must be quite straight, and the frame free from winding. The large main curves are well secured with clips to the framing. The smaller curves are well secured again to the main curves, and where they touch the framing to that also. This is a very plain bracket; I shall show one of a much more elaborate character in another article.

The Supporting Link.—The large link is made as follows:—A central bar (B) of iron, of about $\frac{3}{16}$ in. or $\frac{1}{4}$ in. square, is tapered down at each end and turned round to form a hook. This operation is shown in detail in Fig. 44. At A, one end of the bar is seen tapered down. This is done by hammering it while red hot, or by grinding, or by filing. At B it is seen partly turned by hammering round the mandrel (C). At D the hook is seen completed round the mandrel. Upon each flat face of this bar a symmetrical arrangement of scroll-work is fastened with clips. There are seven separate pieces of iron in each set, bent as shown, and fastened one to the other with clips. From the bottom hook of the star the three chains depend, and from these the ornamental bowl is suspended. It is made thus:—

The Bowl.—Two rings (C and D) of $\frac{1}{8}$ in. square iron are bent round and brazed with scarfed joints. The bottom ring is of smaller diameter than the top one, say by from $1\frac{1}{2}$ in. to 2 in. To the rings (C and D) the scrolls (E) are riveted or soldered, or fastened with wire, crossing diagonally. The scrolls are of stout iron, say $\frac{1}{4}$ in. by $\frac{1}{8}$ in., or $\frac{3}{8}$ in. by $\frac{1}{16}$ in. The ornamental bent iron around the bowl is formed of ten similar sections. These are prepared separately, and fastened with clips both to the rings C and D, and to each other. The precise form of the curves is obtained by dividing the lengths, which are equal to the circumference of the circles A and B, each into ten equal parts; and a middle imaginary circle midway between A and B, also into ten equal parts, when the lines drawn through these three points of division will be the bounding lines of the curves. Ten similar sections, bounded by these lines, will, when united, form the outline of the bowl.

The Bottom of the Bowl.—The bottom of the bowl can be formed in various ways. The simplest is that shown in Fig. 45, in which a number of similar double or C curves are united to the bottom ring (B), and to each other, with clips.

Suspension Lamp.—Fig. 46 illustrates a suspension lamp. It is suitable for hanging in a passage or hall, either from a bracket, like those already illustrated, or from a hook only, secured to the ceiling. There are three suspension chains, which are formed wholly of ornamental links. Four chains may be used instead if preferred. The details of the work are as follows:—

The Supporting Link.—Beginning at the top, there is first the large short link (A). The central stem is made of rod, $\frac{1}{4}$ in. or $\frac{5}{16}$ in. square, and the thin iron strips are of the same width as the rod, and the ends are tapered down and bent round as described in connection with the similar ends in Fig. 44. The scrolls (B), eight in number, and precisely alike, are fastened to A with clips. From the point of contact of the curves with each other the copper flowers (C) stand out upon their stems, made and fitted as follows:—

The Copper Flowers.—These are made of copper in quite a conventional fashion. Little discs of thin copper of about 20 B.W. gauge are cut out either to a truly circular form (Fig. 47, A), or with shallow waved margins (B), or with deeply dentated margins to represent petals (C and D). A slit or a hole is punched in the middle of each, and then the copper is hammered into a hemispherical, or a nearly hemispherical, form, upon a cake of cement; or if there are a good many flowers of the same size required, a concave mould of hard wood, or of metal, may be used, and a punch with a convex end of the same size as the concavity of the flower may also be used to expedite the formation of the flower, and it will be smoother, cleaner, and more free from bruises if so made. The central part of the flower, in this case supposed to represent stamens, is formed of a flat bit of thin copper (Fig. 47, E), and the stem is a prolongation of this, and passes through the slit punched in the disc. Of course this is very conventional indeed, but nevertheless the grouping of these rude copper flowers is very effective among the black iron. I will, however, show some more elaborate ones in later illustrations. The advantage of these flat stems over those of round wire is that they can be clipped with less trouble between the flat iron curves. It is a considerable advantage in this case that the clips which connect the scrolls (B) at their points of contact also embrace the stems of C between them.

The Disc.—To A is attached the disc D, from which the suspension chains depend. This is formed of a disc of sheet iron, or of copper of about 14 B.W. gauge. Its edges may be left circular and regular, or waved or toothed. It is then dished by hammering. A ring (A) is riveted through a hole in its centre to receive the bottom hook of A. Three other rings are riveted at B, B, B to receive the eyes of the top links of the suspension chains.

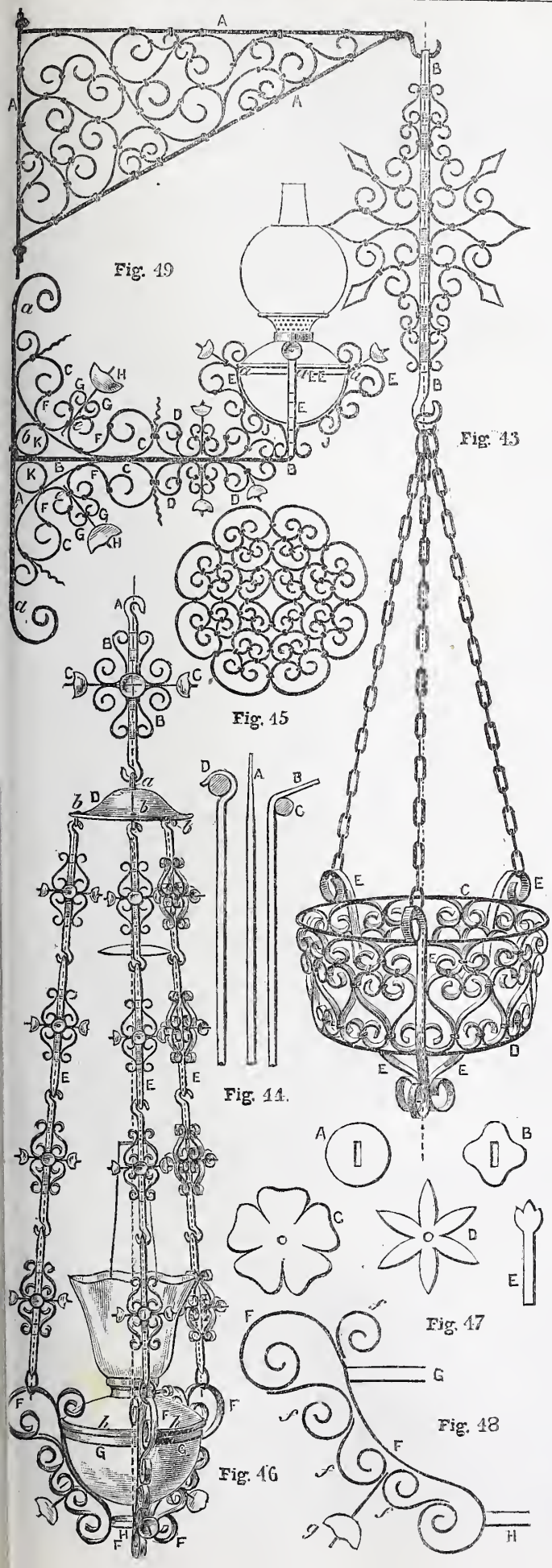
The Suspension Chains.—The suspension chains (E) consist almost of a repetition of one pattern like that from which the whole is suspended, but smaller, as shown, so that the link may be taken as an enlarged view of the chain links, but for a slight variation in mode of curvature of the links of which the chains are composed, and the description given above will apply to each. The central bar for these links will not be more than $\frac{3}{16}$ in. square, and will do very well if an $\frac{1}{8}$ in. square only. The thin iron strips must be of the same width. Four links are shown in each chain, but the number will depend upon the height from which the lamp has to be suspended. The eyes of the three bottom links pass through rings which embrace the scrolls (F) that carry the lamp. The scroll-work is shown enlarged and separated in Fig. 48. There is a main scroll (F) and four minor scrolls (*f*, *f*, *f*, *f*). There is also a copper flower coming out at *g*, made as just now described. The scrolls are curved closely round the bowl of the lamp, and are united at top and bottom to the rings G and H respectively. The ring G encircles the lamp bowl immediately underneath the beading (*h*); the lamp is, therefore, supported by the ring G. Wire crossing diagonally will be made use of to unite the ring G to the scrolls F. The ring (H) beneath ties the scrolls together at the bottom, and is fastened with crossing wire.

The glasswork of the lamp is a matter that need call for no remark. There are the chimney and shade, and the smoke glass above.

Bracket, or Wall Lamp.—Fig. 49 illustrates a lamp mounted to fasten against a wall for passage or bedroom. There is a fair amount of work in it, and I introduce some floral ornaments into its decorations. Any lamp may be used, but it is better to use one having a copper bowl.

The Back.—For the back (A), get a piece of stout hoop iron of about 14 B.W. gauge; taper off the edges at the ends, and bend them round to form broad scrolls. Drill and countersink holes at *a*, *a*, to receive the screws which hold the bracket to the wall. Into this back, tenon with a square tenon, and rivet over the horizontal bar (B); or turn one end of B upwards as at *b*, and rivet it into A. At the other end the bar is turned up for about 2 in. to receive the attachment of the lamp supports. The size of this bar should not be less than $\frac{5}{16}$ in., and would be better of $\frac{3}{8}$ in. or $\frac{7}{16}$ in. square. It should be square, in preference to circular, to receive the top and bottom series of bent iron curves, which stand opposite each other upon its two sides. The width of the thin strips will be the same as that of the bar.

The Main Scrolls on the Horizontal Bar.—On each of the two faces there are two main scrolls, C and D. An encircling clip will unite each series to B. A rivet or some solder will unite C C to A.



The Main Scrolls that Support the Lamp Bowl. — The lamp bowl is united to B thus :—Four strips of stout iron (E), say, $\frac{3}{8}$ in. by $\frac{1}{16}$ in., are curved to fit the outline of the bowl. They are prolonged to embrace the turned-up stem of B below, to which they are riveted with two rivets passing through each pair of strips. At *a* the curves are fastened to the encircling ring (EE) with crossing wire. This completes the framework of main curves.

The Minor Curves. —Taking the minor curves, those which are attached to C and D are similar, except as to size. The curves F, G are typical of those attached to D. F, F are each fastened to C at two points with clips, and to each other at *e*. G, G are also fastened to F, F, and to each other at their points of mutual contact. The stem of the copper flower (H) is also embraced between F, F and G, G, and secured with the clips that hold F, F and G, G together at their points of mutual contact. Small circles are inserted at K, K, and tendrils at various places. Small supplementary curves are shown at J, J; where they come in contact with the curves D they will be fastened with wire; at other parts they will be secured with clips.

Suggested Modifications.—In this, as in other examples of bent iron work which I have given, it should be remembered that the amount of work may be increased at pleasure, in some cases diminished, according to the workman's leisure and taste. I have shown, as a rule, comparatively simple examples. But I have seen many specimens that are simply smothered with elaborate and overflowing wealth of ornament in consequence of the multiplication of similar parts. In this bracket lamp, for example, while I show two series only of curves, one above and the other below the bar B, four or eight such series might be used. The series of four might stand at right angles with each other on the four sides of the bar. The series of eight would be fixed at angles of 45° with each other. Alterations of this character my readers can make for themselves to suit their individual tastes, and to make the amount of work harmonise with their leisure.

Bent Iron-Work. Fig. 43.—Suspended Bowl. Fig. 44.—Method of bending Eyes of Link. Fig. 45.—Bottom of Bowl. Fig. 46.—Suspension Lamp. Fig. 47.—Floral Ornaments in Copper. Fig. 48.—View of Scroll-work that supports the Lamp Bowl. Fig. 49.—Bracket, or Wall Lamp.

CHEMICAL APPARATUS: HOW TO MAKE AND USE IT.

BY H. B. STOCKS.

Retort Stand: Methods for Making—Rings—Rings Made from Wire — Deflagrating Spoon: Easily-made Form — Test-tube: How to Make, Kind of Glass Required—Test-tubes Used for Preparing Gases: Oxygen, Sulphuretted Hydrogen, etc.

I had intended in the present article to devote the whole of my time to another lesson in glass-blowing on a small scale, but I find that there are one or two articles required before we can properly perform the experiments connected with oxygen and hydrogen. I shall therefore describe these first, as I wish to follow as nearly as possible the order usually followed in teaching chemistry.

We are in want of a retort stand and a deflagrating spoon.

A retort stand with three rings will cost about 4s. 6d. It is possible that you may find a stand at a marine store dealer's that will answer the purpose; or get an iron moulder to cast a rectangular iron base, 6 in. by 4 in., and hollow (Fig. 1). A piece of $\frac{3}{8}$ in. gaspipe, 18 in. long, will do for the rod. Drill a hole in the stand 1 in. from the side. Get a 2 in. bolt and nut, file the head of the bolt smaller, until you may just hammer it into the pipe, leaving about $\frac{3}{4}$ in. of the bolt out; and having pushed the bolt through the hole in the stand, screw the nut up tight until the rod stands upright and rigid.

In place of this you may have the stand and rod solid, with a hole in the stand tapped and a corresponding thread on the rod, which will make a very solid stand; but for those who do not want to go to any expense at all, I advise them to get the lid of a tin canister, 6 in. by 4 in., or near that, fill up the lid with melted lead, and, after cooling, bore a hole, of less than $\frac{3}{8}$ in. diameter, right through the lead down to the tin and hammer in the piece of $\frac{3}{8}$ in. pipe.

This will do for the stand; now we want rings. These also will have to be cast. They may be of iron or brass, and require thumbscrews to grip the retort stand. You might try Caplatzi, who advertises in Work, for these and any other articles required.

Rings may be made of stiff iron wire, and will do quite as well as any. Three sizes will be useful—4 in., 3 in., 2 in. Having procured some very stiff iron wire, cut off three pieces of it, and bend each one of them around some cylindrical body of the size required, so as to form a ring; bring up your stand, and commence winding the loose end of the wire around the rod, four or five coils close together; and wind on very tight, so

that the ring may stand horizontal, and with about 2 in. of wire in a straight line before coiling. The rings should have their centres all in the same plane, so as to hold apparatus in a proper manner. If the wire is sufficiently stout, the rings ought not to bend appreciably under the slight weight they have to bear. By pressing downwards or upwards on the rings close to the stand they will easily move, but simple pressure of an apparatus on the stand tends rather to make the rings grip harder.

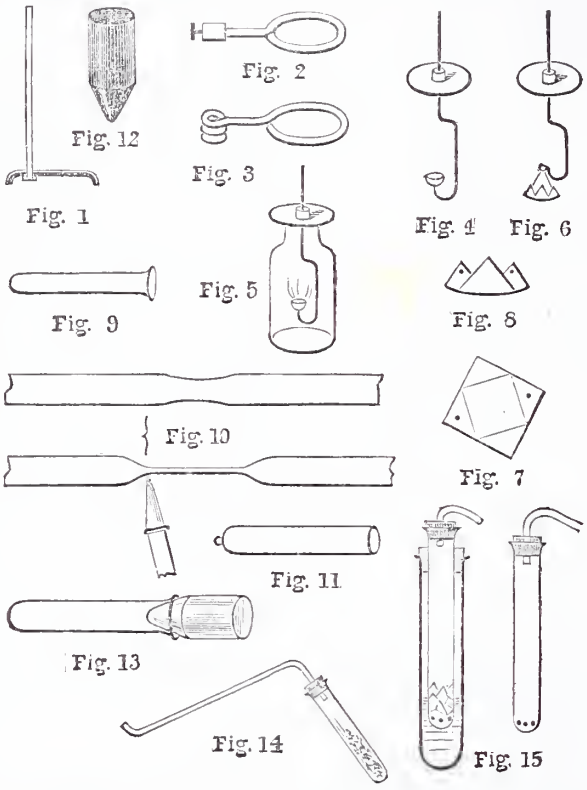
The deflagrating spoon (Fig. 4) is used for burning substances in various gases, the substance to be burnt being placed in the small cup.

The deflagrating spoon consists essentially of a small metal spoon, which is rivcted or brazed on to a stout iron wire. The latter passes through a cork in a circular piece of tinplate, intended to cover the jar containing the gas to be experimented upon, and thus prevent, as much as possible, fumes from the burning substance entering the room.

Fig. 6 shows a device for a spoon where brazing or riveting will not be necessary. The little cup is made from a piece of sheet-brass ⅝ in. square, in which are punched two small holes at opposite corners. The corners may then be turned up. The tinplate cover is 3 in. in diameter, and in the centre of it a hole is punched, the hole being fitted with a cork, through which passes the iron wire (16 in. long), bent as shown (Fig. 6), and to the end of which the small brass cup is connected by means of a piece of thin iron wire. There should be no difficulty in making this piece of apparatus, and the materials are to be found in almost every house, so that the cost should be practically *nil*.

I shall now endeavour to give a few more practical details in glass-blowing on a small scale, and for this purpose have selected the test-tube as a good example. I should not, however, advise anyone to make their own test-tubes—they are so cheap—but for our purpose we could have no better example than this simple and largely-used piece of apparatus (Fig. 9).

Cut a piece of the tube, ⅝ in. diameter, 12 in. long. Now, tube of this size may not always be cut in the manner shown for tube of a smaller diameter. To cut it neatly and at the place required, make a file-mark (it need not extend around the tube); select a short piece of the glass rod, and draw it out in the blowpipe flame to a point; heat up the pointed end of the rod, and immediately place it upon the file-mark on the tube. Take care that the tube is held close to the bench over a duster, as this procedure usually cracks the tube right around, and the portion unheld falls; if not, the crack which forms may be led around the tube by moving the hot rod in front of it. This property of glass is very useful, and I will show how it may be utilised later on. Having cut off a portion of the tube of the required length, commence heating it at the centre in the blowpipe flame very gently, as thin tube like this rapidly fuses—a rather smoky flame is best—and as soon as the tube is sufficiently soft, withdraw your hands from one another in a horizontal direction, first removing the tube from the flame. The tube will now consist of two large tubes, connected together by a capillary tube (Fig. 10). Turn down the flame of the blowpipe, and blow at the point shown in the figure; and, as the glass melts, draw it away. The tube with the long capillary may now be laid down for a short time, and the first tube proceeded with before the end has had time to cool. Continue heating the closed end of the tube until it rounds off (as at Fig. 11), and has a small bulb of glass in the centre. This latter has to be removed. Turn the blowpipe very low, and hold the tube in such a position that the knob of glass only is heated to redness, and proceed to remove it by touching it gently with a cold glass rod and drawing away the melted glass. Repeat this until the knob has entirely, or almost entirely, disappeared. When this is the case, turn up the gas, and, having the flame rather smoky, as before, heat the bottom of tube gently; remove from the flame, and, holding the tube vertically, blow gently into the open end, twisting the tube all the time, so that the bottom may be blown out into a nicely rounded shape. Repeat this until the desired result is obtained; smoke and cool.



Chemical Apparatus. Fig. 1.—Section of Retort Stand, with hollow Foot. Fig. 2.—Cast Ring. Fig. 3.—Wire Ring. Fig. 4.—Deflagrating Spoon. Fig. 5.—Substance burnt in Gas. Figs. 6, 7, 8.—Easily-made Spoon. Fig. 9.—Test-tube. Figs. 10, 11, 13.—Method of making Test-tube. Fig. 12.—Charcoal Cone. Fig. 14.—Tube Apparatus for Oxygen. Fig. 15.—Tube Apparatus for Sulphuretted Hydrogen, showing Inner Tube.

While the tube is cooling, proceed with the second one. Heat the tube in the same position as you did the first one, and draw away the capillary tube; then proceed as above.

To finish off the tubes, we require a piece of charcoal sharpened to a rough point (Fig. 12). A piece of hard charcoal, about 1½ in. diameter, will do.

Now heat up the mouth of one of the tubes, very gently at first, and turn constantly, so as to have it equally heated. When sufficiently soft, withdraw from the flame, and place the charcoal cone in the mouth of the tube. Press upon it slightly, and twist the charcoal once round. This will press out the mouth of the tube into the form of a lip, and will render it stronger and neater than if left in its rough condition (Fig. 13). Smoke the tube, and allow to cool. The tubes may then be washed and used.

The tubing for this purpose should be good Bohemian tubing, and, upon heating, should not become covered with a frosted appearance, which would show it to be bad tube, and entirely unfit for the purpose. No good tubes could be made from this kind of glass, so take care you get tube of Bohemian glass, as I have come across many bad specimens, which have led to nothing but failure for glass-blowing purposes.

Test-tubes come in very handy, not only for testing, but for many other purposes. They may be used for preparing small quantities of gases. Fig. 14 shows a test-tube used to prepare a small quantity of oxygen.

Fig. 15 shows an apparatus for preparing hydrogen, sulphuretted hydrogen, etc., and is specially useful for preparation of small quantities of the latter gas for testing purposes, as the supply of gas is under control.

The apparatus consists of two stout test-tubes—the outer tube 1 in. diameter, the inner tube ⅝ in. diameter, and preferably as long as the outer tube.

Heat up the bottom of the smaller tube in the blowpipe flame, and when it is sufficiently soft, pierce it with four or six radial holes by means of a darning-needle; smoke and cool.

Two corks are required—one fitting the outer tube, bored with a hole large enough to take the inner tube easily. Soak the cork in melted paraffin-wax after cutting the hole. The second cork fits the smaller test-tube, and is bored and fitted with a bent delivery-tube.

Place the acid in the larger tube (about quarter full), put in the cork, and slide in the smaller tube. It will be found that the wax coating assists this. Place the sulphide of iron in the inner tube, sliding it in with the tube held at an angle; otherwise, the bottom of the tube will be knocked out. Now, by pushing the inner tube down into the acid, the latter penetrates the holes and attacks the sulphide, with an immediate evolution of sulphuretted hydrogen, which may be immediately stopped, when required, by raising the tube out of the acid.

MICROSCOPIC DRAWING.

Place the body of the microscope horizontally; remove the mirror; put the slide on the stage; condense the light upon it by means of the bull's-eye, taking care to centre the light; attach the concave mirror to the front of the eye-piece by means of a spring or a piece of thin wood. Have its surface at an angle of 45° with the plane of the anterior glass of the ocular. This will project an image of the object on the paper beneath. If the outer ring of light is circular, there will be no distortion. With a black cloth exclude all outer light, covering both your head and the instrument.

NEW SELF-LIFTING COUCH-RAKE.

BY J. CHARLES KING.

Of the many troublesome weeds which are the pests of the English farmer, couch-grass —or "quitch," as it is sometimes called—is the most difficult and costly to eradicate, unless the proper method be adopted. Couch-picking on the surface does rather more harm than good, as the rootlets are left in the soil to start a new career.

The couch-rake about to be described was used on the farms-in-hand of the Duke of Somerset, Bulstrode Park, with conspicuous success in results and economy of cost of working.

Its make and action are as follows:—A triangular frame of iron, 8 ft. back beam and 11 ft. sides, running to an apex, where an upright socket took the spindle of a swivel-wheel, 12 in. diameter. Two hind wheels, each 20 in. diameter, upheld the back beam by means of axles, which are adjustable up or down a slotted groove at each end of beam. So far it is as a triangular trolley-iron, 3 in. by ⅝ in. in section.

The rake-head, made of 2 in. stout L-angle iron, had teeth 12 in. long by ¾ in. wide, with the shoulders mortised through one angle side and riveted to the other, as is done with iron garden rakes. These teeth are 2 in. apart, so that there are forty-eight teeth in the 8ft. rake-head. To make this rake-head always self-lifting is simple enough.

From the top side of the apex of the frame were fixed two long three-plate springs, each 3 in. wide and ⅜ in. thick, that extended to the beam end, spreading out to within 1 ft. of each end of the rake-head, and fixed there, to hold it one foot above the beam. When the rake-head is fixed to the springs, its weight depresses the flexible ends of the springs, bringing the teeth-points just below the line of the beam. There it hangs ready for aetion, when pressed down by foot or hand, or both, to do its extirpating work; and the instant the hand or foot releases it from downward pressure into the soil, it flies up to the end "check-stops" on the beam with a recoiling clash, that knocks off the weeds and couch, earth and stones, that may cling to the teeth.

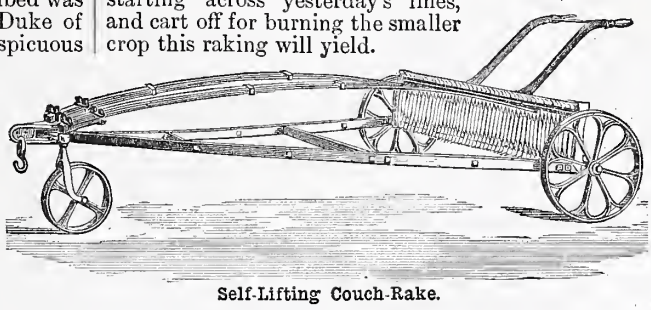
To ensure thorough cleansing, just in front of the beam and the rake-teeth is an extra beam of lighter iron, which scrapes the front of the teeth of the rake in its upward spring, or recoil. This is not shown in the sketch. The handles fixed to the rake-head stand up and back about 30 in., with a round bar of wood, 3 ft. long, joining them for the hand-pressure of the driver.

A footboard of iron stands out from the rake-head for foot-pressure, or for standing on when the rake is wanted to scour deep into the soil.

The teeth are slightly curved on their length, and skim about 5 in. from a vertical line. For extra foul land, a five-tined dung-fork is carried on top of the handle for cleaning the teeth of the weeds and earth. It is pulled by a horse, led by a boy at a slow pace; but the rake-man must be nimble and methodical, so as not to let the rake be more than an instant out of the ground, and that only when in a true line, at right angles to the rakings. This line has to be cross-raked, so that no part of the field is missed.

Eight acres may be more thoroughly done in one day with this rake than would be the case were eight men to fork over one acre in the usual way; hence its obvious economy for the purpose intended.

Having got the couch roots to the top of the ground, do not leave them there long, but cart at once; sowing the land again by hand-picking is wasteful cost. With close-tined dung-forks, lift the couch-grass into carts—particularly all earth that clings to the roots: for in these are the most potent couch rootlets. Burn the lot. The next day, if fine weather, work the same ground, starting across yesterday's lines, and cart off for burning the smaller crop this raking will yield.



Self-Lifting Couch-Rake.

For the most effective use of this rake, the land should be in good tilth after ploughing and harrowing—if with the circular harrows, that rotate as they advance, a thorough cleansing will be the result. These neglected harrows are strongly advocated. The man who farms well under the ground will be well helped by Nature above ground; and if acquainted with the laws of master-growth of crops and weeds, he will put in the couch-weed's master-growth—sainfoin—if the land is suitable and in good heart. The roots of the sainfoin will kill and feed on the little amount of feeble couch-root growth that may be left in the soil after the use of the couch-rake.

HOW TO REPAIR A SLATE ROOF.

BY E. DICKER.

Before laying out any money on whitening ceilings or papering walls, especially in those rooms directly under the roof, I should strongly advise a thorough examination of the roof, to see if there are any broken or displaced slates, as there are very likely to be during the frosts, etc., of winter. If there is a slate loose or broken, the wet is sure to come in *after* you have whitened the ceiling or papered the walls. I can speak very feelingly upon this point, as the very thing occurred to me only last summer.

Fig. 1 represents a portion of a slate roof, and we will suppose the slate marked A is broken, so that the water which goes through the joint between B and C finds its way through that, between the upper part of D and E, and from there runs down the boarding or rafters, and shows itself on the ceiling below near the walls, or it may fall direct on the ceiling below the broken slate.

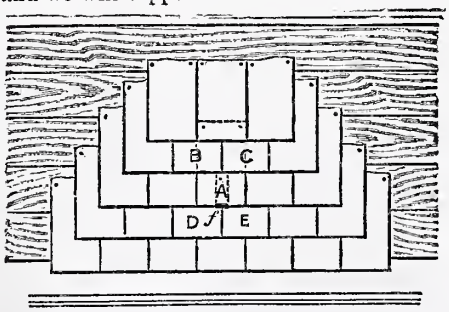


Fig. 1.

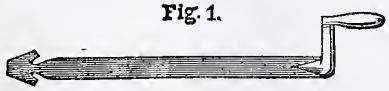


Fig 2.

Slate Repairs. Fig. 1.—*f* shows appearance of Metal Slip when new Slate is in. Fig. 2.—"Slate Rip."

To put in a new slate, it is first necessary to take out the broken pieces of the old and the nails that held it in position, or else you cannot push the new slate into its place. You will at once see that to get at the nails you would have to take up the slates B and C; and before you could take off these slates you would have to take off those above, and so on until you reached the top of the roof. Now, this would never do, for it means that you would have to strip nearly the whole of the roof to put on one new slate. What is done is to draw the nails from under the slates with a tool called a "slate rip" (Fig. 2).

The blade of the slate rip is pushed under the slates, and the head of the nail caught in one of the notches, and then, by giving the "rip" a sudden pull downwards the nail is pulled out; if the nail is held so tightly that it will not give, a sharp tap or two with a hammer on the front of the handle will soon draw it out.

A piece of stout hoop-iron with a notch made on it near one end, and turned up at the other to form a handle, will serve the same purpose as a special slate rip, especially if you have only one slate to put on. Sometimes it is found that the new slate will pass the heads of the nails and bed all right without taking the nails out at all; if this is so, no useful purpose is served in drawing them out.

You cannot nail the new slate in its place any more than you could draw the old nails out; so a strip of thin copper, lead, or zinc, about ¾ in. wide, is laid directly over the joint between the slates, D and E, and nailed to the boarding through the joint as close to B and C as possible, allowing it long enough to turn up over the bottom edge of the new slate when it is in position. The new slate is then pushed into its place over the metal slip, and the slip bent sharply up over the bottom edge of the slate, and so holds it there. For the sake of appearance, the slip is cut off as near to the bottom of the slip as you dare.

In measuring for a new slate, measure the width only—the length generally follows. For example: if a slate is 8 in. wide, it is generally 16 in. long; and if 10 in. wide, then 20 in. long; while if 12 in. wide, the length will run 24 in.; and so on.

WRINKLES.

Worms in Wood.—To remove worms in furniture, dissolve 2 dr. of corrosive sublimate in 2 oz. of methylated spirit and 2 oz. of water; to be applied freely with a stiff feather or brush. This is an unfailing remedy, but the mixture is poisonous, and therefore should be carefully labelled and kept out of harm's way.

To get Rid of Pot and Kettle Fur.—If the incrustation is confined to the spout, stop the inside orifice with a cork; fill the spout with dilute hydrochloric acid (to be obtained from any chemist); allow it to remain for about half an hour, and then clean out with a piece of cane; and if not entirely removed, repeat as before.

"WORK" PRIZE SCHEME.

NOTICE.

"WORK" COMPETITION COUPON

will be found on page 448.

NOTICE TO READERS.

Among the illustrated articles in next issue (No. 185) will appear :—

A Fancy Convertible Table.
Clock Water-Wheel Novelty.
Perspective in Drawing Furniture.
Helical Gears.
Æolian Harp Making.
Specula for the Newtonian Telescope.
Etc. Etc.

*** The Editor makes this intimation in the hope that readers, having friends interested in any of these subjects, will bring the same to their notice.

"WORK" PRIZE SCHEME.

"Useful Household Article" Competition.

Prize Winners (see No. 182).

"Improvement" (A. Beck), 2, Carpenter Street, Horseferry Road, Westminster, S.W.

"Bookmarker" (Sydney C. Smith), Balliol House, Toynbee Hall, Commercial Street, E.

"Aster" (S. M. Chapman), 11, Simpson Street, Newcastle-on-Tyne.

"Pater" (J. Charles King), Burchett's Green Cottage, Maidenhead Thicket, Berks.

"Forkless" (Mervyn W. R. Bunbury), 15, St. Mary's Terrace, Paddington, W.

"Dhobia" (Harry T. Baker), 14, Southgate Road, Kingsland N.

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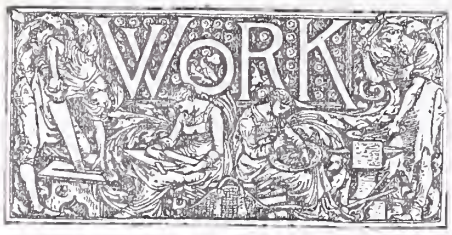
Cassell & Company, Limited, *Ludgate Hill, London.*



is published at La Belle Sauvage, Ludgate Hill, London, at 9 o'clock every Wednesday morning, and should be obtainable everywhere throughout the United Kingdom on Friday at the latest.

TERMS OF SUBSCRIPTION.

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3 months, free by post	1s. 8d.
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Eighth of a Page	1	17	6
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Small prepaid Advertisements, such as Situations Wanted and Exchange, Twenty Words or less, One Shilling, and One Penny per Word extra if over Twenty. All Other Advertisements in Sale and Exchange Column are charged One Shilling per Line (averaging eight words).

Prominent Positions, or a series of insertions, by special arrangement.

*** Advertisements should reach the Office fourteen days in advance of the date of issue.

*** All letters suggesting Articles, Designs, and MS. communications for insertion in this Journal will be welcomed, and should be addressed to the Editor of Work, Cassell and Company, Limited, London, E.C.

Work and Wage.—"The labourer is worthy of his hire." The sacredness of these words is too often overlooked in the shameless advertisements of those who want to hire labour. Here are two samples out of many nearly as bad :—

Wanted, a teacher of technical classes; efficient, painstaking, etc. Salary, £25 a year.

Wanted, a bailiff and gardener for seventy-six acres of land; must understand stock and make himself generally useful, etc. A comfortable home in return for services.

These advertisements have been abbreviated for reference, but enough, and too much, is here to show the baseness of some would-be hirers of labour on such terms. Convicts get their food, lodging, clothing, and a deferred payment for exceptionally good conduct, but the sham British yeoman, who wants a capable man to give his lifetime for his food and lodging, is a disgrace to his order. The institution also that needs a talented expositor of the technics of various mechanisms and processes in manufacture for £25 a year deserves to be ended, and its accounts overhauled to find out if its officials are being paid a relative rate of salary to the one it offers for the services of a technical teacher. Even worse advertisements than those quoted make bids of a shelter and food for ladies to teach and train children of other people, for which they are expected to be proficient in music, drawing, and languages. All for a comfortable home! Home, forsooth! Such advertisers cannot know the meaning of the word. It may be a shelter for those sad creatures who, by adversity, are compelled to immolate their young lives, but morally it is a thief's den, where the poor teacher becomes the victim of *soi-disant* respectable people, who thus rob a girl of her life's brightness and her soul-joy of its charm. All noble-hearted men and women should steadily discourage this particular species of iniquity.

An Aim for Trade Unions.—It is being generally conceded by even the friends of labour that strikes are not a satisfactory method of arriving at an adjustment of disputed points between employers and employed. There is the suffering that never fails to accompany a strike, there is the abiding ill-feeling engendered whichever side wins, and there is the depletion of the coffers of the men's organisation. Now these funds might, we think, be turned to a better use; and in view of the recent appearances of advanced labour leaders and co-operators on the same platforms, perhaps our suggestion may receive some attention. It is that trade unions should become co-operative distributors—not of tea and sugar and other articles, but of labour. Let each union be like a co-operative store, the commodity it supplies being labour. For example, a shipbuilder tenders for the building of a ship. To build this ship he requires, besides material, various classes of craftsmen — engineers, carpenters, sail-makers, riveters, and so forth. In preparing his tender, let him submit specifications of the work he needs to be done by these different groups of workmen to their unions, and let them thus tender to him for the work. In this way disputes during the progress of contracts, and their consequent damage to the contractor, would be avoided, all points having been settled previous to the signing of the different agreements by the unions. This risk, and the supervision of the men being withdrawn, contractors would be able to afford much greater sums than they now give to labour. The contractors would pay the unions the agreed upon amounts, and the unions would pay the men. By some such scheme as this all disputes about wages and hours of labour would lie between the men and the officers of their unions, and if the men were not satisfied with their officers they could elect others. There is no satisfactory ground upon which workmen can fight with capital—such a fight, besides being injurious to both parties to the contest, must always end by putting the men out of court. If an employer says to a demand for higher wages, "No: I shall not raise your wages," there is no power to make him do so. He can shut up his shop, and there the matter may end. All that the man can do, if he wishes to carry on his business, is to strike, picket his shop, and seek to injure him. Suppose an employer, because a man refused to work for him, determined that that man should not get work at all, and did all in his power to prevent that man from getting work, he would then be in the same boat as strikers often find themselves in. We hope our suggestion may be carefully considered.

Winter Work.—With the long evenings gradually creeping upon us, thousands of our subscribers will be parcelling out their winter's work. It will be our aim to help them very materially by providing a variety of subjects such as will afford scope, week by week, for the best energies of our varied classes of readers. Novelties and special subjects will be placed before "Workites," and it is hoped that any subscriber in need of a subject will make his want known. Meanwhile, the enlisting of new subscribers—of which the Editor will always be glad to have particulars—may be zealously pushed on by those subscribers who, not content with taking in Work themselves, very properly induce others to do so also. This is the way in which thousands who cannot write for Work can do their share in helping the publication.

THE ART OF STAIRCASING.

BY GEORGE F. CHILD.

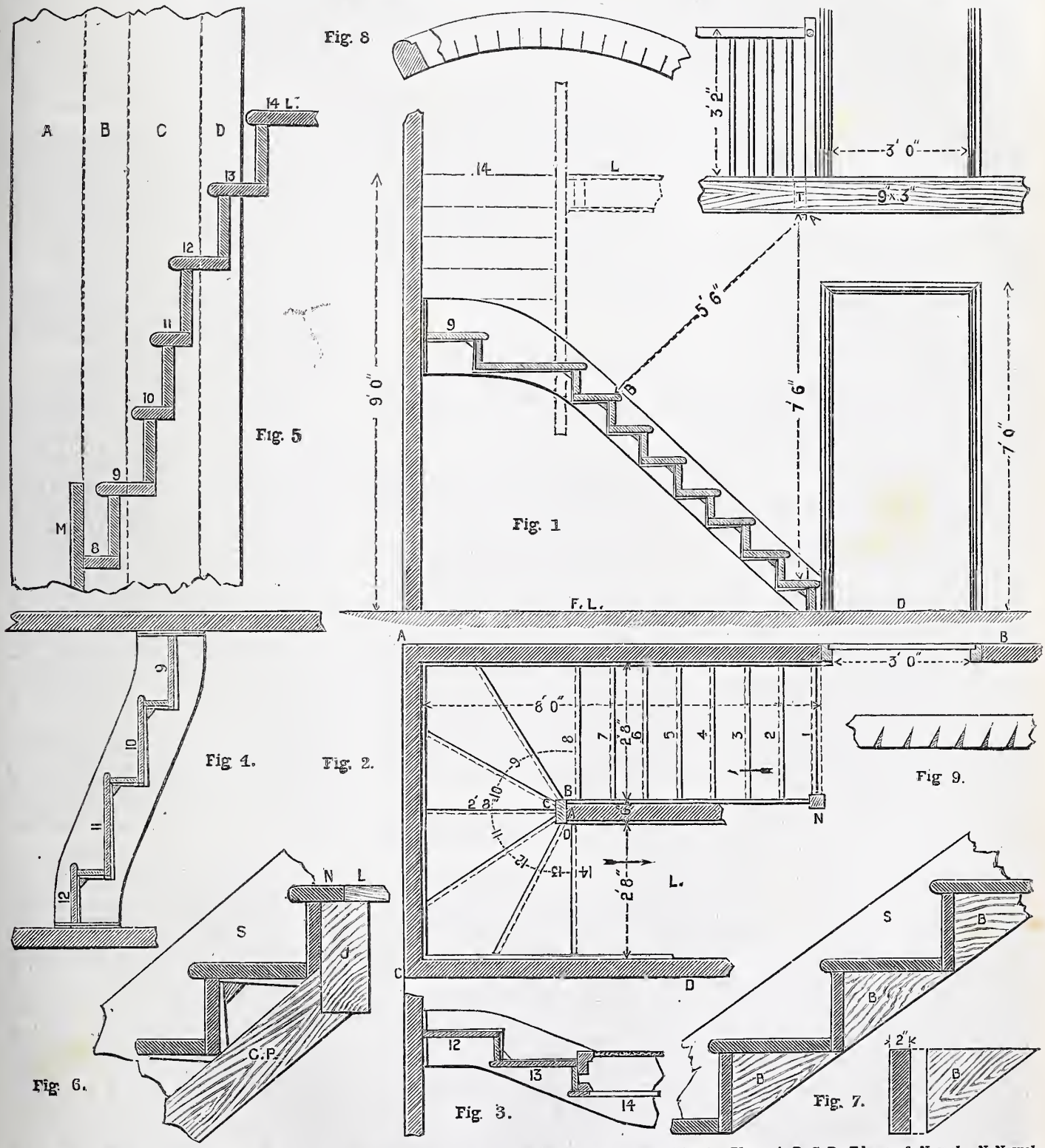
STAIRCASE WITH HALF-SPACE OF WINDERS.

WORKING DRAWINGS — SETTING OUT THE STRINGS—OUTSIDE STRINGS — SETTING OUT THE NEWELS — SCALE DRAWINGS — MODEL NEWEL — CARRIAGE PIECES — BEADS, ETC. : METHOD OF BENDING — CUTTING OUT THE DRAWINGS.

Working Drawings.—The subject for our present lesson is a flight of stairs over a rather difficult plan, inasmuch as we have a wall, 4½ in. thick, occupying a position midway between the top and bottom flights. This is merely given as a good illustration of one of the many difficulties the staircase hand has to deal with. I may perhaps here state that this staircase (as all others in the present series) has actually been constructed by the writer, and therefore the drawings are placed before the novice in full confidence of their being correct.

The plan and elevation must be drawn as in all preceding examples, dividing the "height" and "going" according to the data given. It will be observed that there are six winders, occupying the whole width of the staircase. When this is the case, they are known as a *half-space* of winders. The reason for these winders will be readily understood when the measurements are taken, as explained before.

Setting out the Strings.—Fig. 1 shows a sectional elevation on A B, which, as we know, is obtained by projecting lines from



Staircasing. Fig. 1.—Sectional Elevation—F L, Floor Line ; D, Door ; L, Landing ; T, Trimmer. Fig. 2.—Plan—A, B, C, D, Edges of Newel ; N, Newel ; L, Landing. Fig. 3.—Sectional Elevation on C D. Fig. 4.—Sectional Elevation on A C. Fig. 5.—Development of Newel—M, Mortise ; L, Landing ; 8 to 14, Ends of Winders ; A and C, Sides of Newel ; B and D, Edges of Newel. Fig. 6.—Diagram showing at C P Carriage Piece ; L, Landing ; N, Nosing ; S, String ; J, Joist. Fig. 7.—B, B, B, Pitchboard Brackets ; S, Stringboard. Figs. 8 and 9.—Method of bending Beads.

the plan, to intersect with the riser-lines. The dotted lines, 9 to 14, show the winders up to the landing. The portion of the drawing shown above the doorway (D) represents the door leading into the bedroom, with a part of the handrail, balusters, etc. This rail is returned on the landing at right angles to the staircase, a trimmer being inserted below, as at T. The distance from this trimmer to the nosing of our steps will require careful attention, as upon its being placed in proper position depends our ability to pass up and down the stairs without striking the head: this is known as *head-room*. It will be seen the distance in the present instance is 5 ft. 6 in., in a line perpendicular to the nosing-line, and gives 7 ft. 6 in. in a vertical direction. Correctly speaking, the distance between A and B should not be less than 6 ft. 6 in.; but, of course, we are entirely guided by circumstances, as it rarely happens that we are able to design the stairs as we should desire, on account of construction of the building not admitting it.

The strings at Figs. 3 and 4 are set out as before. Fig. 3 appears to be upside down, but is drawn thus to show it in proper position. If the paper were folded up round the plan (Fig. 2), all the strings in elevation would be shown in their proper position. This can easily be proved.

Outside String.—The outside string requires no explanation, being set out as all other examples.

Setting out the Newels.—Fig. 5 represents the newel developed—that is, each side of the newel is marked off as seen, the dotted lines being the angles. A is the side next the wall (see plan, Fig. 2), B the edge following, C the side facing the winders, and D the corresponding edge.

Scale Drawings.—I should advise the student to set out the plan of the *winders* to a large scale, say 1½ in. to the foot, dividing them equally on the centre line, which is, as we know, 15 in. from centre of newel; also mark them out equally *round* the *newel*, as seen in Fig. 2. Now develop the newel, as at Fig. 5, by first drawing the space marked A, which is 6 in.; next draw the space B, this being 3 in., and represents the edge of newel. Draw the following side (C) and edge (D) in the same manner.

Model Newel.—Now, at M, mark the mortise for the string, and draw the first winder, No. 8, on the edge B. By taking the respective distances from the plan, and transferring them to the development, we can mark each winder in its proper position—of course, marking the height of each step as we go. If the drawing is set out on a piece of cardboard, and a knife lightly drawn along the *dotted lines*, the model can be bent round, thus forming a miniature newel, and showing each winder in its true position. This may appear to be taking a lot of trouble, but as it is almost as good as setting out a real newel, the experience gained will give greater confidence when the actual work is taken in hand.

Carriage Pieces.—Where there is no spandril under the stairs, a carriage piece, C P (Fig. 6), is often introduced to stiffen them. This may be a piece of *quartering*, about 5 in. by 3 in., and is fixed to the floor at bottom and notched to the trimmer at top. This piece may be cut out to take the edge of each step: a better plan being to nail rough pieces on the side of the carriage piece, and letting them extend under each step. This makes a very good job.

Fig. 7 is another method often adopted. This is simply pieces about 2 in. thick, cut out like a pitch-board, and nailed to step and riser in the *centre* of the staircase. This is plainly shown at B.

Beads, etc.: Method of Bending.—As we have before explained, mouldings of various kinds are usually nailed on the top edge of all wall strings. The method of forming casements to meet the skirtings has been also fully shown. In the present instance, however, a bead is all that we require, which will readily lend itself to our proposed course of action. This will consist of a series of saw *kerfs*, or cuts, run in on the top or bottom of the bead, according to which direction it is wished to bend. This is shown at Fig. 8.

The object of the saw-cuts is to remove a certain portion of the wood, which will be closed up upon bending. Fig. 9 is somewhat exaggerated to show the principle. The subject of bending wood will be more fully explained in a future paper.

Cutting out the Drawings.—A good plan to adopt would be to place an order with your newsagent for *two* numbers of WORK, in which case the drawings could be cut out of one and the text read from the other. This would save a lot of trouble in constantly turning the pages from text to plate, and would well repay the extra outlay.

THE CYCLE: ITS WORTH TO THE NATION.

Being the Third Prize Essay, by "CURRUS" (J. CHARLES KING), *Burchett's Green Cottage, Berks.*

The Name and Notion in the Past.—The term "cycle" comprehends two or three wheeled pedomotors, whatever adventitious sub-designations may be given to them for fancy or trade distinction. Manumotors, of course, are included under the generic term, "cycle."

The evolution of a cycle appears to have been by a series of stages of developments, these developments being dependent, not on the muscular skill to propel a wheeled frame supporting a rider that propelled it, but on materials being discovered suited for the cycle improvements, and methods to make the frame, wheels, and intermotor light enough to serve the purpose of a bearing vehicle for the rider or riders that impelled it. Roadways favourable for easy wheel traction also formed another feature that determined the development of the cycle to its present advanced position as a source of pleasure to so many inhabitants of the United Kingdom, and a trade which is so important that it has been proposed by some persons as an eligible source of future taxation.

In bygone years a cycle was used for foot propulsion on the road, the rider sitting astride a connecting perch, holding a guiding handle as arm-rest.

About seventy years ago one of the Penn family, who was owner of Stoke Park, near Slough, rode a cycle he made from Stoke-Pogis to Southampton and back. It was designated a "Hobby-horse," and where the roads were good, in the vicinity of London, they were commonly in use and let out for hire from wheelwrights' and coachmakers' shops.

In one of the painted windows of a cloister of Stoke-Pogis Church is a beautifully executed design, in a central position amid other stained glass, of a boy angel riding a two-wheeled hobby-horse, blowing a trumpet fixed through the head of the perch he bestrides. The drawing and colouring of the angel are masterly and vivid, but the hobby-horse is vague, and as conventional as so many heraldic devices of implements and machinery are. Certainly far better are the classical and mythological portraiture of war chariots and horse accoutrements; these appendages in some cases are absent, and cloud-whirling ether takes their place. By the sketch it will be seen that a veritable solid framework is shown in this old glass staining, that has been in the present window more than 180 years; but how long before it was done, or who was the clever artist, is a mystery not likely to be solved now. A bullet-hole through the pane of glass above it shows the narrow escape it had from destruction by the stray shot of a deer-shooter in Stoke Park a few years back.

The Velocipede for Road, Rail, and River.—The hobby-horse died a natural death; the work more than the pleasure predominated, and not till the advent of railways did cycling make another start in a velocipede—a safe vehicle on four light wheels mostly, but sometimes on three wheels, the feet working a cranked axle in the hind wheels connected by treadles to swinging rods from the head of the perch. A comfortable high-backed seat was often used, by which considerable lumbar strength was imparted to the foot thrusts.

On railways, hand or foot levers were used, by which the navvies, on a little trolley that held several men, easily worked themselves and tools along the metals. A boat with paddle-wheels worked as a velocipede was to be met with on smooth water. Even horses were experimentally used to carry themselves and their loads, and work a cyclopede by a tread-mill action of an endless flooring, on which they walked and turned gear-wheels actuating road wheels.

The Cycle that came to Stay.—A stanza from a poem on work, will tell that improvements, or the advent of new inventions, were often due to the discovery of materials and their application to simple construction of mechanism.

"And science, too, is circumscribed by chance
Of what materials come to hand, and how.
Without coal, iron, loadstone: what advance
Would man have made? To what do nations bow!"

The light wood cycle on two wheels was a French invention, and worked by an acrobat as a feat for a brief time, till others found how easy it was to do the same thing. This was about thirty years ago. It struck and grew rapidly in England, and as soon as wire wheels were applied, and with rubber tires, it bounded into favour. Tubular ironwork, by which parts were lightened, further promoted its use for long-distance journies; and the almost endless methods of gearing to gain speed and ease the foot motions, or add arm and back power, have each been adapted to the varying powers of the riders.

The pneumatic tires used on invalid carriages nearly fifty years ago, have asserted their value for the healthy athletes whose last long-distance records are 1,000 miles of road travelling in 5 days 11 hrs. 35 min., and 341½ miles road travelling in 24 hours.

For spurts on tracks, a quarter of a mile in 31⅕ sec.; half a mile, 1 min. 9¾ sec. on bicycles; and a mile in 2 min. 28⅗ sec. on a tricycle. Such records attest the perfection of mechanism and the stamina of modern Englishmen, and this whirlwind speed seems likely soon to be eclipsed by the lightning's flash to aid the pace and lessen fatigue.

The Commercial Aspects of Cycles.—Cycles would not be made up as stock unless sales were sure. The certainty of disposal warrants large outlay of capital in their manufacture, and, unlike many other things, they seem unaffected by fashion or season to any great extent where they have merit. They are weather-proof, and to use them is deemed sensible and worthy, so that as the youth becomes strong enough he must adventure on a steel steed. The very pace that is necessary to advance takes to new scenes so rapidly, that an impelling attraction to go further and enjoy more of life-motion and mind-views, ever changing, has an almost irresistible charm that seems to make the rider forget the flight of time and the wear of the machine. That they wear out is a proof that they have done good work, and the best made machines get that hard work.

There is no getting a correct census of the cycle trade, as they are made everywhere, from the large Coventry works to the amateur's back

kitchen. The accessory trades have a large added share by repairs and alterations, renewals, and experiments.

The foreign trade cannot be gathered from our costly and viciously faulty Board of Trade returns. It might, perhaps, be dug out of the item, "Hardware," which is put down in these returns by the "ton." The reports of the exports by leading manufacturers would be a reliable statement, and worth annotating annually.

The Moral Aspect of Cycling.—The old song says truly that "He who leads a good life, is sure to live well."

You may make a pun but you cannot pick a pocket while cycling, and you may ride till tired and wobbly, but sobriety is indispensable to cycling. In fact, the machine drills the mind to method, forethought, and order. For a framework of steel and rubber to drill mentally, morally, and physically 50,000 men in a way no general could do, nor any preacher profess to accomplish, is what may be termed in ethics an antinome. That it is done is indisputable; we bow to the fact, and subscribe to the contradiction that mere matter has a temporary, supreme, beneficial sway over mind, and makes a cyclist honest, sober, and virtuous. Another stanza from the same source as the previous one will, perhaps, say all that can be concisely said of this potency:—

"Antinomies that rule in nature show
Or hide profound unfathomable laws
In morals, which from naught, to Heaven grow,
While humble wisdom whispers—
"Perhaps?" for cause.
—*The Epic of a Day.*

Back again to the Factory.—It has been deprecatingly said that the modern, improved, up-to-date cycle is the collaboration of a mangle-maker with a bit of old mangle-chain, and an iron bedstead-maker with parts of an old bedstead. Certainly, when broken down, it seems as if made up under these auspices. No doubt the make-up of many cycles is not consonant with economical muscular action of the human frame, or its graceful pose or ease, or for durability of the cycle. If so, the rider is to blame in tolerating that which is harmful, grotesque, and wasteful of means.

As a Trade and Luggage-carrier.—The use of the cycle by tradesmen in cities and towns fairly level, is an important aid to business, and an economy over the horse and cart, with its cost of forage, repairs, stable-rent, and attention. A better form of foot-thrust would be a relief to the hard-working men and boys who carry out orders on the cycle. This is attained partially in some, as the "Monarch." The postmen find it such a boon that they do more work far easier than by walking, so that anything to save wear, and lighten draft, would be a welcome matter for them, whose journeys sometimes reach to 6,000 miles in a year.

For military use its success will lead to machine gunnery from cycles, for which it is so well adapted. The perch may be the barrel of a repeating rifle, the fork-head a rocket-tube. Now a hint in parenthesis. (Please do not rush off to the Patent Office to secure the invention. If you have the craze for patenting, I can make you a present of a score of inventions, so that you can get rid of a lot of money all at once, and save time over the job.)

Of the one-wheeled cycle the riding is immensely clever, but it is out of the range of practical utility except you invert the proceeding, and instead of making your wheel carry you, you make it carry your luggage to the station, and then either boldly or bashfully put your wheel in a hat-box, and slide your bamboo rods together as a fishing-rod, and find you have saved the expense of a luggage porter. There is another embryo patent, but I must stop. I find I have a grumble to let out, so I will wind up with it like a true Briton.

The Cycle of the Future, and a Grumble.—They are too dear for a working man, who has to wait till he can afford to buy a second-hand one, often patched, etc., and with a lot of out-of-date parts. If one firm can make 26 in. wheel cycles for £6, and tricycles for £6 15s., and give money's worth in late improvements, why cannot other larger firms? Another firm offers cycles for £7 10s. These prices approach a workman's means, and the workwoman's also, so that a moderate price would augment the trade with those who would wear them out in usefully going to and returning from work. A cavalcade of men and women cyclists on their journies to and from their healthy suburban homes would be a gratifying sight, and spare many a Londoner the repulsive sights of soddened misery lounging round public-house doors, or wallowing in slum filth.

It would not be in human nature for a cyclist who has ridden up roads rising 1 ft. in 6, and down them, to write about cycles, and think perfection is obtained with—(1) a chain with its drag and back-lash; (2) a pedalling with a getting-upstairs motion, though going on the level; (3) a seat that is a sorry crutch, without aid to the weary back, or from the strong back to aid the weary legs; (4) with arms that are needlessly idle, when they might save the legs, and by their reciprocal and natural action promote health; (5) and with wheels that have a quick-wearing, rolly-pudding on the rims to be devoured by the road, when proper rims would guard this fragile puff-pad, save draft, health, and pocket; (6) or when spinning on a smooth road to have to keep moving the legs instead of resting them on the pedals; (7) or have to impel along a safety bicycle weighing 40 lb. when they can be made to weigh only 22 lb., or a tricycle weighing 60 lb. when they can be made to weigh only 30 lb. Thirty-six pounds was the weight of a tricycle used by the writer thirty years ago, when roads were not so good as now.

I have formulated these seven grumbles. These are seven weak points of the cycle, which must be made the strong points. They may not emanate from the factory with its large stock of parts to be used up, but more likely from the isolated worker who plods at the forge thoughtfully long after his neighbours have gone to dreamy repose. He is the man who will improve the cycle, as it much needs improving, be it two or three-wheeled. Then the trade will improve, and the workers will have less hesitancy of taking a cottage a little way out from the turmoil of the town, and his or her health and joys of life will be increased and maintained, and practically demonstrate the Cycle's worth to the Nation.

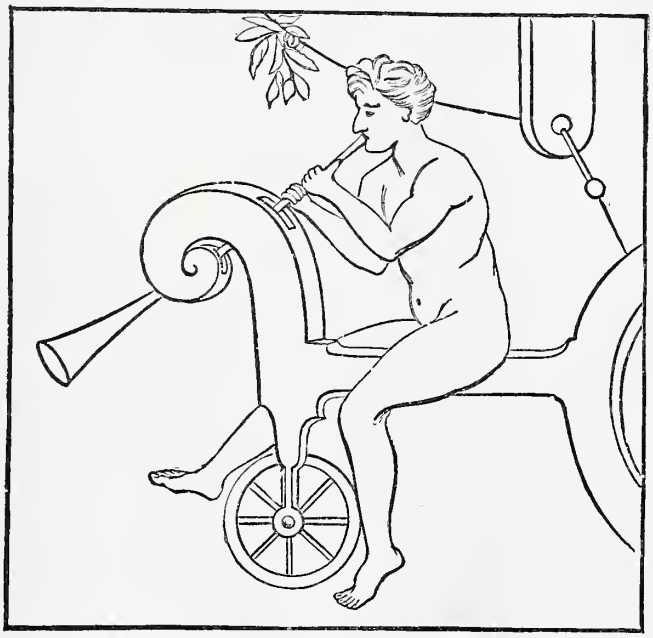


Diagram copied from Stained Window in Stoke-Pogis Church, Bucks.

NOTES FOR WORKERS.

The first telegraph line in the United States was from Washington to Baltimore, a distance of forty miles, and was opened on May 17th, 1840, by Professor Morse. In 1890 there were 800,000 miles of wire, over 24,000 offices in use, and nearly 67,000,000 telegrams were sent.

In Norway and Sweden habitual drunkards are imprisoned, and during incarceration they are fed on bread and wine, no water being allowed them. The bread is steeped in wine for an hour before being given to the prisoner, who, although liking it at first, after eight or ten days is so nauseated by it that he refuses it.

If the finger-nails be kept well trimmed and polished, there is not the same danger of poisonous matter adhering to them as when untrimmed and dirty.

All the commissions that have visited Peru during the last two years agree that the country is suitable for European immigration on a large scale. Peru wants both skilled labour and agricultural labourers.

The sewing-machine is the only machinery used in Sierra Leone. The colony is 103 years old, and has a population of 50,000, without a saw mill or any other sort of mill to do any kind of woodwork.

BOOKS.

Handicraft.—"The Manual of the Guild and School of Handicraft." C. R. Ashbee, M.A. (Cassell & Company, Limited.)—At the present time, when the subject of technical education is demanding the attention of all thoughtful minds, the issue of such a manual as this is particularly welcome. Its purpose is to serve as a guide to those who, in connection with the various County Councils, schools, and institutions, are seeking to establish on a firmer footing what has hitherto been neglected—the intermediate and technical education of the country. It is also to serve as a guide to the instructor and elementary teacher in technical work. Mr. Ashbee has done such good work for technical education in connection with the Guild and School of Handicraft at Mile End, E., that we can recognise the value of what he says or writes upon the subject he has at heart. The future of British trades and crafts is a matter of great moment. Much information relating to the technical education movement is contained in this manual, and everyone concerned ought to read it.

Pigeons.—"Pigeons: their Origin, Variation, etc." Rev. W. F. Lumley, A.K.C. ("Feather World" Office.) This may be briefly characterised as a handy little book for pigeon fanciers, which will put them in possession of pretty well all they want to know and ought to know about their particular pets. It is one of the "Feathered World Guide Books," known collectively as the "Simplex Series," and its full title runs thus—"Pigeons: their Origin and Variation, their Housing and Management, accompanied by Practical Illustrations." It is divided into two parts, whereof Part I. deals with the pigeon house in different forms and appliances suitable for it; the parasites that are found in the nests; and all about the choice, purchase, mating, pairing, nesting, hatching, and feeding of pigeons, with remarks on judging and classification. Part II. contains twenty-two chapters devoted to the consideration and description of different fancy pigeons and their varieties. These fancy birds are illustrated sufficiently well to exhibit their various characteristics as noted in the descriptions. The engravings of the pigeon houses, etc., are useful, but they are not marked by any novelty of form or artistic conception, such as an amateur would look for who was willing and able to house his birds in structures that were somewhat out of the current run.

TRADE: PRESENT AND FUTURE.

*** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

TIMBER TRADE.—A good demand for mining timber and pit props continues.

CHEMICAL TRADE.—Trade is very firm, higher prices prevailing. Bleaching powder is very scarce. More inquiries for caustic soda. In sulphur the changes are slight. South Durham salt is quiet.

COAL TRADE.—The Newcastle coal trade for best steam is firm; for gas coals the demand is beginning to increase; bunker coals are dull; manufacturing coals quiet. Coke is steady, with an increasing demand for northern furnaces.

IRON TRADE.—At Middlesbro' the finished iron manufacturers report a dearth of fresh orders, and the condition of the shipping and shipbuilding industries does not speak favourably for the future. Business in the Lancashire iron trade continues slow, but prices continue firm. In the manufactured iron trade no improvement is reported, the prices taken only just covering cost of production. In the Staffordshire pig-iron trade, large sales have been effected recently, and iron founders have been placing orders up to Christmas, many of the leading makers having now their full make contracted for up to that date.

TINPLATE TRADE.—The condition of trade in the Swansea district is becoming very serious. About 12,000 workmen in South Wales are already out of employ, many large works being closed. The proprietors of the Worcester and Upper Forest tinplate and steel works at Morriston have intimated their intention to close the works. 2,000 hands will be affected.

STEEL TRADE.—Small business is being done in the Lancashire steel trade. Steel boiler plates have been bought at £7 5s. per ton; steel angles have fallen considerably; and in small girders, both English and foreign makers have lately been quoting 15s. per ton under recent prices in order to secure business.

COTTON TRADE.—The Oldham spinners have decided to give notice of a 5 per cent. reduction of wages if 80 per cent. of the employers are found to be in favour of the proposal. Bad reports as to the condition of the industry continue to be received, especially from North Lancashire. At Preston a proposal is on foot to work three days a week and reduce wages 10 per cent. until trade improves.

ENGINEERING TRADE.—Many of the leading firms of machine tool makers continue fairly busy, as also do the makers of large stationary engines. Machinists are experiencing the effects of the depression in the cotton trade, and have little work on hand, with a bad outlook. Locomotive builders are keenly competing for the few orders that are coming forward. Boiler makers are busy, and have good prospects, but the prices rule low. A Tyne engineering firm are required to build twin triple-expansion engines for a large Russian battle-ship, also boilers for the same. They have also on hand three sets of triple-expansion engines for torpedo gunboats, as well as their boilers, for the British Government. Trade on the river generally may be considered as only fair.

SHIPBUILDING TRADE.—No change has taken place in the condition of the Mersey shipbuilding trade, but at Barrow, although new orders are not easily obtained, there is a fair amount of work on hand. A difficulty with the workmen is expected, however, as a 5 per cent. reduction of wages is demanded by the masters, and a strike appears inevitable. Messrs. Railton, Dixon & Co., shipbuilders, of Stockton-on-Tees, will close their No. 2 shipyard through scarcity of orders. We understand that if a million of money is expended, as is proposed, in Bristol for dock improvements for the mail and passenger trade between that port and America, Liverpool companies have intimated, or promised, to give a share of patronage. The principal advantages offered by the Bristol authorities are: (1) That there will be a saving in cost of coal to the extent of from 4s. to 6s. per ton; (2) a saving of from four to five hours as between New York and London, also a slight saving as to Liverpool; (3) that Bristol is more centrally situated as regards the distribution of traffic.

PAINT TRADE.—Colours are quoted as follows: Ochres: Oxfordshire, common, £10, medium, £12, best, £15; Derbyshire, 40s. to 60s.; Welsh, common, 18s., best, 70s. Umber: Turkish, quiet; Devonshire, 50s. to 55s. Venetian red, £6 10s. to £10. Cobalt, prepared oxide, 10s. 6d.; black, 9s. 9d.; blue, 6s. 6d. Zaffres: No. 1, 3s. 6d.; No. 2, 2s. 6d. Oxide of iron: common, £6; medium, £10; finest, £20.

SILVER TRADE.—This is gradually improving in Sheffield. Britannia metal departments are quiet.

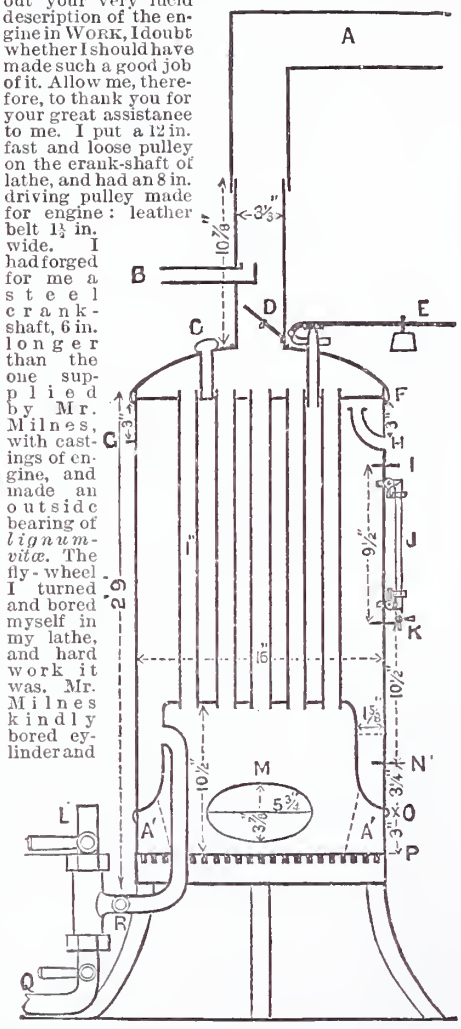
WOOLLEN TRADE.—An old firm in Bradford have resolved to close their Yorkshire factories, where they employed 1,200 hands and turned over £200,000 per annum, and transfer their business to Jamestown, U.S.A., where their factories are now being built. Arrangements are being made for the workpeople to accompany the firm to the States.

SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

I.—LETTER FROM A CORRESPONDENT.

Quarter Horse-Power Steam Engine.—"S." writes:—"You may be interested in hearing that, having finished the ¼ h.-p. engine as described by you in WORK, I made a trial run recently, which was, I think, most successful. The engine took a deep cut off a bar of 2 in. iron, working at only 25 lb. pressure. My lathe is one of Milnes', of Bradford, 5 in. screw-cutting. I think I may be fairly proud of my work, seeing this is only my second attempt at engine-making; my first was a small brass one, a very different thing from this, but without your very lucid description of the engine in WORK, I doubt whether I should have made such a good job of it. Allow me, therefore, to thank you for your great assistance to me. I put a 12 in. fast and loose pulley on the crank-shaft of lathe, and had an 8 in. driving pulley made for engine: leather belt 1½ in. wide. I had forged for me a steel crank-shaft, 6 in. longer than the one supplied by Mr. Milnes, with castings of engine, and made an outside bearing of *lignum-vitæ*. The fly-wheel I turned and bored myself in my lathe, and hard work it was. Mr. Milnes kindly bored cylinder and planed bed; the rest of the engine is all my work. I had some difficulty with arms of governor, as there was no casting nor forging for same. I made them by screwing on small levers at an angle of 120°, but I am not very pleased with the appearance—it doesn't look quite workmanlike. I think I shall either make a pattern and have them cast in gun-metal, or get someone to forge them for me. If I might make a suggestion, it would be better not to have the top cover of cylinder with hole for piston-rod cored out: I found in turning up cover that the hole wouldn't true up to ⅜ in., so had to make my piston-rod a shade larger; and same with the gland. I had to get another gland cast for me solid, as the hole cored out wouldn't true up to size. Also steam-chest—the casting was in the rough a shade over 1½ in. across, so I had to just take off a very little from both slide-valve and steam-chest to get them square; you might also, in slide-valve, allow a little more for squaring up hole inside, for, even leaving part of rough casting, I made it a full 1½ in. I must say that the castings were wonderfully good and very cheap. I should be obliged if you would give me some advice *re* boiler. I have had made a copper boiler ⅛ in. thick all over and riveted, twenty-one 1 in. tubes for flues, water space diameter 16 in., height 30 in., very good draught. This burns a lot of charcoal; would coke or coal do instead? I am told that the sulphur is very bad for copper boilers; is that so? If it is, as the boiler is an expensive affair, I don't want to spoil it in saving cost of fuel. As to feed water, I softened the water with lime and caustic soda, but don't know the right proportions. Could you tell me the proper quantities to put for the East London water? I think at present there is an excess of caustic soda; that would not hurt the boiler, I suppose? Even at the best some scale is sure to form, and yet there is no means of getting at the inside. How would it do to nearly empty the boiler occasionally, and throw in some diluted hydrochloric acid to dissolve the scale and then wash out? I believe hydrochloric acid has very little action on copper."—In reply to a request for a sketch of the boiler, "S." sends the one accompanying this, and writes again as follows:—"I have one of Fletcher's burners for lighting fire, to put underneath, and then remove when fire is well alight. Gas supply, ⅜ in. iron. From top of funnel I put stove-pipes to ventilator into chimney, and closed fireplace, and packed around stove-pipe with asbestos where it enters chimney, so get a very fair draught. Passed exhaust into funnel. Instead of turning up end of tube, I plugged it and filed hole in top of pipe. For water supply I have injector, and the water passes through furnace before entering boiler. I intend to make pump as well. Injector did not act first time, but was all right when I ran engine again. There was probably some white-lead in the injector the first time. There are no hand-holes, only holes for fittings. One might examine interior with a taper through them, but that is all. The boiler was tested to 195 lb. per square inch by hydraulic pressure. I used wood as fuel; it made steam very quickly, but of course coke or coal would be more convenient. Governor I made with lever to regulate with weights. I don't see why one could not get ¾ h.-p. out of this engine, or even more, if you ran it fast enough; it is merely a matter of enough steam and pressure. I should have had a larger boiler, but workshop being at the top of house the weight of an iron one would not have done. Later on I shall make a dynamo, and thought of making one described by Croft—120 candle-power. Do you think my boiler would supply enough steam to do that? If not, I might make a 50 candle dynamo instead, merely to light up workshop. I put on blow-off cocks for cylinder, and think of putting oil-cup for cylinder on top of steam-chest, as there is room." I do not consider myself an authority on small boilers, and I have therefore submitted the above letters to two practical men. The first points out the unusual position of the fire-bars—3 in. below the water—which he thinks "would cause a loss of heat." This is evidently done to simplify the fire-hole, and it will give a large fire-grate, useful for burning wood. In my opinion the objection to this plan is that the sediment may fall into and accumulate in this lower part just over or in the fire, instead of, as usual, below it, and thus the plate may become overheated. I think there should be at least one hand-hole to admit of inspection of this part, and the blow-off cock should be opened before starting work, so as to drive out any sediment that may have settled. If coal is burnt it might be well to line the lower part of the fire-box with fire-clay, where the dotted lines A', A', are seen, which I have added to the sketch, and this would both prevent the loss of some heat, concentrate the heat of the fire, and protect the lowest part of the boiler. The method of introducing the feed-water seems to me objectionable, interfering unnecessarily with the removal of the fire-bars. It is usual to introduce the feed-water at about the water-line, because then if any of the valves—retention or pump-valves—leak, so that the boiler loses water, it cannot run down very far. My friend writes further:—Copper is by far the best material for small boilers, but workmanship becomes the most important factor for strength. Hydraulic testing is the safer, but this should not be pushed too far; for a boiler intended to work at 60 lb., 100 lb., or 110 lb. is ample. Boilers may be weakened and almost ruptured by excess in testing. Your friend's exhaust would be better had he formed it as a taper and round elbow, which he could easily have inserted. The expanding steam should form a central jet, which acts as a piston to expel the air, and the more accurately this is in the centre the better. Fuel in a small boiler is a difficulty. I fear anthracite coal will be found unmanageable unless broken into small pieces, freed from dust, and a small portion of charcoal used with it; this would give a stronger and cheaper fire than all charcoal. All caking coal must be avoided; the lighter varieties that burn to a white ash might do. If your friend must use hard water, I should recommend the original Clark's process, without the soda, as a caustic alkali in a small boiler is sure to be carried by the steam as priming into slide and



Quarter Horse-Power Steam Engine—A, to Chimney; B, Steam Exhaust; C, Man-hole; D, Damper; E, Safety-valve; F, Rivets; G, Pressure Gauge and Injector; H, Steam Supply; I, Tap Steam; J, Water Gauge; K, Tap Water; L, for Pump when made; M, Fire-door; N, Tap Water; O, Rivets; P, Top of Fire-bars; Q, Water Supply from Injector; R, Back Pressure Valve.

cylinder, converting the oil or tallow into a soluble soap. Make some lime-water from good quicklime, and stir in about two fluid ounces to a gallon of water, leaving it ten hours to settle, and use the upper clear portion. But why not use rain-water? A 100 gallon galvanised cistern would store all that so small a boiler would require, and an occasional dose of a little hard water to form a slight deposit would add to the durability of the boiler. I now come to the reply given by my second adviser. He says:—"Sulphur in fuel is injurious to boilers, but would not tell much on a small boiler, which is probably not used very much. Coke is the worst; house coal is better, but is likely to cause too much soot (especially in the case of 1 in. tubes); anthracite coal is the best fuel to use provided there is enough draught. This boiler would not burst at 250 lb. if the seams and rivets are sound; it might bulge if this pressure is exceeded; I consider 50 lb. to 60 lb. working pressure quite safe. A very little soda now and then, or any of the compositions sold for that purpose, will keep the boiler free from incrustation. Also to vary the level of the water daily, when not in use, is of importance. The boiler is capable of working a good dynamo of 120 candle-power, but the attention and stoking may be troubleseme to raise enough steam in so small a boiler. I can find no fault with the construction and fitting up in general but the steam supply to engine, if carried upward through top of boiler instead of downwards." I think "S." will find here most of the information he seeks, and that what he and we have written will be useful to others who have undertaken to make the ½ h.-p. engine. I am very glad "S." has succeeded so well, and that he found the description clear and the castings good. With regard to what he says about some of the holes coming out too large, that would arise if they were not exactly in the centre of the castings; and if the easting was held in a universal chuck, so that the outside ran true, it might have been remedied by putting a bit of tin under one of the jaws of the universal, so as to bring the hole more nearly true, and throw out the rim a little. On the whole, perhaps, it would be better to cut off the prints from these little things, and cast them solid. The plan of having a longer crank-shaft which "S." has adopted is a very good one. Very likely the *lignum-vitæ* bearing will last well, but it would look better to have another bearing, similar to the other two, and there should be made a strong wooden frame, properly bolted together, to keep the third bearing firmly fixed at the correct distance, and in exact alignment with the other two. It was intended that the arms of the governor should be made of forgings, but Mr. Milnes now has a pattern, and sends out the arms cast in gun-metal. The general appearance of the boiler gives me the impression that the fire-box is too low, and that the fire-door should be higher up, so as to admit of a greater depth of fire, and more room for combustion before the gases enter the tubes; still, no doubt the boiler is a good one, and will serve you well. With regard to the strength I reckon it thus:—The plate of the shell being ⅛ in. thick, a 4 in. length of the shell being cut through diametrically will expose a section on each side of ⅛ in × 4 in. = ½ in., or on both sides taken together of 1 sq. in. Now, one square inch of sheet copper has a tenacity of 33,000 lb., and if riveted with a single row of rivets its strength will be reduced to a little over half this—say, 17,000 lb., or, to be on the safe side, 16,000 lb. Now, since the diameter of the shell is 16 in., and the length of the piece of shell we are considering 4 in., and 16 × 4 = 64, the pressure of steam tending to burst the ring or section of shell having a sectional area of 1 sq. in. acts on an area of 64 sq. in., and $\frac{16000}{64}=250$, the lowest bursting pressure. The furnace is smaller in diameter, and it is also so short that it derives strength from each end; if it were longer, or rather taller, it would require to be rather thicker, since the tensile strength of copper is more than double its crushing strength. In conclusion, I beg to congratulate "S." on his success, and to say that if he will write again by-and-bye and tell us how he gets on, it will probably interest and encourage others who are following him.—F. A. M.

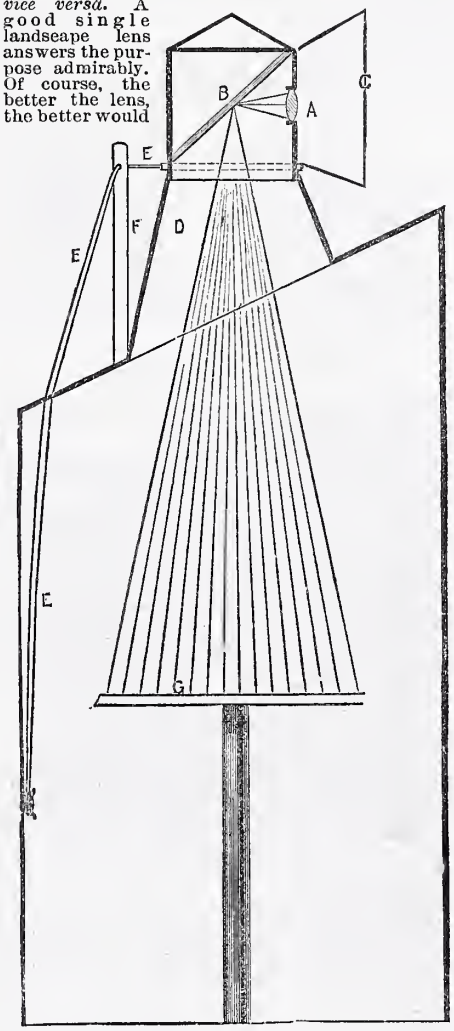
II.—Questions Answered by Editor and Staff.

Patent.—Poor Man.—If our correspondent will refer to our article on Patents (No. 44, Vol. I., p. 694), and also to our article in No. 175, Vol. IV., p. 296, and read and *carefully* study them, he will no doubt be able to see how far it would be to his interest and advantage to follow the course proposed. If he will take our advice, he will carefully avoid anything of the kind mentioned, as he would infallibly meet with great trouble and disappointment, and most probably end by losing it altogether. Such affairs are carried on on the principle of "heads, I win—tails, you lose," and you are not placed on an equal footing in the matter. It would not pay to do that; the risk to them would be too great.—C. E.

Oil Colours.—A Reader.—The question you ask could be as easily answered at any large stationer's shop, where oil colours can usually be bought in collapsible tubes. With respect to their being sold "in boxes like water colours," Rowney & Co. sell admirable little sets for painting in oil. These are contained in japanned tin boxes, and are furnished with colours, brushes, and palettes. Brodie & Middleton are a good firm for such requisites. If you buy locally, see that you get the goods of a reliable firm, such as Rowney, Reeves, Barnard, or Winsor & Newton.—Decorator.

Dry Battery.—J. H. (*No Address*).—You may utilise your 6 in. × 3¾ in. stoneware jars as outer cells for a dry battery. Place zinc cylinders in these, put an ordinary carbon block in the centre, and pack the space between carbon and zinc with a mixture of equal parts of zinc white and plaster-of-Paris, made moist with a little killed spirits. Cover the filled cell with a seal of pitch.—G. E. B.

Camera Obscura.—Camera.—In arranging a camera obscura, the first condition is that it shall be elevated above the surroundings, so that the lens may have an unobstructed view. The next is to construct a small box in which the lens can be fixed, and which can be revolved by means of a cord from the inside. The light, passing through the lens, is reflected from a mirror placed at an angle of 45 deg. to the lens (inside the revolving box), on to a table placed beneath. A lens of about 20 in. focus is suitable; the longer the focus of the lens, the larger the reflected image will appear, and *vice versâ*. A good single landscape lens answers the purpose admirably. Of course, the better the lens, the better would be the definition of the image. It is important that the surface of the table on which the image is thrown is a perfectly dead white. This is attained by coating the table with plaster-of-Paris, and then scraping and sand-papering it perfectly level; another advantage of this surface is that if it gets soiled, a rub with sand-paper will set it right again. The height of the table must be suited to the image thrown by the lens, and ascertained by experiment. When the image is sharply defined, the height is correct. The accompanying diagram will show how the camera is generally managed. The lens is better protected by a hood, which improves the brightness of the image and also protects the lens from the raindrops that, falling on the glass, would cause indistinctness of the picture. A cover is generally made to protect the lens when not in use. In the diagram sent it would be as well to make a turret for the lens, so that it would overlook the highest part of the roof.—D.



Camera Obscura. A, Lens; B, Mirror; C, Hood; D, Turret; E, E, E, Cords; F, Upright Guide for Cords; G, Table.

Makers of Electrical Apparatus.—W. R. M. (*Sowerby Bridge*).—Either of the following make and sell model dynamos and other electrical apparatus: Mr. G. Bowron, Praed Street, London, W.; Mr. S. Bottone, Wallington, Surrey; Mr. T. Bonney, Avenue Road, Lewisham, S.E.; Mr. A. Crofts, Dover, Kent; or consult the advertisement columns of Work.—G. E. B.

Glass.—C. S. (*Derby*).—It would be impossible for the writers of the various articles that appear in Work to give all the names of the firms where everything could be purchased that is required to make the piece of work described, because they would naturally be more conversant with those firms located in or about the part they lived, and whose addresses would most likely be farthest away from the person requiring the goods. For instance, let us suppose I am writing an article for this paper in Manchester. I should give the names, etc., of those firms I knew of in Manchester, who could supply the necessary goods required. Now, you reside in London, and wish to make the article; what good would the names of the firms I should have given be to you? And I need hardly say that it would be most impracticable to give the names of firms in every town in the United Kingdom that supply the things in question, even if it were possible. That is partly the object of "Shop"—viz., to answer individual questions relating to the articles appearing in the other part of the paper. I think I might venture to say that if you looked through a Derby directory you would be almost sure to see the name of some firm who would supply you with bevelled glass. If you cannot see one, you could obtain it from Stevens, Charles Street, Hatton Garden, London, E.C.—E. D.

Knotting.—Accrington.—"Knotting," or as it is usually written, *Patent Knotting*, is a quick-drying, semi-transparent fluid. It is made from naphtha and shellac, hence its quick-drying nature. The knots of woodwork, especially pine, contain much resin, which gradually exudes from the surface. This resin will speedily darken and ultimately destroy the covering film of oil paint with which woodwork is usually coated. The object of coating knots in woodwork with "patent knotting composition" is to seal up, so to term it, the resin. In the earlier history of house-painting processes a mixture of red lead and strong glue size, applied warm, was often used. The chief point in view is to stop the "cause," but without objectionable "effect," therefore the thinnest perceptible covering—so long as it is effectual—is the best. The *Patent Knotting* of commerce is the article now generally purchased and used. The knots are given one or two *bare* coatings—according to the nature of the knot and the conscience of the workman. The best knotting is the colour of dark oak varnish, the worst is the blackest and dirtiest-looking. It always pays to have the best knotting, since "black knotting" requires an extra coat of paint to cover the dark patches which "grin through" any light tints. For the best work it is usually advisable—especially when the woodwork has to be finished and perhaps hand-polished in "ivory white" enamel—to have the knots cut out with a chisel or gouge, then fill up with lead "filling-up" in distemper. I recently had to have the door of an elaborately decorated drawing-room so treated, since, despite being fresh knotted, the resin began to discolour the work, which had received some six coats of paint and enamel, ere the room was furnished—a very annoying and costly matter. Very occasionally knots are gilded over with best gold leaf; this is generally conceded to be an effectual plan to adopt, when gouging is not resorted to, for finest work. Knotting woodwork is, therefore, not an insignificant detail of house painting, especially when we are dealing with a door side; that alone, when finished in hand-polished enamel, may cost a ten-pound note to produce. "Tin paint" will do for common priming; good linseed oil is the chief element required. All new woodwork requires three coats good lead and oil paint before standing any time—viz., priming, and two after coats. This is known as "builders' finish." When permanently decorated it usually requires "getting up" to a proper surface, and two or three more coats.—Decorator.

Electric Light Cable.—T. A. (*Hammersmith*).—The size of cable for the main of an electric light installation to supply 100 8 c.-p. lamps at a pressure of 110 volts, should be 19-strand No. 18 copper wire rope, well insulated. This will safely carry a current of 35 ampères. A 7-strand No. 16 copper wire cable will only carry 23 ampères, and this will not be enough for your installation. From your letter, I suppose you are having a transformed current. If that is so, the fault may be in the transformer, or it may be in the meter, or it may be that the main switch offers too much resistance. Have you means at hand for testing the temperature of any of the connections at the meter, or at the main switch when the full load is on? If any of these get hot, the fault is in the hot connection, and this must be made larger. If the cable is large enough and the connections all right, have the transformer seen to, for the fault is likely to be there.—G. E. B.

Model Dynamo.—T. W. (*Harpurhey*) and E. W. (*Strand*).—If you wish to make a model dynamo capable of doing useful work, get Nos. 92, 94, and 99, Vol. II., of Work, and select one of the machines described and illustrated in those numbers. If you only desire a pretty little model for show purposes alone, get No. 108, and make the model electro-motor described and illustrated therein. This motor is a model of a dynamo, and will serve to show what a dynamo is like.—G. E. B.

Dry Battery.—Richmond.—I am doubtful whether any person outside the manufactory and the inventor's own sanctum can tell you the "exact composition of the excitant and of the depolariser in Dr. Gassner's dry battery." What end can be attained by knowing the exact details of a patented

invention? I believe the paste to be a compound of zinc oxide, lime sulphate, zinc chloride, and ammonium chloride, but do not know the exact proportions.—G. E. B.

Book on Prices.—A. E. H. (*Lowick*).—I do not think any book has been published dealing with house painting and decorating prices alone. As a branch of the building trades, you will find certain average values of labour and material in any of the established builders' price books. The price of labour and craftsmanship differs very materially in various home districts, hence the impossibility of publishing a scale of charges for the trade generally. In house painting especially, the amount of time required to prepare old work for repainting may differ with a dozen rooms, otherwise exactly similar. Woodwork in a sunny room gets badly blistered; a north room may be in good condition, and cost but half the former to make a good job of. Again, the style and finish is a very important factor. The best and safest standard for pricing the ordinary work of a provincial town or village is practical experience, a personal knowledge of how long a piece of work will take in execution, and how much material will be used. Respecting "general information," subscribe to and read diligently the special literature of the art and craft, and much that has appeared in the back numbers of WORK.—DECORATOR.

Circular Saw.—SUBSCRIBER.—Your belt will continue to slip while you drive your saw with a 12 in. pulley, the diameter not being great enough to drive a 48 in. circular saw. If your saw is principally for cutting soft wood, the pulley should not be less than 16 in. diameter; 18 in. would be still better. Also, if its chief work is to cut hard wood, the pulley should be 20 in. or 22 in. diameter. Several reasons may be given why a belt slips when driving a circular saw. The teeth may be improperly sharpened for the kind of work they have to do; a belt may be too narrow or too short. I might say here that a belt to drive your saw should not be less than 7 in. or 8 in. wide when running over pulleys of the diameter above given, and the distance between centres about 20 ft. The speed and feed, too, are matters of importance. To deal fully with these points would take up too much space in "Shop." You should get a larger pulley on your saw-spindle, and a belt the width mentioned above; then if you have further trouble, write again, stating the speed at which your saw is driven, and the rate the timber is fed to the saw. In reference to allowing for stretch when putting on a new leather belt, the belt should be passed around the pulleys and pulled tight, and the length measured from the end to where it butts. Then allow 1 in. for every 5 ft. of its length. For instance, if a belt measures 60 ft. in length, 12 in. should be allowed for stretch. Again, when the belt has been working a while, and becomes slack so that it slips, take it up 1 in. to every 10 ft., and, when it requires taking up again, 1 in. to 20 ft. If the leather is of inferior quality, it will require to be taken up more than stated above, and the belt will give a deal of trouble. There are so-called cheap belts sold which are dear in the long run. Now, if you wish to test the quality of a new belt, the following has been recommended. Cut a piece of the leather off and put it into strong vinegar. If the leather has been thoroughly tanned, and is of good quality, it will remain for months in the vinegar without alteration, merely becoming a little darker in colour. But if not well impregnated by the tannin, the fibres will swell, and after a short period become transformed into pulp.—A. R.

Workshop Alarum.—J. H. B. (*Liskeard*).—As you are a clockmaker, and know "Gent's Watchman's Clock," you can easily adapt any clock to your purpose, taking that clock as your model. Arrange a train of wheels to revolve a small horizontal table once in twenty-four hours. Attach a circular piece of clean paper, or a disc of cardboard, to the centre of the table, and divide the paper into sections, each representing an hour. These may be subdivided into parts of hours. A metal arm, carrying at one end a pencil-holder, and at the other a soft iron armature, must be pivoted in such a position as to allow a pencil to touch the revolving disc of paper when the armature is attracted to an electro-magnet fixed above the armature. The electro-magnet and armature should be similar to those employed in small electric bells. The sections of the revolving disc must be numbered to correspond with the figures on the clock dial, and the two sets must synchronise at all times. A Leclanché battery of three medium cells may be used, and an ordinary door trigger placed inside the door to close the circuit when the door is opened. This should be made to work stiffly. When the door is opened, the circuit will be closed by the trigger, the electro-magnet will pull up the armature, and cause the point of the pencil to touch the disc, leaving its mark there at the exact hour, and, at the same time, ring a bell.—G. E. B.

III.—QUESTIONS SUBMITTED TO READERS.

**** The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Yacht Hull.—F. A. D. (*London, S.W.*) writes:—"Will any reader of WORK kindly give me full particulars for making the boarded hull of a 5 ft. model yacht?"

Enamel.—COLNEITE writes:—"Would some reader of WORK give a recipe for a good enamel, white or red—one not too complicated?"

Fuller's Bichromate Battery.—H. C. G. (*Islington*) writes:—"Would some reader of WORK inform me what are the quantities of chemicals used in Fuller's bichromate battery—quart size, method of making up, and size of porous cell?"

Monograms.—J. H. B. (*Glasgow*) writes:—"Will any kind reader be good enough to give me designs for monograms of 'J. H. B.' and 'M. B. B.'?"

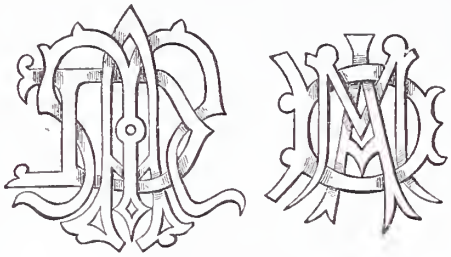
Albumen.—LEARNER writes:—"(1) From what material can a good cheap albumen be obtained? (2) By what process? (3) How can it be sterilised?"

Mail Cart.—TINKER (*Reading*) writes:—"Will S. P. (*Plymouth*) kindly give a little fuller description of the mail cart shown in No. 174, page 284? I am thinking of making one for my little girl, and I like S. P.'s design, but cannot quite understand the material the body-frame is made from. A few dimensions would also assist."

Oval.—OVAL writes:—"Will any of our kind readers inform me how to draw an oval to any given length or width? A few diagrams would greatly oblige."

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

"A. M. D." Monogram.—R. D. T. (*Marylebone*) writes:—"I send to C. H. D. (*Shepherd's Bush*) (see



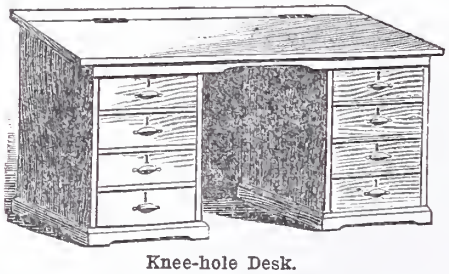
"A. M. D." Monograms.

No. 174, page 286), who asks for an easy monogram, 'A. M. D.,' for fretwork, two designs, one of which I trust will help our correspondent."

Frame-Making.—J. ANDERTON (475, *Bolton Road, Smallheath, Birmingham*) writes in reply to query by J. T. M., who asks for his address.

Asphalte Paths.—A. B. (*Salford*) writes, in reply to W. R. (*St. Albans*) (see No. 176):—"The best plan would be to get this done by some local contractor. If W. R. wants to do them himself, let him proceed as follows:—Excavate the soil to a depth of 3 in. below intended surface of path; see that the ground is hard and solid; or if not so, fill up with broken bricks or stone, and ram well. Lay on the bottom coating of asphalte 2 in. thick, composed of gravel or, better still, angular broken stone, small enough to go through a 1 in. riddle, and coated with gas tar by pouring the tar over the stones when in a heap, and turning them over several times with a spade. This bottom coating must then be well rolled to consolidate it. The top coating, 1 in. thick, is made in the same way, but with stones or gravel that will pass through ½ in. riddle. Finally, sprinkle fine limestone chippings on the surface and roll over and over again until hard. You cannot roll it too much if you go on for a month. See that the stones are quite dry before mixing with the tar. Do not use cinders if you can avoid it, as they take up too much tar, and make a soft job which will crumble away. See that you slope the surface to allow for rain-water getting away."

Knee-hole Desk.—R. A. L. (*Church*) writes to H. L. (*Oxford*) (see No. 163, page 110):—"I enclose a sketch of a desk, the sizes of which are as follows:—Length of top, 3 ft. 10 in.; width, 1 ft. 10 in.; height at back, 3 ft.; height in front, 2 ft. 8 in.; plinth,



Knee-hole Desk.

3 in.; drawer bearers, 1 in.; sides or ends, 1 in.; drawers, 12 in. wide; inside of desk, 3½ in. deep at front; width of knee-hole, 16 in. For instructions as to how to put together, see WORK, No. 140, page 555, Vol. III.: 'How to Make a Chest of Drawers.'"

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—T. S. (*Bolton*); 1892 READER; E. C. (*Norwich*); J. T. (*Ashington*); T. P. (*Warsaw*); R. B. (*Glasgow*); J. H. (*Kinnetty*); WORKITE; TRIPLE; J. G. E. (*Armagh*); DERWENT; ELECTRUM; J. F. (*Leyton*); H. T. R. (*Hamilton*); REV. S. C. W. (*Loughborough*); J. A. K. (*Nottingham*); H. H. (*Devonport*); G. W. A. (*Borough, S.E.*); E. H. L. (*Leicester*); JAW AND SHILLING; LEATHER; R. C. J. (*Upperthorpe*); H. B. (*Brighton*); SPONGE; W. H. W. (*Castleton*); L. E. M. (*St. James's, S.W.*); H. T. M. (*Saltash*); W. O. (*Burton-on-Trent*); A. W. (*Aberdeen*); J. N. D. (*Durham*); W. H. C. (*Orillia, Ontario*); IDEA; T. H. S. (*Newport, Mon.*); A. J. (*West Bromwich*); S. J. A. (*Slough*); H. H. (*Sussex*); LAPI; H. W. R. (*Stanningley*); J. B. (*Eastbourne*); E. W. (*Hull*); T. D. (*Oldham*); F. B. (*Dublin*); HYGIENE; J. T. (*Huddersfield*); A. F. B. (*Selly Park*); J. S. (*Derby*); BAINSFORD; T. E. (*Riverside*); A. R. (*Scorrier*); J. W. (*Old Kent Road*); TINSMITH; J. B. (*St. Helens*); W. K. (*Waterloo*); P. J. (*Perranwell, R.S.O.*); JUPITER; ELECTRIC; J. H. (*Battersea*); A. B. C. (*Kendal*); A COUNTRY CABINET-MAKER; DRILL; G. S. (*Preston*).

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All manuscripts intended for the "Tourists' Travelling Requisite" Competition must be addressed to the Editor of WORK, c/o Cassell and Company, Ltd., Ludgate Hill, London, E.C. They must reach him on or before SATURDAY, OCTOBER 29, endorsed, "Tourists' Travelling Requisite" Competition.

"WORK" WEEKLY CONTENTS.

SEVERAL subscribers have kindly made the suggestion to exhibit a weekly contents bill of WORK in their workshops and elsewhere, for the benefit of fellow-workmen not already subscribers.

Doubtless many others who write expressing their indebtedness to WORK may be similarly disposed. If so, and they will furnish their names and addresses to the Editor, such a bill for exhibition will be sent to them by Messrs. Cassell & Co.

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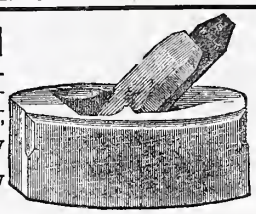

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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VOL. IV.—No. 185.] SATURDAY, OCTOBER 1, 1892. [PRICE ONE PENNY.

WORK WORLD.

ONE of the Nevada salt mine beds covers 15,930 acres. The bed is solid rock salt.

* *

Over sixty tons of freestone have been landed as material for the new lighthouse to be erected on Helliar Holm, in String Sound, at the entry of Kirkwall Bay.

* *

Wages of seamen in Australia are being reduced to £6, and those of firemen to £8, per month—with discontent and even a little rioting.

* *

Not content with having a perfect model of the Forth Bridge at the World's Fair, an idea is on foot to reproduce the St. Gothard Tunnel. Go on, America!

* *

An ingenious and economical arrangement for watering streets by electricity is in use in America. The machine—in the form of a street car—ensures a rapid and regular sprinkling.

* *

Petroleum mixing with sewer gas becomes an explosive. Officials should be warned in time not to allow petroleum to enter sewers. If it does so by accident the sewers should be flushed out.

* *

"General" Booth lives and works on about a shilling a day! This ought to be cheering to readers of WORK, some of whom, doubtless, have to content themselves with even less.

* *

Tight joints of water and steam pipes may be separated by heating them in a smith's fire. The heat will expand and liberate them. Many a good bend and branch can be saved thus and used over again.

* *

At Providence Works, United States, an engine has been running for nearly fifty years, and is reported equal to a second half century of work. It is one of the earliest engines designed by the late George H. Corliss.

Growth of electric railways in America has been rapid. In 1884 there was only one, now there are 436. Last year they carried 250,000,000 passengers without causing one death. The steam railways caused 5,241 deaths. Underground London companies—note!

* *

A gigantic drainage scheme, promoted by the President of the Tampa Board of Trade, will work a tract of land eighty-two miles long and from three to twelve miles wide along the St. John and Indian Rivers at a cost of £800,000. This ground, when drained, will be available for sugar producing, as the mud is 3 ft. deep all over it.

* *

The sale price of emery is to be fixed periodically by the Greek Government. The industry in this mineral is a State monopoly. The island of Naxos supplies most emery used, but in recent years much has been brought from the neighbourhood of Smyrna. It is found in large blocks, sometimes embedded in limestone.

* *

The difficulty of getting perfectly tight joints with screwed tubes is overcome by using conical threads, which readily adapt themselves to any slight inequality in the tubes, and admit of being screwed up much tighter than the ordinary threads. By means of a special machine the whole thread is produced at one screwing, as in other dies.

* *

The *Birmingham Daily Gazette* and *Weekly Mercury* printing machinery is now driven by electric motors run by a current of 110 volts, furnished by the Birmingham Electric Supply Company. By this arrangement two large machines, each capable of producing 20,000 copies per hour, ready folded, can be started at any hour of the day or night.

* *

Aluminium, instead of steel, for shipbuilding reduces the weight of the hull by one-half. There are five small craft constructed in this material. Three are petroleum yachts built at Zürich, one a Swedish lifeboat, and another a yacht built in England. This material, on account of its strength, incorrodibility, and lightness, is peculiarly adapted for shipbuilding.

* *

The force-power of the Niagara Falls will soon be employed. Two years ago a start was made on the great tunnel, which is to be about a mile and a half long, and about a thousand feet remain to be accomplished. Through this tunnel the water from the river will be conducted to four turbines, from which the power will be distributed electrically.

* *

Work might be found for discharged soldiers and sailors by instituting an entirely new body of public servants—something between the police and commissionaires. They might have a distinctive uniform, and take the place of policemen at all public buildings, etc. Then Sir Edward Bradford's men could be wholly employed in more important and suitable work.

* *

Indiarubber and gutta-percha threaten to become extinct. The former is imitated by a compound of bitumen, benzine, Manilla gum, and resin oil. This is said to stand vulcanising, and also to produce perfect insulators. What about the world's supply of gum, which is being used up at a rate far exceeding production? Modern civilisation depends as much on lacquer and varnish as on macintosh and vulcanite.

* *

The wages earned at the Homestead Iron Works, Pittsburg, U.S.A., are indeed phenomenal, as is shown by the figures below, which have been converted into pounds sterling:—

	Per day of 8 hours.	*Per hour.*	*Per annum of 300 working days.*
	£ s. d.	s. d.	£ s. d.
Rollers	2 3 2	5 6	647 10 0
Rollers	2 10 3	6 4	760 0 0
Shears helpers	0 17 3	2 2	258 15 0
Heaters.. ..	1 11 9	3 11½	476 5 0
Heaters.. ..	1 12 3	4 0	483 15 0
Heaters.. ..	1 13 11	4 3	508 15 0
Heaters.. ..	1 14 7	4 4	518 15 0
Helpers.. ..	1 3 6	2 11	352 10 0
Cranemen ..	0 19 2	2 5	287 10 0
2nd Cranemen	0 15 6	1 11	232 5 0

Giving an average in earnings of the men, working eight hours per day, of 3s. 9d. per hour, or £452 12s. 6d. per annum.

FANCY CONVERTIBLE TABLE.

BY JAMES SCOTT.

INTRODUCTION—ADVANTAGES—THE SUPPORT OF THE FLAPS—THE STOP-PIN—THE FRAMING—THE TRAY—THE TABLE-TOP—CONNECTION—OPTIONAL SPRING.

Introduction.—I do not think I shall be far wrong in gauging the desires of readers by assuming that the small fancy table which I have designed for them in this issue will be received as something acceptable, by reason of being rather new in idea and a trifle fresh in general appearances. For a mere fancy table, capable of being turned out with a reasonably small expenditure of material and labour, nothing could possibly be better; and as the constructive details of the table are so arranged that a convertible table is provided, the frequently unquenched desire for obtaining temporary relief from a general sameness, which sometimes tires a person who possesses a table with parts immovable, is surmounted. Only the sense of change afforded by the temporary conversion of the article would, in many cases, alleviate the unsatisfied feelings which might be caused by it, supposing it were but a permanent fixture, either in the form shown in Fig. 1 or that represented in Fig. 2.

It may seem strange and sentimental on my part to speak of the need of change concerning pieces of furniture; but if each reader will ask himself whether there is not a fancy article which he now owns for which he would willingly accept a substitute, I feel convinced that he would answer in the affirmative. He may have tired of its presence after the ownership of it had extended over a period of but a few months' duration; while, eventually, he may have wondered how he *could* tire of it—the old love would return. I have particularly noticed this trait in humankind; and frequently, when I have shown a new design in a catalogue to a friend, he has remarked: "How much I should like that in place of so-and-so"; and yet previously he had attached his sentiment to the piece of furniture he still possessed. Thus is it ever: human nature—as the sea is always the sea, yet always changing—is always the same, but continually on the ebb and flow. So much for the sentimental side of the question; now for the practical.

Advantages.—In ordinary flap tables it is necessary to raise each flap separately, and adjust a bracket underneath it, in order to support it; and also, in such cases, the respective corners of the flat top remain in the same adjacency with the legs. With my table, however, brackets are dispensed with. One flap would be raised with the right hand, while the under parts were being held with the left hand and the flap moved towards the right, when the top would partly revolve and all flaps adjust themselves, requiring no further support of any kind whatever. The result is that the corners, then pointing in the same direction as the legs, are those which otherwise, as in Fig. 1, lay *between* them. This naturally gives a greater contrast than would ensue did the flaps rise exactly over the area which they occupy in Fig. 1. Moreover, the nuisance occasioned by the use of brackets is entirely obviated.

The Support of the Flaps.—A reference to plan (Fig. 3) will render a clear explanation of the manner in which the top parts are supported when turned. The dotted lines in that diagram represent the outline of the under framing to which the legs are attached. This is pivoted to the almost square top board, in the middle of course, so that the corners A may coincide with the corners B (that is, when the table is as in Fig. 1), or be placed as shown in the diagram in question (when the table appears as in Fig. 2). It will be seen, therefore, that when the flaps are raised they rest upon the corner parts of the under framing, where, not being of large dimensions, they receive all necessary support.

The Stop-pin.—It is advisable that a short pin or dowel be driven into the under side of one of the flaps, for the purpose of restraining the top, etc., from going further round than is desired. Either flap may receive the dowel (the small dot in Fig. 3 representing it), it contacting with the under framing when the flaps are adjusted.

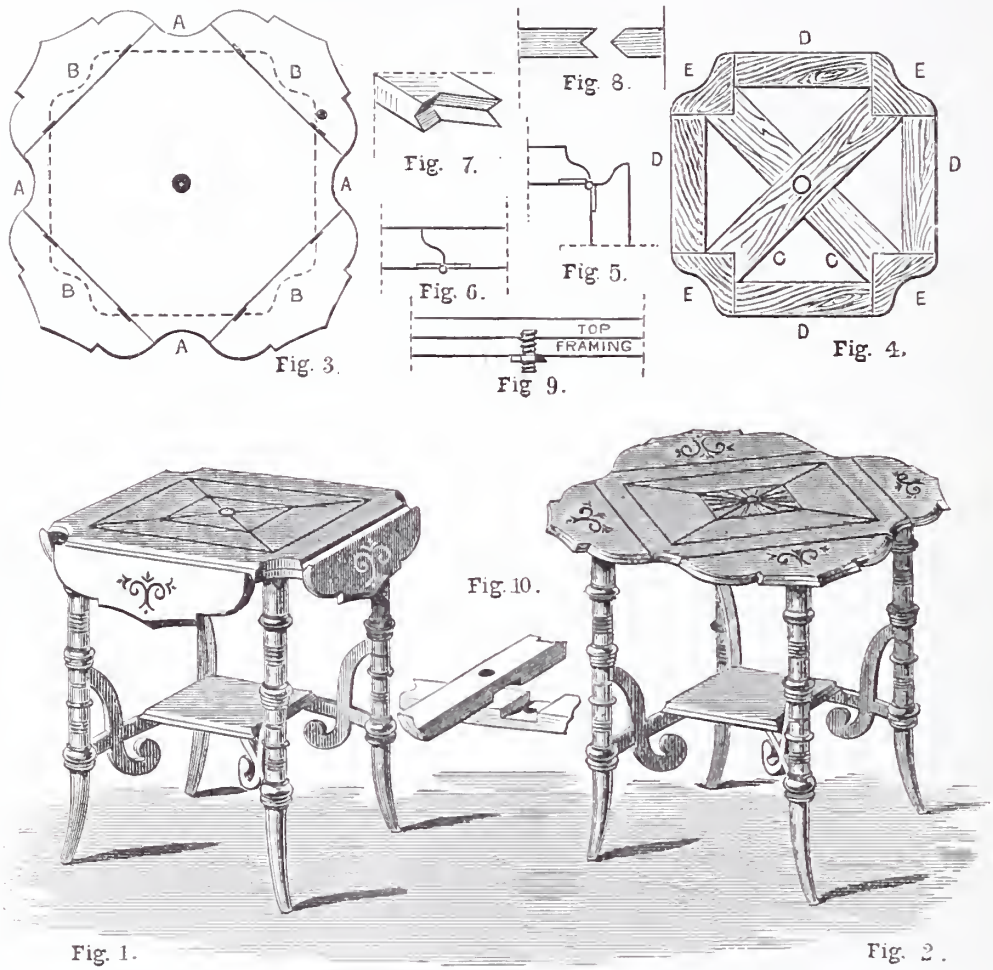
The job will be enhanced in appearance if the edges of the top board are moulded, and the hinged edges of the top similarly treated, to correspond with the top board. Figs. 5 and 6 will explain what I mean.

The Framing.—A method of putting together the framing which is intended to take the legs is made clear in various diagrams, to which further allusions will be made. In Fig. 4 (a plan), C, C are halved cross-rails whose ends are shaped, as in Fig. 7, to fit over the corner-pieces D (see Fig. 8). For the guidance of beginners, I repeat the halving joint, and it is shown in Fig. 10. The rails D should be carefully tenoned into the pieces E. It will not be found at all a difficult matter to secure all parts together. The tops of the leg-blocks should be screwed or dowelled to the under sides of the parts D, further strength being obtained if they are sunk within shallow mortises. The outside ends of the pieces E should be rounded, thereby facilitating the actions of all parts during the adjustment.

The Tray.—So far as the joining of the tray and supporters is concerned, the latter need only be tenoned to the legs, the respective pairs being halved. The opposite end of each plain curved stretcher would then be screwed to the underneath part of the footboard.

The Table-top Connection.—The most desirable way in which to unite the table-top to the under framing will be to fix a screw-dowel, of a few inches length, to the under side of the top board, allowing it to pass down through a hole penetrating the pair of cross-rails, using in conjunction with it a small nut with which to engage it, and render the loosening of the parts an avoidable feature. (See Fig. 9.)

Optional Spring.—A spring may be used in connection with this job, although no



Fancy Convertible Table. Figs. 1 and 2.—The two Forms of the Complete Table. Fig. 3.—Plan of Top of Fig. 2. Fig. 4.—Plan of Under Framing. Fig. 5.—Section of Flap and Top. Fig. 6.—Ditto. Fig. 7.—View of End of Cross-rail in Framing. Fig. 8.—Section of the latter End of a Corner Block. Fig. 9.—Elevation of Top and Framing. Fig. 10.—The Halved Cross-rails. (Top Board, 24 in. square; Flaps from Boards, 6 in. wide; Width of Side Pieces of Under Framing, 3 in.; ditto of Cross-rails, 4 in.; Thickness, 1 in.; Legs from 2 in. stuff.)

real necessity exists for the adoption of such. One of the spiral pattern, wound round the revolving pin, should have one end attached to the table-top, and its remaining end to the pin or spindle.

Accommodating dimensions are indicated upon the various diagrams, to which I must refer the reader for particulars.

As readers are aware, the rule with me is to provide designs, the materialisation of which will result in the creation of pieces of furniture possessing many points of utility; but the present article pretends to no further practical use than any ordinary table.

MECHANICAL NOVELTIES: CLOCK AND WATER-WHEEL.

BY F. A. M.

The figure represents an apparent impossibility. A clock is made in a cylindrical case and placed upon an incline; it does not immediately roll to the bottom, because it cannot do so without setting in motion the train of wheels contained therein, and this train is controlled by a pendulum. The clock then has no spring nor any weight, except that it is itself the weight. The hand does not turn, but remains vertical, so that the top of it indicates the hour upon the dial, whilst the lower end points to the same hour upon the front of the inclined plane. This hand must evidently be attached to a heavy weight hanging within the clock from the centre of the case, and the wheel-train must be between this weight, which does not turn, and the case of the clock, which does. When lifted up from the inclined plane the beat of the pendulum ceases, and when replaced it recommences. To wind up the clock, then, it is only necessary to pick it up and replace it higher up on the incline, so that the figures on incline and dial shall properly correspond.

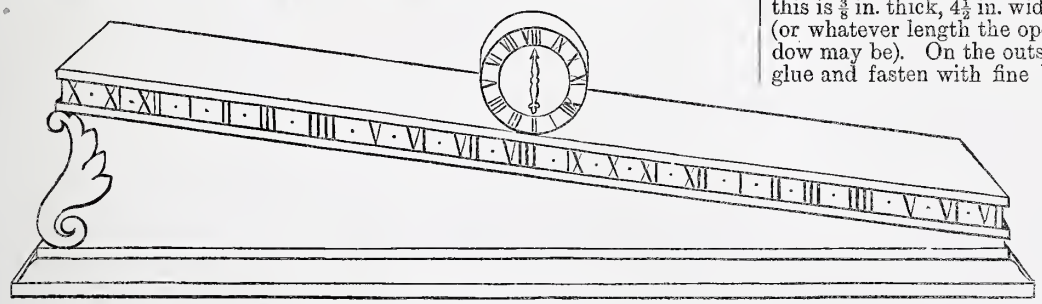


Fig. 1.—Curious Clock, whose Body turns and not the Hand.

This clock is copied from an old French work, dated 1719: "Description du Cabinet de Monsieur Grollier de Servière," which contains many other mechanical curiosities. This one seems worth making, and perhaps some young watchmakers amongst our readers will like to exercise their wits upon it, all the more as no information is given as to the arrangement of the movement. It would seem as if there should be a rack laid down on the incline for teeth cut upon the rim of the clock case to engage in, and a step of some kind provided at the bottom of the incline to prevent the clock from falling off.

Fig. 2 is from the same work, and represents a machine for raising the water of a river to the height of the half diameter of the wheel. The circumference (A) of the wheel is hollow, and is divided by partitions, so as to form so many boxes, which are filled as they dip into the water. In that part of each division which first leaves the water there is a hole (B) through which it can enter, and for delivering the water there is in each division a second hole (C) communicating with a pipe passing along the arm of the wheel, and conducting the water to its hollow axle, through which it passes till it reaches the reservoir (D). The current of the river striking against the float-boards turns the wheel, and each partition of the hollow circumference as it passes through the water lifts a quantity, which, passing through the radial pipes, is discharged through the axle into the reservoir at the height of half the diameter of the wheel.

There seems no reason why an appliance of this kind should not be constructed by a country carpenter or wheelwright; it might be useful in the colonies, and it looks as if it would continue to work for a long time without giving any trouble.

Doubtless there are many of the thousands of Work readers who may be acquainted with other mechanical novelties which they might bring under the notice of the Editor. He wants to get all the good things he can into Work, and mechanical novelties especially stimulate the interest of those who think out such things. I would recommend this for the benefit of us all.

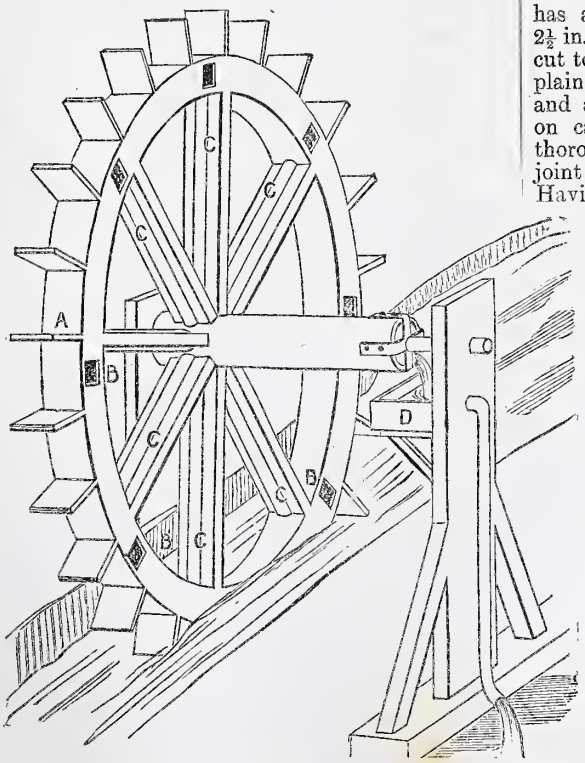


Fig. 2.—Water-wheel for raising Water to Height of Centre.

ÆOLIAN HARP FOR EVERY WINDOW.

BY R. F.

R. B. (*Galashiels*) and other correspondents will read this concerning harp making:—

Æolian harps are of two kinds, the single and double, but very little is gained by having a double harp, except, perhaps, the extra trouble of tuning; and as it is essential that the instrument be kept perfectly in tune, this object can be better attained by making one of the single kind.

The kind mostly in use are about 32 in. long by 5 in. broad and 3 in. deep, but the best effect is to be got from an instrument which exactly fits the window-frame, so that the sash may be shut down close on to the top or wind-board. They are made of yellow pine, with beech blocks at each end for the insertion of the hitch- and tuning-pins, and with two bridges, over which are stretched the strings.

Commence by getting out the bottom; this is $\frac{3}{8}$ in. thick, $4\frac{1}{2}$ in. wide, and 32 in. long (or whatever length the opening of the window may be). On the outside edges of this, glue and fasten with fine brads two pieces, of $\frac{1}{4}$ in. by $2\frac{5}{8}$ in. This will form a trough $2\frac{1}{4}$ in. deep. In each end of this trough fit accurately a block of beech; that in the right end should be 4 in. long, and in the left end 3 in. The grain of these blocks must run in the same direction as the rest of the wood, not crosswise, and the blocks should *exactly* fill the ends up. Glue these in, and cramp up till dry. If no cramps are available, a few brads may be used to hold the sides and bottom to the blocks. When dry and cleaned off, it is ready for the sound-board. This is also made of $\frac{1}{4}$ in. pine, and has a sound-hole cut in the exact centre, $2\frac{1}{2}$ in. in diameter. A ring or fret may be cut to fit this sound-hole, or it may be left plain. Glue and cramp the sound-board on and again leave to dry; but in getting it on care must be taken that the glue is thoroughly clean and quite hot, so that the joint may be as nearly as possible invisible. Having completed the body of the harp, attention may be given to the wind-board. This consists of a piece of $\frac{1}{4}$ in. stuff the same size as the harp, and is fastened at each end to a cross-piece $1\frac{1}{4}$ in. by $\frac{3}{4}$ in., so that the wind-board lies $1\frac{1}{4}$ in. above the sound-board. It must be set upon the harp itself by dowels, so that it may be easily taken off for tuning. Two bridges will also be required. These are made of hard wood, are the width of the harp in length, and are $\frac{1}{2}$ in. high, $\frac{1}{2}$ in. wide at base, and $\frac{1}{16}$ in. at top. They are placed on the sound-board, at a distance of 2 in. from the pegs at each end.

The instrument is now ready for the varnishing. First punch in all heads of brads, and stop up the holes with putty the same colour as the wood, then give all over a coat of size, made of clean glue and hot water, one part glue to six parts water. When dry rub this down with very fine glass-paper; then give another coat of size, and when this,

too, is dry, give a coat of the best copal varnish, lightly and evenly applied. If the sizing has been properly done this one coat of varnish ought to be sufficient, and the instrument may be set aside in a place free from dust to become thoroughly hard and dry. When this time arrives, draw across the harp, at a distance of $1\frac{3}{4}$ in. from the right end (that is, the one with the longest beech block), a line, and on this line bore six holes, at a distance of $\frac{2}{3}$ in. from each other, the first hole to be $\frac{11}{16}$ in. from the front edge. One inch in advance of this line draw another, and on this bore six more holes which come exactly halfway between those on the other row. These holes should be 1 in. deep, and just large enough for the tuning- or wrest-pins to fit tightly in. They should be slightly countersunk, and inclining to the end at an angle of about 20°. At the other end of the harp, in an exactly corresponding position, drive in two rows of pins, with their heads inclining at an angle of 45° to the left end, and leaving about $\frac{1}{4}$ in. for the attachment of the strings. The wrest-pins are made of No. 6 wire B.W.G. (dulcimer-pins), are $1\frac{3}{4}$ in. long, are flattened on both sides at one end, and have the other end rounded. A small hole for the string to pass through is drilled at a distance of $\frac{1}{2}$ in. from the top. The hitch-pins are made of wire about $\frac{3}{32}$ in. in diameter, and are 1 in. long. When these are in their places and the tops filed level, the harp is ready for stringing.

To string up, procure twelve violin first strings, rather stout, *and all of the same size* (this is important). Tie a knot at one end of each string and draw it up quite tight; then tie a second knot close to the first, and slip the noose thus formed on to No. 1 hitch-pin, and draw it up tight. The other end of the string is then passed through the hole in No. 1 wrest-pin, which, allowing about 3 in. of slack, is then turned to the right until the string is nearly tight. When all the strings are on, place the bridges under them, at a distance of 2 in. from the pegs at each end, and proceed to tune.

The tension of the strings should be low—or, in other words, they should be rather slack—as when the instrument is sounding the lowest or fundamental note is not heard. They must be tuned to the *most perfect unison* possible, or the beats caused by the difference of pitch would sound very disagreeable. Some prefer to tune them in fourths and fifths, but this is wrong, as the harmonics of these intervals will not agree with each other.

When required for use, place the instrument on the window-ledge, and bring the sash down close upon the wind-board, so that all the wind that enters the room must pass over the strings. If the draught is not sufficiently strong to start the strings into vibration, set the door ajar and the desired effect will be attained.

PRACTICAL PERSPECTIVE APPLIED TO THE DRAWING OF HOUSEHOLD FURNITURE.

BY WILLIAM CORBOULD.

I SHALL begin with the rules of perspective. After explaining them, we will draw a few objects by their use. I will be as concise as possible; but without a knowledge of perspective it would be impossible to draw anything correctly.

RULES OF PERSPECTIVE.

There are two rules of perspective—viz., parallel and angular or oblique—which constitute the point of sight, point of station, vanishing points, and points of measurement. Should the study be found dry, a little patience will soon simplify the matter. By working out the rules a few times, the student will find the subject easy enough, and will soon be able to work without them, or partially so.

First I will explain the horizontal line. This line gives the elevation (see Fig. 1). B B is the horizontal line; A the point of sight. Supposing the student to be standing on the sea-shore, looking out to sea, the line dividing the water from the sky would be the horizontal line, and the spot on that line straight before the vision would be the point of sight. You will say, But we are not drawing the sea or sky, but household furniture. Granted; but the

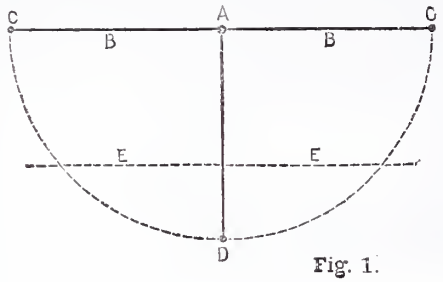


Fig. 1.

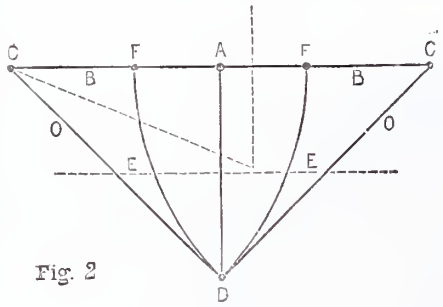


Fig. 2

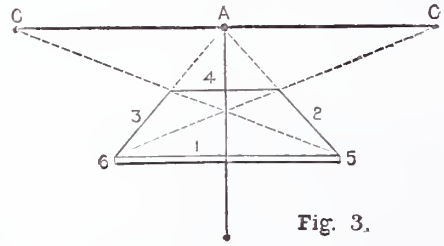


Fig. 3.

Fig. 1.—Points and Lines for working out a Drawing in Parallel Perspective. Fig. 2.—Whole of Points and Lines for Subject in Angular Perspective. Fig. 3.—Flat, Square Surface drawn in Angular Perspective.

rule is the same. In parallel perspective the point of sight is the vanishing point. When the spectator is standing directly opposite the object, one side, or the front of that object, immediately faces him, while all lines directly from him are falling into the point of sight, A, the spot the eye of the supposed spectator is looking at. If through this point you draw a straight line, parallel to the top and bottom lines of your drawing, this is called the horizontal line. All lines above it incline down towards it, and every receding line below will tend upwards to the same. The student must keep this in mind. C, C are the points of measurement; E E the base line. Now, on the elevation and depression of the point of sight depend the horizontal line, whether it is high or low; for if the point of sight is high, so will be the horizontal line, and if low in the drawing, this line will be the same. This rule is invariable. There are other points, but all lie in the horizontal line; to them all lines in angular perspective converge.

Our next rule refers to angular or oblique perspective. In A, Fig. 2, B B is the horizontal line, A the point of sight, C, C two vanishing points, D point of station—that is, where the person viewing the object would be supposed to be standing; E E is the base line. The lines O, O, drawn from C to D, determine the vanishing points, C, C. Now take your compasses, place their points on C and D, and strike a curve upwards. Where it comes in contact with the horizontal line the two points of measurement, F, F, are secured. Master these two rules thoroughly, and then we may commence to draw any object from them.

No better idea of perspective to the student could be obtained than to stand at the end of a long broad street, and take notice of the lines of the houses, street lamps, pavements, etc. He would see that they all come to one common centre. This would be the rule of parallel perspective.

For our first subject, let us take a square—such as the top of a table, a chair, sideboard, washstand, dressing-table, etc.—drawn in parallel perspective (see Fig. 3): 1, the front edge of the object; 2, a line drawn from the corner, 5, to vanishing point, A, which in this rule is the point of sight. This line will give one side, 2, and a line drawn from 6 to A will give the same for the other side of the object. The dotted line, 3, drawn from the corner, 6, to measurement point, C, also from 5 to the other point, C, where these two lines would cross line 4, would give the *back* side of the object.

For our next subject we will select a toilet-table drawn in parallel perspective. The student will see here (Fig. 4) that the point of sight is just above the centre of the toilet-glass; therefore, all lines fall into that spot, it being the point of sight, the person looking at the object standing direct in front. The first thing to do would be to draw your imaginary horizontal line, your point of sight being at the centre (see Fig. 1). Next draw your base line. Now set out your toilet-table on your base line—that is, determine the size you wish to draw the subject you are doing. The dotted lines in the figure will show the student the way to work, which I have no doubt, after a few trials, he will find easy enough.

We will now take a subject in angular perspective (Fig. 5; see rule, Fig. 2). In this case it will be seen that all lines fall into measuring point, C, which becomes the vanishing point, or point of sight. Supposing you wished to represent the same object from the other side, the perpendicular dotted line, showing the right-hand corner of object drawn, would be shifted to the left hand of the centre vanishing point, A. All lines would then fall into the right-hand measuring point, because it would become the vanishing point, the spectator having shifted his point of station from right to left of the object. (Compare Figs. 5 and 6.)

For our second object in angular perspective I have chosen a bedstead (Fig. 6): which being long, forms a good subject to illustrate this rule. It is drawn the reverse of Fig. 5, all the lines here falling into the right-hand measuring point, which becomes the vanishing point. This is simple enough. Having mastered this rule, you would go to work in this way:—Place a dot for the two front feet of the bedstead on the base line, then draw the right side of the object, continuing this line according to the elevation. At the end of this line make a dot: this will be your

vanishing point. All the other lines will fall into this dot. Any other piece of furniture may be drawn the same way. The elevation is ruled by the vanishing point being high or low from the base line—that is, if you wish to show the top of the object, the vanishing point would be high on the horizontal line; but, on the other hand, if only the front or side of the object is to be seen, the vanishing point would be lower down. The bottom lines of the object would rise upwards to the vanishing point, while the top lines would fall to the same.

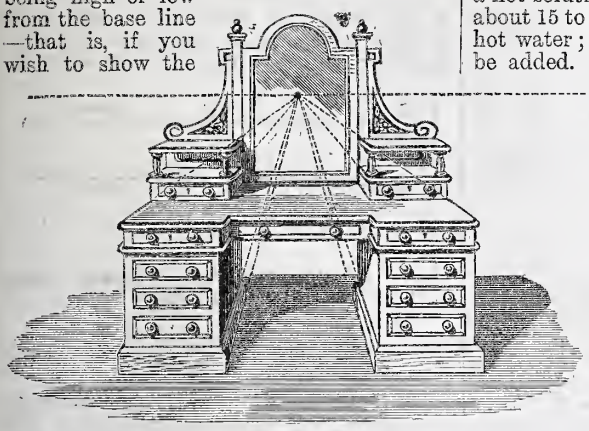


Fig. 4.—Toilet Table drawn in Parallel Perspective.

Our next object is a chair drawn in angular perspective (Fig. 7). This is drawn by the same rule as the bedstead; in fact, if space here permitted I might go on drawing any article of furniture for illustrating examples. I think I have done sufficient for the purpose. If the student will study the rules here laid down carefully, he will soon attain proficiency.

I will now close this article with one more diagram (Fig. 8): for drawing a circle in freehand—for instance, a table-top or any other circular object—by using the rule of parallel perspective, the dotted lines, as here shown, falling into the point of sight. You may now strike a circle in perspective freehand. You may not succeed the first or second time, but practice will make perfect.

PHOTOGRAPHIC EXPERIMENTS.

CURIOUS, AMUSING, AND INSTRUCTIVE.

BY WALTER E. WOODBURY.

PHOTOGRAPHS ON VARIOUS FABRICS—MOONLIGHT EFFECTS—TO RESTORE FADED NEGATIVES—TO MAKE GOLD CHLORIDE—HEADLESS PORTRAITS—TO PREVENT HALATION—HAND-MADE SLIDES—A SIMPLE HYGROMETER.

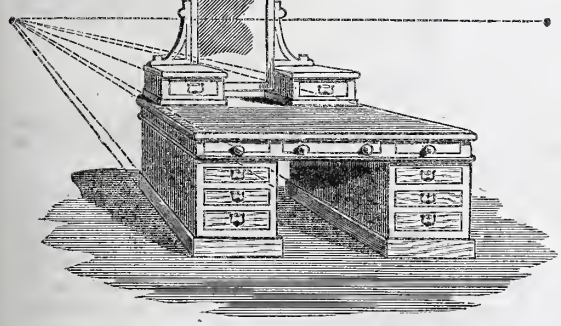


Fig. 5.—Toilet Table drawn in Angular Perspective.

Photographs on Various Fabrics.—By means of a recently discovered process, known as the "primuline process," very pretty images in various coloured dyes can be made upon silks, satins, cotton goods, etc. All the chemicals can be obtained from Messrs. W. Watson & Sons, or other photographic appliance makers. The material is first dyed in a hot solution of primuline, made by adding about 15 to 30 grains of the dye to a gallon of hot water; a little common salt should also be added. On immersing the fabric, and stirring it about in the solution, it becomes of a primrose-yellow colour, when it is removed and washed under a cold-water tap. The next process is to diazotise it by immersion for half a minute or so in a cold solution of sodium nitrate, ¼ per cent., which has been sharply acidified with hydrochloric or other acid. The material is again washed in cold water, but it must be kept in a weak light. It can be hung up to dry in the dark, or exposed while wet beneath the object of which it is required to produce a positive reproduction. This process gives a positive from a positive, so that any ordinary picture on a sufficiently translucent material—flowers, ferns, etc.—can be reproduced. Printing requires about half a minute in the direct sunlight to half an hour or more in dull weather, or if the material to be printed through is not very transparent. The high light becomes of a pale yellow, so that a faint image is perceptible; but this is made visible in almost any colour by development in a weak solution (about ¼ per cent.) of a suitable phenol or amine. The following have been found suitable:—

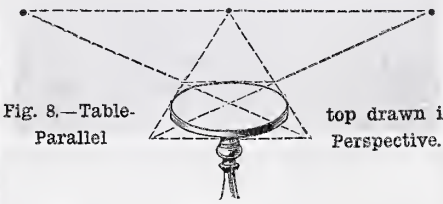


Fig. 8.—Table-top drawn in Parallel Perspective.

For Red.—An alkaline solution of β napthol.

For Maroon.—An alkaline solution of β napthol-disulphonic acid.

For Yellow.—An alkaline solution of phenol.

For Orange.—An alkaline solution of resorcin.

For Brown.—A slightly alkaline solution of pyro-gallol, or a solution of phenylene-diamine-hydrochloride.

For Purple.—A solution of α napthylamine hydrochloride.

For Blue—A slightly acid solution of amido, β napthol, β sulphonate of sodium, now better known as "eikonogen."

If the design is to be made in several colours, this can be done by painting on the different developers, suitably thickened with starch. After developing, the material is well washed and dried. With the purple and blue developers it is necessary to wash the material finally in a weak solution of tartaric acid. Wool and silk require a longer exposure to light than other fabrics, and cannot be successfully developed with the maroon or blue developer.

Moonlight Effects.—Curious as it sounds, very good moonlight effects can be procured on a bright sunshiny day. A photograph is made of a landscape in dazzling sunlight, a small stop and rapid exposure being given. The plate should, if possible, be backed with any of the substances recommended to prevent halation. Choose a landscape, with the reflection of the sun's rays in water, and include this and the sun itself on the plate. It is best to wait, however, until the sun just disappears behind a cloud. Shade the lens so that the rays do not shine on it direct, and expose rapidly. Use an old or weak developer. The sun and its reflection will, of course, make their appearance first. Continue the development until the detail in the under-exposed parts is just visible, and fix. Print very darkly, and slightly over tone. If printing is done upon green albumenised paper, and a little re-touching done with Chinese white, the effect is very good.

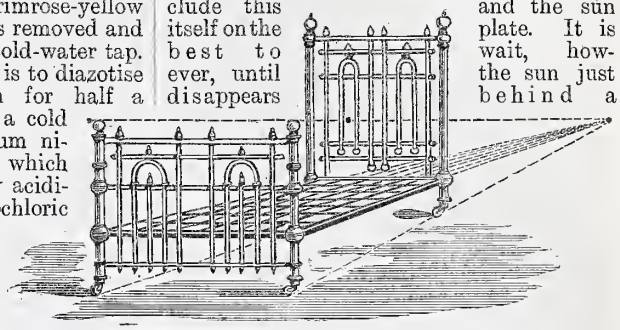


Fig. 6.—Bedstead drawn in Angular Perspective.

To restore Faded Negatives.—Negatives that have been intensified will often fade through some unexplained cause. They can be restored, however, in the following solution:—Schlippe's salt, 10 grains; water, 1 oz. Wet the film by soaking in cold water, and then immerse in the above restoring solution until the desired effect is obtained.

To make Gold Chloride.—Mix in a suitable vessel two fluid drachms of nitric acid and 1 oz. of hydrochloric acid. Into this place a sovereign or other gold coin—the newer the better—and apply a gentle heat. For this purpose a sand- or water-bath is preferable. A considerable quantity of gas will be evolved, and the gold will slowly disappear. If it does not do so entirely, a little more of the acids, mixed in the same proportion, should be added. The solution of perchloride of gold in excess of acid thus obtained is next evaporated in a sand- or water-bath, and the crystals formed are preserved in hermetically sealed bottles, as they are very deliquescent. This trouble of crystallisation can be saved if it is necessary to use the gold chloride in solution, and this is usually the case in photographic operations. It can be kept quite well if preserved in the dark. To the solution add 5 oz. of distilled water, and sufficient carbonate of soda to neutralise the

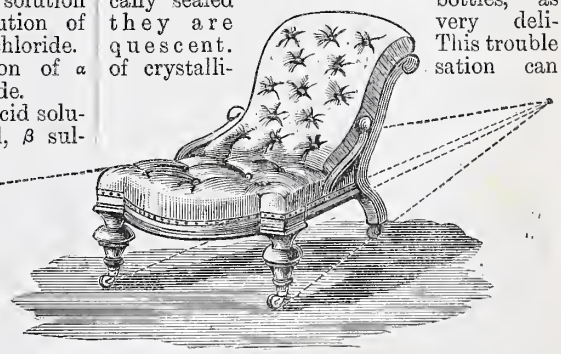


Fig. 7.—Easy Chair drawn in Angular Perspective.

acid. Filter and add water, to make 174 drachms. This solution will contain, as near as possible, 1 grain of terchloride of gold to the drachm of water, as a sovereign contains 113 grains of pure gold, which should yield 174 grains of gold chloride.

Headless Portraits.—The portrait of a man holding his head in his hand, or carrying it on a tray or at the end of a spear, has always startling effect, and serves well to relieve the monotony of the usual portrait album of individuals in the conventional attitudes. Their method of manufacture is very simple. A white background is required. In front of this the subject is fixed, with his hand stretched out or holding the tray or spear to receive the head. The expression on the face should be a suitable one, and the eyes turned upwards or closed. A little care is required in printing, as here the desired effect is obtained. First block out the head with black varnish, put on the back of the negative. A headless man is thus printed on the sensitive paper. Then remove the varnish and block out the body in the same manner, leaving only the head printable. This is then arranged on the outstretched hand, tray, or spear, and printed again, care being taken to cover up all the other parts. Prints thus obtained are then toned, fixed, washed, and mounted in the usual manner, and are very useful for the purpose already stated.

To prevent Halation.—Mention has several times been made in these experiments of the necessity of preventing halation. It will be well, therefore, to explain the meaning of this term, and its prevention. Halation, then, is the term given to the halo which often surrounds the photographs of windows or trees with bright light shining through the branches. It blocks up all the detail, all objects surrounding being either in a mist or entirely obliterated. It is caused by reflection from the back of the plate, and can be prevented by coating the back of the plate with a mixture of powdered burnt sienna ½ oz., gum arabic ½ oz., glycerine 1 oz., water 5 oz. This can be readily washed off previous to development. Another method is to squeegee a piece of carbon tissue or American cloth soaked in glycerine to the back.

Hand-made Slides.—Those who work with an optical lantern will find the following a method of making slides upon which sketches or diagrams can be made for illustrating lectures, etc.: Glass of the usual lantern-slide size is coated with matt varnish of ether 50 parts, sandarach 1 part, mastic 1 part, benzine 10 parts. This gives a surface upon which drawings can be made, but not sufficiently transparent for the purpose. This can be done, however, by flowing it over with ether 100 parts, sandarach 3 parts, mastic 3 parts. This gives, when dry, a perfectly smooth and transparent surface.

A Simple Hygrometer.—An experiment showing the extreme sensitiveness of gelatine or gelatinous preparations. The method is the following:—Take a piece of board and fix in it another piece of wood, upright. Cut a slit in the side of this, and insert a strip of carbon tissue or gelatine-coated paper of any description. The effect of moisture will be to cause the strip to hang in a limp manner, but when the air is dry it will curl upwards. If a disk of cardboard is fitted behind it, and a scale constructed, a simple but perfect hygrometer is formed.

More of these experiments shall follow. Meanwhile, any difficulty that may arise can always be set right in the columns of "Shop."

HAND-WORKING OF SPECULA FOR THE NEWTONIAN TELESCOPE.

BY EDWARD A. FRANCIS.

From Sphere to Parabola*: An Elementary Lesson in Practical Optics.

In so far as the speculum worker is concerned, all the celestial bodies are infinitely distant from the earth, and all light rays, however they may diverge at the beginning of their journey, are parallel to each other by the time they reach the telescope.

A truly polished speculum receives these parallel light rays and reflects them so as to form a quite perfect image of the object (see Fig. 18). This image is called the focal image, and is examined by being magnified by the eyepiece. (See Fig. 2, page 50.)

A speculum polished to any other than the proper curve will form not *one* distinct image at one point, but a *series* of superimposed images, and consequently indistinct. The proper curve is parabolic.

By the surface of a speculum is meant the concave surface on which the silver film is deposited. Reflection takes place not *through* the glass, as in an ordinary mirror, but directly from the silver which is chemically deposited on the surface of the glass.

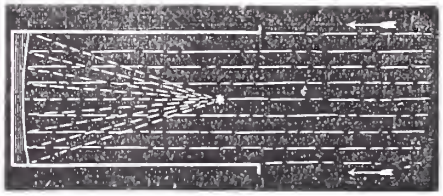


Fig. 17.—Reflection of Parallel Light Rays to one Point by a Perfect Speculum.

By the curve of a speculum is meant that curve exhibited by the concave surface in diametrical section.

A *spheric* mirror is a mirror any diametrical section of which is part of a given circle.

An *elliptic* mirror is a mirror any diametrical section of which is part of a given ellipse.

A *parabolic* mirror is a mirror any diametrical section of which is part of a given parabola.

What relation these three curves hold towards each other we shall now examine.

By means of Fig. 18 it may be traced how parallel light rays, falling directly on to a spherical mirror, are reflected.†

Let A B be the mirror, having its centre of curvature at C. Let D and E be two parallel rays of light from a star. Falling directly on the mirror, they will be reflected so that the angle of incidence will be equal to the angle of reflection. Join F C. Then D F C is the angle of incidence, and C F G being made equal to D F C, the line F G will show the direction in which the ray, D F, will be reflected, forming at G, with other similar rays, an image of the star.

This method of determining the line of reflection holds good for any ray falling on any part of the surface, and if, carefully increasing the angles, the ray, E, be similarly treated, it will be found to form an image at H.*

And so it might be shown that each zone of the surface, A B, would reflect rays so as to form a separate image, the series overlapping confusedly—that is to say, *a spheric*

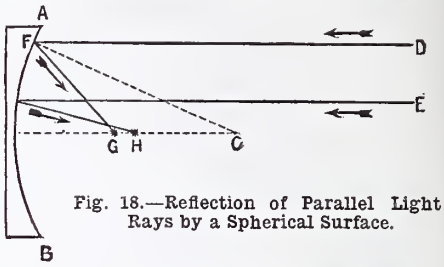


Fig. 18.—Reflection of Parallel Light Rays by a Spherical Surface.

mirror will not reflect all incident parallel rays to one point.

This irregular reflection is called spherical aberration, and it is the business of the speculum maker to correct it by altering the curve of his mirror, which he either deepens slightly, so as to bring the image, H, back to G, or flattens so as to throw G forward to H. The curve given to the mirror in either case is parabolic.

The spheric mirror will, however, under a certain condition, reflect light rays, not parallel to each other, to one point. Thus diverging light rays from a luminous object at C (Fig. 18) would be accurately reflected back to C, and (in Fig. 19) the rays from D, a luminous object quite close to the centre of curvature, C, are reflected unerringly (in effect) to the point E, where a perfect image is formed.

But if D, the source of light, be moved distant from the mirror, A B, spherical aberration will at once set in. Let D be removed to a considerable distance, as in Fig. 20; then, in order that the rays from D may be properly reflected, the curve A B, formerly spherical, will need to be made elliptical—part of the ellipse, A B C—and this will be done by deepening the concavity.

It is the peculiar property of an elliptic reflecting surface that rays diverging from the distant focus are accurately reflected to the near focus, and *vice versâ*.

A star, as has been said, is practically at an infinite distance from the telescope,

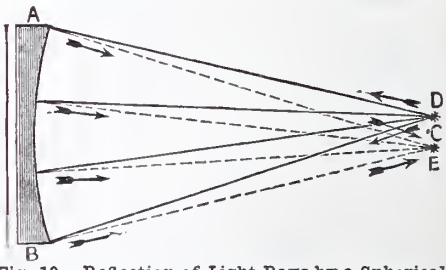


Fig. 19.—Reflection of Light Rays by a Spherical Mirror when the Source of Light is close by the Centre of Curvature.

and, to write colloquially, an ellipse with one focus infinitely distant from the other is a parabola, the parabolic curve being merely a curve more elliptic than an ellipse; so that, to make a spherical mirror perfect for the reflection of rays from an object infinitely

* Properly "from spheroid to paraboloid." These notes are written purposely in colloquial language, and readers who may be students will perceive the intentional departure from exactness in phrase and definition.

† It will be well for readers who intend subsequently to work by these notes to get compasses and paper and construct this diagram for themselves line by line.

* The same law (the angle of incidence is equal to the angle of reflection) applies to rays falling on a flat surface, but the angle of incidence is then found by erecting a perpendicular at the point where the incident ray cuts the reflecting surface. Indeed, in Fig. 18, joining the centre of curvature, C, and the point of contact, F, is equivalent to erecting at F a perpendicular to a tangent to the curve A B.

distant, it is only necessary to carefully deepen the curve from sphere to ellipse and from ellipse to parabola.* An illustration of this is given by one method of working.

The mirror is first polished spherical, so as to accurately reflect some object at the centre of curvature (Fig. 19). The object is then removed to a short distance (Fig. 20), and the curve of the glass deepened (or flattened) until the reflected image is again perfect. The object is then still farther removed, and the curve again modified to meet the altered circumstances. Thus an approximation to the parabolic curve is obtained, and a little careful work in the same direction perfects the mirror for celestial objects.

To summarise: A spherical mirror can be parabolised either by flattening the curve from centre to edge, so as to lengthen the rays reflected from the edge and cause G and H (Fig. 18) to coincide; or (and this is the better plan) by deepening the curve from edge to centre, so as to shorten the centre

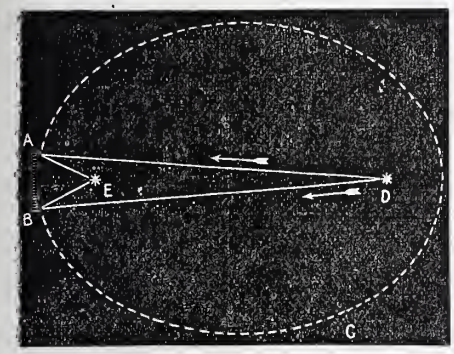


Fig. 20.—Rays proceeding from one Focus of an Ellipse reflected to the other Focus.

rays and throw H back to G. It is essential, however, that the flattening or deepening shall proceed regularly by infinitesimal gradation.

In an ordinary spherical mirror of long focus the distance, caused by spherical aberration, between the images, G and H, would be less than $\frac{1}{50}$ in., and half an hour's work with a polisher in good condition would cut away sufficient glass to deepen or flatten the curve to the parabola. The delicacy of the process will be apparent.

Perhaps the main difficulty is the securing of that exquisitely polished spherical concavity which is the necessary basis for successful figuring. Hence the need for most careful and conscientious work in the early stages of the grinding and polishing.

Even workers—or some of them—do not like wrinkles on the face. Here is Ovid's recipe for removing such:—Take equal parts of bean and barley meal, and mix with raw egg. When the mass is thoroughly hard and dry, it should be ground to a fine powder, and made into an ointment with melted tallow and honey. A thick layer of this applied to the face every night is said to smooth out all wrinkles, and make the skin as soft as a baby's. If this information is of no value to our male readers, they can at least pass it on to wives, daughters, or sweethearts.

* Or to flatten the curve to the ellipse and parabola, so as to throw up the image G to H (Fig. 18). But I treat the plan of deepening only in theory, for simplicity's sake. In practice, also, it is simpler to deepen a curve regularly than to flatten it regularly.

SCIENCE TO DATE.

New Desiccator.—In the desiccator at present in use in chemical laboratories the substance to be dried is usually placed *over* the drying material—sulphuric acid, calcium chloride, etc. Now, since moist air is lighter than dry air, this arrangement is objectionable. Hempel has described a new piece of apparatus, in which the drying agent is placed at the top, and he proves, by experiment, that with this arrangement the drying is done three times more quickly than before.

Meteorology of 1891.—The rainfall for the year 1891 at Greenwich was 25 in., or $\frac{1}{2}$ in. above the average; the number of hours of bright sunshine, 1,222, or about 66 hours below the average of the last fourteen years. The mean temperature was 48·4°, or 1·1° below the average. The highest air temperature in the shade was 85·1°, on July 17th, and the lowest 12°, on January 10th. The mean monthly temperature was below the average in every month except June, September, October, and December. The greatest wind pressure was 31·5 lb. on the square foot, on November 11th.

Nitrogen Flames.—When a high pressure electric discharge is taking place in air long, writhing, ribbon-like flames are formed between the terminals. Professor Crookes has recently called attention to the fact that they are true flames—namely, the nitrogen of the air combining with the oxygen and forming nitric acid. Luckily, the temperature of ignition is much higher than the temperature of combustion, and hence the flame quickly dies out, else the whole of the air might be at once consumed.

Copper in Fruit and Vegetables.—The United States Department of Agriculture have been carrying on investigations on the use of compounds of copper as insecticides and fungicides, with the object of ascertaining if copper is contained to an injurious extent in fruit and vegetables. From their report it appears that, under normal conditions of growth, grapes may contain as much as 2 parts in 1,000,000 of copper. Apples, plums, and other fruit which have been sprayed with Paris green contained about this amount of copper. Analysis shows that wheat may contain 4 to 10 milligrams of copper per kilogram, or an average of 7 parts in 1,000,000. It is curious to note that the 54,887,707 bushels of wheat exported by the United States to Europe in 1890 would contain 23,495 lb. of copper.

Effects of Lightning.—A curious phenomenon occurred at Vienna during a severe thunderstorm. In a large building fitted with the electric light all the Swan lamps were momentarily lit up, the lightning apparently being attracted by the electric wires. No damage was done.

WORKERS' QUESTIONS: THE HOUSING OF WORKMEN.

BY ECONOMICUS.

In all our large industrial centres the problem of how to find healthy house accommodation is a pressing one. Workshops and places of business naturally cluster round railway depôts, and besides forcing rents up to an impossible point for mere dwelling purposes, render the active parts of towns unsuitable, from sanitary and other points of view, for wholesome family life. Busy streets, in which no tree or shrub appears, are not desirable playgrounds for children. The roar of heavy and continual traffic is not a pleasant accompaniment to ailments, and an atmosphere vitiated from a thousand different sources is not the kind of atmosphere in which any country is likely to succeed in rearing sturdy men and women.

Thoughts like these are present to the mind of every earnest man and woman, especially of hard-working parents who, utterly helpless themselves, see their offspring growing up sickly and puny. It is for this reason that the vigorous action of the Housing Committee of the London County Council in bringing pressure to bear upon the railway companies to extend facilities for the spreading of the working population over outlying districts is so heartily welcomed. It is, of course, in London that all movements of this kind begin, for it is in London that defective points in our civilisation naturally first appear and reach their highest point of development. Other towns, however, have quite as much of the housing difficulty already as to show that new lines of policy will have to be adopted to cope with it, and there is no doubt that, as in London, so it will be in the provinces—the railway companies, who hold the key of the situation, will be approached.

This being so, the important question for each individual workman is: How can he assist in promoting this movement? The only way is, of course, for him to combine with his fellows on an intelligent basis, to raise the matter at his club and at meetings of his society, and to insist upon candidates for local boards taking it up. Employers, as well as employees, are interested in the proper housing of the masses, for he who sleeps and passes his leisure in the fresh air will be a far more efficient workman than he who passes from the bench to the fœtid atmosphere of crowded courts and alleys.

We have said that the way to proceed is for workmen and, if possible, employers to combine on an intelligent basis, and for such combinations to bring pressure to bear upon local authorities and, through them, upon the railway companies to so reduce their fares that people of scanty means may be able to live a few miles from the smoke and dust of the city. Now, what do we mean by an intelligent basis? First of all, the workman must be convinced that what he is asking the railway companies to do is within his right. For instance, it would not be within the right of any body of men to demand that the tailors of this country should reduce the price of clothes by one-half or one-fourth, or to any extent. Why should the railway companies be subject to interference that tailors, butchers, shoemakers, and so forth are exempt from?

There is one big difference easily to see between such traders as tailors, etc., and railway companies. If a man does not like the prices charged by one tailor he can easily go to another. This cannot be done in the case of railway travel. Though there are thirteen railway companies with termini in London, for instance, no workman has the choice of using any one of these thirteen railways, but is practically confined to the railway whose terminus is nearest his shop and whose route is towards his home. Another peculiarity in railways is the fact that the different companies are formed into a combination whereby fares are kept up. Before a railway can reduce its charges it must get the consent of other companies. If tailors, shoemakers, etc., had the same power of keeping up prices as railway companies; if, in other words, they enjoyed the same monopoly as the companies, and the monopoly began to be exercised, or was thought to be exercised, to the detriment of the community, then the public would have a right to interfere in their businesses, as they are now doing in railway businesses.

There is an additional reason for expecting the railway companies to relieve our congested towns, and that is because the congestion is due to the railways. No big towns, it is safe to say, such as we are familiar with to-day would have sprung up but for the railways. Indeed, the size of our towns is in proportion to the railway service supplied them. Moreover, the bigger the town the more business does it yield to railways in carrying food, coal, manufactured and unmanufactured articles, out of and into such big towns. Arguments like these—and they might be put more forcibly—show that upon the railway companies the public have a special claim in the matter of this housing question, and that it is not an undue interference with private businesses to force the companies to reduce their fares.

Now, to what extent might they be reduced? This depends upon the size of the town. Where the population is large, and trains at low fares can be filled, the reductions that might profitably be made in fares are enormous. We have already instanced in Work the twenty-two miles' journey between Liverpool Street and Enfield for 2d., which returns a handsome profit to the Great Eastern Railway. Sir J. Blundell Maple, too, has now managed to get the Metropolitan Railway to run workmen's trains at fares of ten miles 2d., twenty miles 4d., and thirty miles 6d. This rate will also rule on the Sheffield line that is coming to London. In London, where low fares can attract an unlimited number of passengers, it is thus proved by the Enfield workmen's trains that eleven miles for 1d. is not too low a rate to expect; and the Chairman of the Great Eastern Railway says that this rate pays the company if they get five hundred passengers to a train. These facts are worth the pondering, and suggest a basis of operation to bodies of workmen anxious to improve the conditions under which they live. They are worth the consideration, too, of temperance reformers, for the dull, leaden lives of those who perforce are driven into the holes and corners of our cities are a fruitful source of the misery entailed by excessive use of stimulants.

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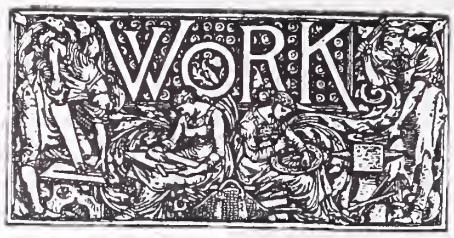

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WORKMEN'S INDIVIDUALITY.—In giving recent evidence before the Labour Commission, Captain Noble expressed an opinion that there is much less individuality among workmen now than was the case thirty years ago; that the present tendency is towards a dead level of uniformity; and that this is due to Trades Unionism. We are strongly of opinion that individuality to-day is not so marked as then, and that the tendency now, as compared with thirty years ago, is in the direction of a dull level of uniformity. But we differ as to the causes of this tendency. We hold that but for the unions matters would have been much worse than they are in this respect. It is, on the contrary, in the minute and ever-increasing specialisation and subdivision of labour that we see the cause of the dull uniformity which all thinking men deplore. Specialisation has killed individuality, monotony has strangled mental activity, repetitive tasks have destroyed interest, and the iron discipline of the big factories has reduced all to military precision and routine. There is scarcely a trade remaining in which the increase in the use of machinery and the subdivision of labour have left much scope for the exercise of individuality, or in which any freedom of initiative worth mentioning is left to the "hands." Not the least departure from set methods can be made by those hands. In any change whatsoever, the initiative can only be taken by principals, managers, or foremen. This, mainly, is at the bottom of the torpidity of the present race of workpeople. Unionism, therefore, has nothing at all to do with it. Men, for the most part, would take delight and interest in their work if they had a free hand, and sufficient variety and scope to occupy their faculties. The old craftsmen were all-round men; the new hands are men of one section, one fractional part of a craft. Carlyle's famous verdict of the population of these islands, "comprising some thirty millions, mostly fools," is, perhaps, not to be gainsaid. But the grand old cynic might have allowed "extenuating circumstances" in the case of a large proportion of that population. Knowing what we do of factory life, the marvel to us is that our operatives have developed so high a degree of intelligence in the midst of conditions which are extremely adverse to intellectual culture, and to the development of inventive genius. It is a positive fact that there are hundreds of thousands of working people whose duties are restricted to one most minute operation, or series of operations, and who, under the discipline and stress of the factory system, are so incessantly occupied all day long therein, that they are absolutely prohibited from giving attention to anything beside. A hundred, a thousand other operations may be going on around them, in other workrooms and departments, under the same roof, week by week, year by year; yet of these they remain in completest ignorance. "All the little piece of intelligence there is left in a man is not enough to make a pin or a nail, but exhausts itself in making the point of a pin or the head of a nail." Of course, we know that these conditions are permanent. We cannot go back to the old domestic system of manufacture. It developed individually, but was too wasteful for present-day requirements. Our aim must be to retain the advantages of subdivision of labour without suffering loss of intellect. The only corrective possible lies *in the development of a broader culture* among our working people. There is the remedy embodied in a single sentence. This would include all aids of an intellectual character, all means for the development of literary, technical, scientific, and inventive genius. By means of these individuality will be saved from atrophy or extinction, dull, daily duties will be rendered more endurable, whatever of faculty there is in a man will be drawn out, labour in many cases will become more remunerative, and so tend to bring about the ideal of a shorter day; and lives now dull and leaden will become transfigured with brightness, and feel the interests and attractions of a new and higher life.

MUSEUM LECTURES.—Numbers of people can be seen wandering aimlessly and listlessly about our museums. Is there any need for this? Where are the peoples' teachers? We ask seriously if free lectures or demonstrations cannot be given during the winter evenings. We know that the gentlemen who have charge of the different collections are proud of them, and anxious to have them appreciated by the public. Will they, or some of their juniors, take up the matter of free lectures and demonstrations? There are no great difficulties in the way. No serious expense is needed. Notwithstanding the excellent "Art Handbooks," we know that much more pleasure and instruction will be given by a few lectures than by reading about this or that class of artistic or scientific object. We trust that all who are responsible for our museums will give this suggestion a trial. At present not half the use is made of these national treasure-houses that might be were some such simple scheme as that indicated carried into effect. Surely it will not be impossible to find men able and willing to give clear and popular lectures on the treasures of our museums during the coming winter evenings. In this way thousands of workmen could be intelligently educated. Something after the plan of the Rev. Dr. Kinns' lectures in another direction is wanted.

HELICAL GEARS.

BY J. H.

Helical Bevel-wheels.

The Relations and Dimensions of Bevel-wheels — The Toothed Block — Marking Out — Working to Outline—Method of Withdrawal.

The figures in this article illustrate the making of a helical bevel-wheel moulding block. It is necessary, however, before describing the bevel tooth-block, to explain the primary relations and dimensions of a pair of bevel-wheels.

The Relations and Dimensions of Bevel-wheels. — In Fig. 9, A represents a bevel-wheel, B the pinion gearing into it, C, *c* are the major and minor pitch diameters respectively of A, and D, *d* the corresponding pitch diameters of B. The primitive cones of the two wheels, upon whose ideal surfaces rolling occurs, meet at E, and the tooth-points and roots converge, like the pitch surfaces, to that apex, E. In ordinary bevel gears the tooth-flanks and faces converge also to that centre; but this is not the case in helical gears, because the teeth form portions of helices, winding upon the surfaces of the primitive cone (as illustrated in Fig. 3, p. 219). Nevertheless, the terminations of the teeth on their outer faces and their apices touch radial lines, as shown at *e*, *e* (Fig. 9).

The forms of the teeth are struck precisely like those of ordinary bevel gears. Lines *f*, *g*, *h*, representing respectively the major and minor terminal planes and the middle plane of the teeth, are projected until they cut the centre line, F E, of the pinion B. Then the radii, *f f'*, *g g'*, *h h'*, are taken and struck in any convenient position, as at *f''*, *g''*, *h''*, below, and represent the projected pitch-lines upon which the shapes of the teeth for the terminal and the middle planes of the pinion are to be struck. The lines drawn concentric with these represent the root and point-lines.

The Toothed Block.—A toothed moulding-block for a bevel-wheel is, in respect of section and curvature of faces, exactly as though a segment were cut out of a complete wheel pattern. In the tooth-block the shape of the back and top face is, of course, exceptional, because these portions are always made by means of cores, with which we are not concerned in this paper. Always the top and back of a tooth-block form a rectangle to receive the carrier, N, in Fig. 10, of the wheel-moulding machine. The way in which a toothed block for a bevel-wheel is marked out, in order that its section shall be the same as that of its wheel, is as follows:—

Fig. 10 shows the tooth-block complete; Fig. 11 shows it in an early stage. By comparing the two and noting the dotted lines, it is seen that there are certain dimensions corresponding with certain definite portions of the wheel rim, of which one set are *concentric*, the other *parallel*. The total thickness, A, of the tooth-block, and its total width, B, are not of much importance, but the relative positions of the cardinal lines are of great importance.

Marking Out.—First, then, a block, B (Fig. 11), from 6 in. to 10 in. long, dependent on the fineness or coarseness of the pitch, and suitably divided, and dovetailed to its backing, is prepared, of a width and depth fairly proportioned to the section of the wheel, and of a convenient size for the carrier of the machine. It is squared carefully to the dimensions, in order that lines

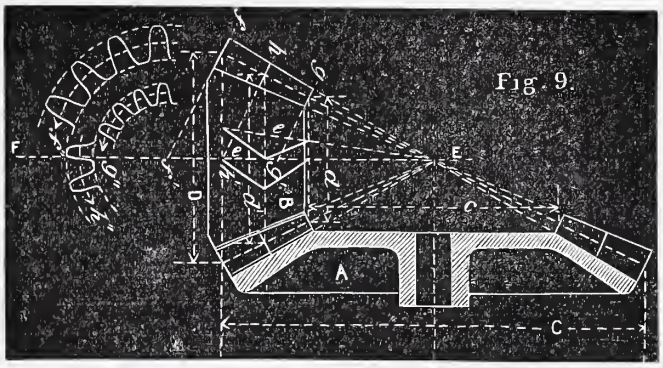


Fig. 9.—Diagram to illustrate the Elements of Bevel Helical Gears.

may be marked accurately upon the faces, and a centre line, A, squared over on all four faces. Then, with suitable radius, corresponding with the radius C, in Fig. 10, the outer line, C, in Fig. 11, is struck on one face, and the line F concentric with it, and the line D on the other face corresponding with similar lines on Fig. 10. The bevelled sweep, G, is then worked down with chisel and plane. This face, G, now represents the root-face of the wheel, to

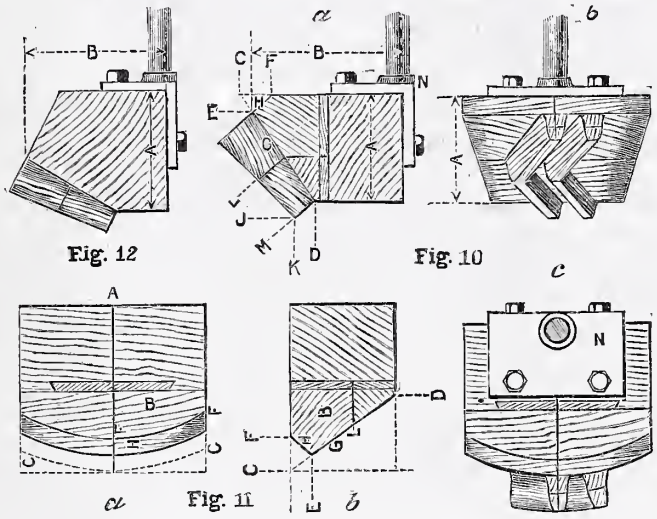


Fig. 10.—Helical Bevel Tooth-block—*a*, Section; *b*, Face; *c*, Plan. Fig. 11.—Block in course of Preparation for the Teeth—*a*, Plan; *b*, Section. Fig. 12.—Section through the Block for a Crown Bevel.

which the teeth are attached. The gauged line, E, corresponding with the line E in Fig. 10, is run round on the sweeped face, G, and the short bevelled sweeped face, H, worked round from E to F, and this face is then continuous with the ends of the teeth on the major diameter of the wheel and the top face of the rim; and the body of the block representing the bottom of the teeth is now ready for the teeth.

At this stage a solid block is fitted around the sweep of the block B, in Fig. 11, for the teeth to be worked from, as in the spur-wheel (Fig. 6, p. 279). The large end of this block is bevelled off continuously with the bevelled face, H, just worked on the piece B, and the small end of the block is struck and worked to its bevel by lines I and K (Fig. 10). Upon the ends of this block, then, the pitch circles, D and *d*, in Fig. 9, are struck with respective radii, the bar of the trammel being held parallel with the faces of the tooth-block. The pitch circles *f''*, *h''*, in Fig. 9, and the striking lines (not shown in the figure), and the circle of the tooth-points, all struck also with normal radii, are marked with trammels. As the centre of these circles lies away from the block itself in all except the smallest pinions, the block is screwed in the vice, or else clamped to the end of a board or bench, and the centre line, A, of the block projected along to the centre of the wheel. While thus set, all the lines for one side are struck, and afterwards, the block being turned over and the centre found, the lines on the opposite side.

Working to Outlines.—The dovetailed blocks, B, with their attached tooth-blocks thus marked, are then removed from the backing-piece, and the pitch- and striking-lines and tooth outlines marked on one of the joint faces, L. The sweeped face of the tooth-points is worked now, and the screw-lines are then marked upon the curved face with bent steel, and the teeth worked through from the outer to the middle face.

The size of the teeth and the radii of their curves on the middle plane are a mean between those of the outside faces. To assist accurate working, templets should be made to the inter-tooth spaces, midway between the centre and the outer faces. For the accuracy of the sections intermediate between these the trained eye may be trusted.

Method of Withdrawal.—It is even more desirable and convenient that the teeth be divided along the line L in this example than in that of the spur-wheel given in the previous article. To ram the lower half of the teeth while the upper half stands over in the way is awkward (see the face view of Fig. 10). Still, it is not actually necessary except in small pinions. But it *is* essential that the block B, that carries the teeth, be made distinct from the backing; for except in those machines where provision is made for withdrawing the block in a diagonal direction—that is, in the line M—the entire block could neither be drawn horizontally, because of the sand behind H, nor vertically, because of the diagonal setting of the teeth on the block.

But there are some bevelled tooth-blocks that can be lifted vertically—that for the wheel A, in Fig. 9, for example. This block is shown in section in Fig. 12, and it is clear that, in consequence of the extreme flatness of its bevel, the teeth can be lifted vertically, and therefore be made fast to their backing-piece, which could not possibly be the case in Fig. 10, as is apparent from the front view.

In my next paper I will speak about wheels made in cores, and then I hope I shall have said enough upon the construction of helical wheel teeth. If not, there is "Shop."

IRON BRIDGE MODELLING IN CARDBOARD.

BY FRANCIS CAMPIN, C.E.

METHOD OF CONSTRUCTING UPRIGHTS—FLOORING—CROSS-GIRDERS—RAIL-BEARERS—ERECTION OF BRIDGE—SLEEPERS AND RAILS.

THE uprights, E, are made by first preparing for each the 3 in. by 3 in. angle-irons shown in section at A, Fig. 5 (see page 293). The actual distance between the insides of the side plates is then to be measured, and the pairs of angle-irons secured at this distance from outside to outside glued to double thicknesses (C) of card, as shown at B. The calculated width of the upright is 1 ft. 9 in.; the height of plates at top and bottom is 1 ft. But it is well to make these rather slack in width, for they can be packed out with a layer or two of note-paper, but, if too wide, cannot be put in place without bulging the side plates of the main members, and would therefore have to be thrown aside, and new ones made. The lattice-bars connecting the angle-irons should be placed as nearly at right angles to each other as the space between the plates, C, allow, opposite corners of which, D, D′, are to be cut away for half their thickness to make room for the extremities of the end lattice-bars. This cutting away should be done before the two thicknesses are glued together, as there is then a clean surface left for the connection of the lattice-bar ends. At other points between the angle-irons the lattice-bars cross, the double thickness of card at each end holding them at the right distance apart for this purpose. Here the bars are glued, as also where they cross each other, and on each side of each such joint a rivet-head is to be fixed. These uprights will extend from the top to the bottom flange-plates, and their lengths must be measured off the general diagram. In putting in the uprights, it will be found most convenient to start from the centre of the span, as they must be inclined to be brought between the side plates. The uprights on each side of the centre may all be placed at first between the side plates in inclined positions near the ends, and they can then be brought successively into their permanent positions, the insides of the arches and ties being first touched with glue at those places at which the uprights are to be fixed. After all this work is set, the 6 in. counter-brace bars between the uprights may be glued at the ends and sprung into place. There are four in each bay, two being fastened on the inside of each side plate. They are not connected at the centres, where they cross.

The open ends at A and C are to be covered by plates 2 ft. 6 in. wide, connected to the side plates by angle-irons 4 in. by 4 in. by ½ in. thick. At each end plates 2 ft. 6 in. wide and 4 ft. long are to be attached as bearing plates. These, in the bridge, would be about 2 in. thick, and should therefore, in the model, be made up with three or four thicknesses of cardboard. Similar plates are to be made to place upon the supports at each end. At one end the bearing plate will rest directly upon the bed plate; at the other twelve rollers will be interposed, which would be about 3 in. in diameter, with a clearance of ½ in. between them. These, in the model, would be represented by wooden rollers 1¼ in. long by ⅛ in. in diameter, kept in position by end-pins in their centres. These pins will pass through holes in the side bars of a square frame which surrounds the rollers. With a slight clearance, the distance apart of the pins will be $\frac{7}{16}$ in. These centres are easily set out by marking off the distance between the end rollers, 1⅝ in., and dividing it into eleven parts. The end bars of the frame should be ⅛ in. clear of the end roller centres. The supports may be of card, plaster, or wood, to imitate masonry work.

Next we have to deal with the flooring, and may conveniently commence by making the buckled plates, which will be required for carrying the ballast and any incidental load that may come upon it. These plates will rest upon the longitudinal bearers on the angle-irons, A; their sides by the cross-girders will be supported by angle-irons, A′, and those against the main tie will rest on angle-irons, D (Figs. 8, 7, and 6; page 293). These angle-irons are 3 in. by 3 in. by ½ in. thick. Where the buckled plate fillets meet each other they will be connected by a cover consisting of a 6 in. by 3 in. by ⅜ in. T-iron, riveted on underneath. Two rows of buckled plates will be placed between each pair of cross girders; therefore, in the direction of the length of the bridge they will each measure 3 ft. 11½ in., allowing for the thickness of the cross-girder webs and a slight clearance for getting into place. Across the bridge there will be three different widths of buckled plates: in the six-foot, between the tracks, they will be 5 ft. 11½ in.; between the rails of each track, 4 ft. 11½ in.; and between the outer rails and main ties they will be 4 ft. 9¾ in. All these are outside measurements over the fillets, which should be 3 in. wide. The plates are to have 3 in. rise in the centre, and will be modelled in the manner previously explained.

The rail-bearers (Fig. 8), to fit exactly between the vertical limbs of the cross-girders, should be 7 ft. 10⅝ in. in length, but it will be safer to cut them a trifle bare, to allow for fitting. The web being cut, the vertical limbs of the angle-irons may be cut the full 3 in. wide, and glued on to coincide with the edges, top and bottom. The angle-irons, A—to carry buckled plates—should then be made separately, and, when quite set, glued on to the web with the full-width strip of card horizontal and 4⅛ in. below the top of the finished bearer. This cannot be well scaled off, so the guiding lines may be put 3½ in. below the edge of the web. The bottom flange and angle-irons will run the whole length of the bearer, but the top flange must terminate 5½ in. short of the end, and the horizontal limbs of the top angle-irons 2½ in. short, to allow the vertical limbs to run in under the cross-girder angle-irons, the ½ in. plate of the bearer butting against the side of that of the cross-girder. Angle-iron brackets, B, are glued to the ends of the bearers, with packing underneath, where necessary, to connect them with the cross-girders. They should be so joined up that the angle-irons, A, on the bearers are on the same level as the angle-irons, A′, on the cross-girders.

The cross-girder (Fig. 7) has two flange-plates at the centre and one cover-plate. The outside plates at the top and bottom are ⅜ in. thick and 20 ft. long. The inner plates are in two lengths, and meet in the centre. The joints are covered by plates outside the ⅜ in. plates. The covers are 12 in. wide and 4 ft. 8 in. long. They are placed in the centres of the cross-girders, which have an outside depth of 2 ft. at the centre, and taper to 11½ in. at the ends, where they rest upon the main angle-irons of the main tie, D (Fig. 3), and are secured by angle-brackets on each side to the side plates of the main tie exactly opposite the uprights, E (Fig. 3). Above the vertical limb of the main angle-iron a piece of card is fixed as packing, to make a flush surface for the cross-girder end to bear against. The exact length of the cross-girders is 25 ft. 7 in., as they run 3½ in. on to each main tie. The general mode of construction is the same as already described. Between the spaces occupied by the ends of the rail-bearers (Fig. 8), angle-irons, A′, are fixed to support the buckled plates, and between these, and at the same level, similar angle-irons, D (Fig. 6), are fixed on the inner side plates of the main ties.

The point is now reached when the whole work is to be put together. The four cross-bearers for each bay are to be connected by the central and two side rows of buckled plates, the greatest care being taken that the work is absolutely square and parallel, and the bearers at their correct distances apart. To ensure this, the bearers may be secured to a marked board by drawing-pins, the heads of which clip down their bottom flanges when they have been properly adjusted to the marks. The pins must not pierce the flanges. The buckled plates may then be fitted, their edges being pared down, if necessary. When the buckled plates are glued on, the work is left thus secured until it has thoroughly set. Some modellers prefer to leave out a few of the floor plates, in order that the work beneath may be seen without having to look underneath the model. The rivet-heads on the bearers and cross-girders will all be 1½ in. in diameter and 4 in. pitch, except at the ends, where they must be worked in as near that pitch as they will come. On the buckled plate fillets a rivet-centre should be marked at each corner in the centre of the fillet, and the sides divided up to as near the pitch of 4 in. as it will come, and, whatever it is, the bearing angle-irons must be marked to correspond. It must be remembered, in setting out the rivets in parts connected by angle-irons, that the rivets in the angle-irons are always zig-zagged, so as to avoid making two rivet-holes in one section of the bar. This arrangement is shown in Fig. 9 (see page 293). It will be observed that the rivet centres in the top plates fall between those in the side plates.

When the bearers and central part of the flooring have been made up—with the T-irons under the buckle-plates where they meet—they must be connected with the cross-girders. In this case it will be most convenient to lay the work upside down, as the cross-girders are flat on the top, but tapered underneath. The positions of the cross-girders having been exactly marked on the table or board on which the bridge floor is to be put together, one end cross-girder should be secured by drawing-pins, as described above, the intermediate bearers and flooring glued and applied to it, and the next cross-girder immediately applied and secured to the board. This process is continued until the flooring is completed in length, and it is then left to set.

This is not, of course, the actual way in which the iron bridge itself would be put together in any case, but is the most convenient way to erect the model structure, in which glue or cement takes the place of rivets.

Where surfaces to be glued meet, rivet-heads must be left off. In actual practice the rivets would pass through all the plates superposed. When the floor work has set, its sides must be gauged by a straight-edge to ascertain that all the cross-girder ends are in line, and by a square to show that they are vertical. If not true, they must

be trimmed with a knife or the glass-paper file. The flooring is now to be turned the right way up, and the ends of the cross-girders glued, and then the main arches and ties, blocked up to the height required by the tapers in the cross-girders, applied to them, and held until the glue adheres. The arches should be fitted with notched distance-rods, to keep their upper flanges at the proper distance apart while the glue or cement sets. It is very convenient in this final process to have a board fixed at right angles along one side of that on which the joining of the floor to the arches is made, so as to secure absolute verticality of the arches. The outer rows of buckled plates can be slipped into position after the rest of the work has set. Longitudinal sleepers in wood, with model bridge rails in card, may be fixed over the lines of bearers c; or transverse sleepers, with card representations of ordinary rails, may be laid on a bed of sand spread over the floor, to suit the modeller's fancy. The end cross-girders will be connected with the supporting surfaces by buckled plates, carried by angle-irons on the cross-girders at one end and resting freely on the supports at the other.

PROCESS FOR ENAMELLING SILVER PRINTS.

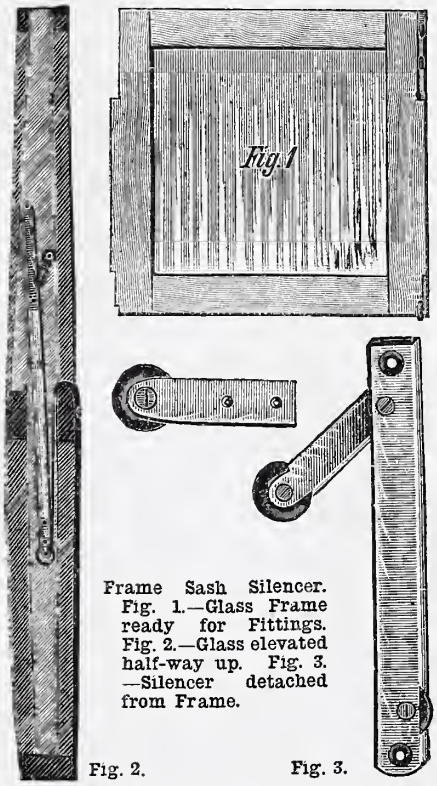
BY DR. LEO BACKLAND

This process gives a better finish to the prints and renders them waterproof. Such enamelled prints can be easier mounted than by the usual methods, and when being mounted the gloss is not decreased by the application of paste. Clean glass plates are rubbed in with talcum as for the usual process, and then afterwards the plates are collodionised with collodion containing 1 per cent. gun-cotton. When the layer of collodion is perfectly dry, the plate is coated a second time with a solution of rubber in benzole. This solution is easily made by dissolving 1 oz. of unvulcanised Para rubber in 100 oz. of benzole, and straining through muslin after complete dissolution of the rubber. When the indiarubber coating is dry the so prepared plate is ready for receiving the print. If the print is on albumen paper, it is soaked in a warm 10 per cent. solution of good gelatine, after which it is applied with its surface on the prepared plate, softly squeegeed upon it, and then allowed to dry, and when dry it is stripped off in the usual way. Prints on aristotype paper can be enamelled with much less trouble by squeegeing them simply when wet on the glass plate coated with collodion and rubber, and slipping them off when dry.

Furniture Reviver.—To make a good furniture reviver, pour half a pint of linseed oil, two ounces of distilled vinegar, half an ounce of muriatic acid, one ounce of spirits of wine, one and a half ounces of oil of almonds, a quarter of an ounce of muriate of antimony, three-quarters of an ounce of spirits of hartshorn—all to be mixed cold. To polish: Take a piece of *clean* rag, shake the mixture and pour a little upon the rag, and rub the furniture well, and finish off with a piece of *clean, soft* rag. N.B.—The mixture must be shaken each time the rag is replenished.

SOME GOOD THINGS.

Glass Frame Sash Silencer.—That there is another "Glass Frame Sash Silencer" in the market implies that one was wanted for carriages. The smooth roads and spring wheels in their quiet action show more plainly where any rattle exists in a carriage. Indiarubber wheels on the ends of metal blades let into the edge of the glass frame are the silencing media. The glass of a carriage works up and down grooves with fences to hold the glass in, at all degrees of elevation. Fig. 1 is a glass frame ready for fittings. Fig. 2



Frame Sash Silencer. Fig. 1.—Glass Frame ready for Fittings. Fig. 2.—Glass elevated half-way up. Fig. 3.—Silencer detached from Frame.

Fig. 2. Fig. 3.

shows a glass elevated half-way up; the silencer, acted on by a spring, is pressing the top edge of the glass frame against the fence; at the bottom it has a rubber wheel, acting also against the fence. Fig. 3 shows the silencers detached from the frame. There are four to each frame. The whole construction is simple, and its application to carriages will add to the comfort of riders, and enable them to converse without the accompaniment of a rattle. Messrs. Whittingham & Wilkins are the agents.

Forge and Bellows.—Fig. 1 is an illustration of a cycle brazier and ordinary forge combined, made and sold by Mr. Walter Careless. It is a speciality for those trades requiring a good and powerful brazing forge. It will be noticed that the bellows are worked by foot to leave both hands at liberty. An advantage is that it can be used for bottom heat at the same time that the blowpipe is in use, thus saving gas and time during the operation. There are no expensive taps to get out of order, as by inserting a plug in the back of the pipe it can be used as a smith's forge, or by plugging the front of the tuyere it can be used as a brazier without bottom heat. Fig. 2 represents Careless's Double Blast Gas-blowing Foot Bellows. These are compact and powerful for all small brazings and solderings wanted by brassfounders, silversmiths, coppersmiths, electro-platers, glass-blowers, dentists, etc. They are made with width of bellows, 10 in., 12 in., 14 in., and 16 in., at a charge respectively of 28s., 30s., 35s., and 40s. each nett.

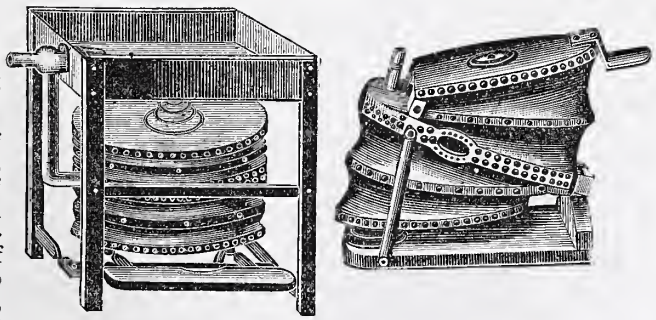


Fig. 1.—Combined Brazier and Forge. Fig. 2.—Foot Bellows.

NOTES FOR WORKERS.

Mines for copper ores, antimony, iron pyrites, and galena are worked in Newfoundland, but, owing to the absence of roads, the mining is confined to near the sea-coast. Zinc, molybdenite, manganese, chromite, nickel, hæmatite, gold, silver, etc., are all known to exist. Clay has lately been discovered near St. George's Bay, and building materials and clay are abundant.

The total quantity of beer consumed in the United Kingdom during 1891 was 1,140,021,648 gallons, of spirits 39,164,762 gallons, and of wines 29,855,753 gallons. The total amount of intoxicants would, therefore, be 1,209,042,163 gallons, or just over 32½ gallons per head of the population.

In April, 1893, a grand international naval review, in connection with the Chicago Exhibition, will be held in New York Harbour.

Rape oil has no action on brass and tin, and of other metals it acts least on iron and most on copper.

Aluminium is now used instead of gold-leaf for ornamentation, and, whilst being cheaper, is quite as neat. Two locomotives and tenders at Indianapolis, U.S.A., have been lettered with it.

In future, Spanish war-vessels will be armed with Ordenez instead of Krupp guns. The gun factory at Trubia, in the province of Asturias, will soon be equal to supplying all required.

The moon is 400 times nearer to the earth than the sun is, and hence appears to us to be as large as the sun, although, in reality, it would require 70,000,000 of bodies as large as the moon to equal the volume of the sun.

During 1891 the total export of Russian petroleum from the Baku district was 218,881,225 gallons, of which the British Empire took a third. During that time there were 238 wells at work, yielding about 125,000 barrels, of 42 gallons each, per day.

The new "Greenwich" steam fire-engine added to the Salford Fire Brigade is capable of throwing 750 gallons per minute in one, two, four, six, or eight jets.

Mr. Edison is perfecting an instrument by which he says twenty-five men in a fort can destroy an assaulting enemy by means of an electric stream of water directed against them.

To dye silk black, it must be first washed free from grease, then gently boiled for half an hour in a dilute solution of iron nitrate, rinsed in cold water, and boiled for one hour with half its weight of logwood.

As an instance of the spread of electric lighting, the municipality of Mandalay, Burmah, are considering an application to light several streets of that town with incandescent lamps.

In hydraulic forging, a pressure of 3,000 to 4,000 lb. per square inch will deform hot steel, but at least 15,000 lb. is necessary to fill the corners of a mould, and 20,000 lb. if the corners are square.

The new tent being introduced into the German army is divisible into two portions, each of which can be used as an overcoat by the soldiers in case of rain or cold.

A new submarine vessel, to be propelled by electricity, has been invented by Signor Pullini, of the Italian Navy, and one is now being constructed by the Italian Government at Spezia.

There is to be a tower 1,150 ft. high and containing 6,000 tons of steel at the Chicago Exhibition.

TRADE: PRESENT AND FUTURE.

Rolling Mills.—Sheffield rolling mills and forges are only employed about four days a week.

Cutlery Trade.—The dispute at Messrs. Rodgers & Sons' continues. Trade is dull and depressed, few orders coming in from America and the Continent.

Cotton Trade.—Over 80 per cent. of the Employers' Federation are in favour of a 5 per cent. reduction in wages, so that notices will be given to the operatives forthwith.

Silver Trade.—The plate trade is depressed, with no demand for cheap goods. The foreign request is for goods of best quality. The German scare has only proved how superior English silver manufactures are.

Engineering Trade.—The improvement in the engineering trade of Lancashire has not been maintained, and most branches are very short of work. Locomotive builders are quiet, and boiler makers have little new work coming forward. The returns for the month of the Amalgamated Society of Engineers show a considerable increase in out-of-work members, 6½ per cent. of the total membership now being in receipt of "out" support. So far as the Manchester district is concerned, it is considered that the number of members unemployed is now larger than for a very long time past. As regards the Steam Engine Makers' Society, there is little change, the returns still showing about 2½ per cent. "out"—the largest proportion of unemployed being found in the marine engineering centres.

File Trade.—The depression in this and kindred branches continues, the workmen being reduced to three and four days per week.

Boot and Shoe Trade.—In Liverpool the retail boot and shoe shops are only doing very little trade, and the leather market is unchanged.

Gold Thread Trade.—The home trade is still very quiet. The latest advices from Bombay report trade very dull there on account of large stocks of old threads. A similar state of things exists at Madras. A small trade is being done in frosted threads, but other imitation gold and silver threads are not in demand.

Coal Trade.—The South Wales coal trade seems to be approaching a crisis of no ordinary nature. For many years this great industry has been regulated, in the matter of colliers' wages, by a "sliding scale," this being regulated by the average prices realised by the colliery owners and brokers, and fixed by representative auditors at regular periods; but the colliers have determined to throw up the sliding scale basis of payment, and to join the Miners' Federation.

Iron Trade.—A revival marks the Midland pig iron trade. The demand is for both foundry and forge iron, and prices are being advanced to keep off pressure by consumers. Best Derbyshire pigs were advanced to 47s. delivered; Northamptons, 45s. 6d.; and Lincolns, 50s. Foundry prices are 1s. 6d. per ton above these figures. The Lancashire iron trade shows little business. In Derbyshire a better tone prevails, and at the blast furnaces there is a good output, while the finished iron trade is steady. Our Liverpool correspondent writes:—The export of iron shows a decided decrease upon last year's quantities. In iron, etc., the following prices are ruling: Marked bars, £8 10s.; common Crown bars, £6 5s. to £6 7s. 6d.; hoops, £6 10s. to £6 12s. 6d.; black sheets (singles), £7 2s. 6d. to £7 5s., doubles, £7 10s. to £7 12s. 6d.; Alloway charcoals, 13s. 6d. to 14s.; Siemens' tins, 12s. 6d.; Bessemer tins, 12s. 6d.; B.V. cokes, 12s. 3d.; Dean ternes, 12s. There is very little inquiry either for black or tin sheets.

Steel Trade.—In Lancashire there is an improvement. In the Barrow district, however, several mills are temporarily idle, owing to trade disputes. At Sheffield the better class of crucible steels has received a slight impetus, but common brands cannot find a market.

Shipbuilding Trade.—In Lancashire this is very bad. At Barrow business is very quiet, and at the present time it is, temporarily, almost at a standstill, owing to a strike of smiths, pattern-makers, engineers, etc., who are resisting a 5 per cent. reduction of wages. At Liverpool the trade has not recovered its tone at all, and it does not appear as though there would be any improvement this year. Our Aberdeen correspondent writes:—A slackness is beginning to be felt in some branches of the shipbuilding and marine engineering trades here. Pattern-makers have little to do, and moulders are gradually getting out of work.

Jewellery Trade.—In London things appear on the move—slowly, it is true. Still, there is an undoubted increase in the orders.

Building Trade.—In Aberdeen trade is exceptionally busy, and fresh work comes steadily in. Master masons and granite workers refuse to grant the men the extra ½d. per hour. In the Liverpool district builders are still actively employed on small dwellings. Bricklayers have been wanted for Lancaster, 9d. per hour being offered. At Cardiff the strike, which is in its sixth month, continues—masons, plasterers, and plumbers being concerned. The points in dispute are rates of wages for mechanics and labourers and the question of sub-contracting.

SHOP:

A Corner for Those who Want to Talk It.

I.—Letters from Correspondents.

Technical Education for Soldiers and Sailors.—J. C. K. (*London, N.W.*) writes:—"The subject is a vast one, yet it can be put in the metaphorical nutshell. The military and naval system of hond service under perpetual supervision admits of the easy application of training men to the arts and crafts of useful things in every-day demand. The success of the partial application of technical training of soldiers and sailors is a full warrant for its general application to every man in the service; this, of course, includes officers. What is now done is briefly noted for reference. The cavalry regiments have so many farriers and armourers, who are highly efficient workmen. They have saddlers and harness-makers, clerks, tailors, shoemakers, cooks, etc., and these are generally coveted situations, as the drills are fewer and military duties less. The artillery are similarly favoured, with the addition of wheelwrights, carriage-makers, etc. The Engineers have many more arts and crafts to which their soldiers are trained, and the survey of Great Britain and Ireland, as well as much of our Colonial Empire, attests the highly intellectual training of the men, in which the officers participate and supervise. But this technical education only includes about 10 per cent. of the army numbers. Of the navy, about the same extent of technical training in arts and crafts prevails—of course, combined with engineering and seamanship. The Marines are less favoured by this training than any. What prevents its general adoption? Nothing but the inertness of those who have the power to say, 'Let it be done.' The question comes in at once, 'What prevents this order for technical training?' 1st. Incapability of officers, who should be teachers of the technology of crafts, to a great extent, as they are of drill, etc. 2nd. False pride at having to attend to common work that soils the hands. 3rd. The absence of suitable workshops in or near barracks. Reviewing these reasons *seriatim*, it will be asked if officers should be the teachers. With bonded men none others could be introduced to barracks, especially as the teaching would be primarily for the service requirements, for its material of transport, barrack building, including workshops, and all that is needed for the exigencies of war. Officers are the *élite* of the people for dash and energy, and could soon be efficient teachers. Now comes the insurmountable barrier—pride. Many of these gallant fellows, whose silly mothers—and fathers, too—would deem it *infra dig.* for their darlings to soil their hands at honest work, which really would give dignity to their existence as men, would exclaim, 'What! like a common working man?' 'Yes,' I would reply, 'even as exalted as that.' And I should like to have the power to add, 'The order must be obeyed.' This would imply school and college training. The want of workshops in barracks or on ships would at once be a prime starting action of technical education for the soldiers and sailors to build them. Here would be a dozen crafts, and some professions included—as the surveyor, draughtsman, designer, architect, quantities estimator, brickmaker, potter, iron-founder, smith, forester for felling timber, sawyer, waggon-builder, carpenter, joiner, plasterer, stonemason, bricklayer, ladder-maker, glazier, plumber, carver, gilder, painter, upholsterer, etc. etc. The diversity of work, even in extending barracks and dwellings for furtherance of workshop erection for technical training, would find out the capacity of every individual in a regiment or ship, and a superfluity of talent or lack of it might be regulated by exchange of men from other regiments or corps. In some cases the work would be extra-mural, so that quarry work, brick-making, forest work, or foundry work, would be done as convenient to the depôt of a regiment or its barracks as might be deemed serviceable. All this technical work has to be done when a regiment is on foreign duty in war time, though mostly done in a perfunctory and haphazard way. Bridges have to be built from timber cut down by soldiers, forts erected, huts raised, and much unexpected work has to be met by men who are not trained for it, often without adequate tools, shops, or appliances. So in time of peace thoroughly capable workmen might be turned out of the whole of the rank and file of army and navy. Soldiers and sailors now receive extra pay as artisans; this should be extended to all. Officers, whose pay, it is said, in the lower grades is barely enough to pay laundress and tailor, would be owners of a craft and earners of honest money. I fancy I hear some persons say, 'Fudge! It is easy enough to let your pen gallop away with your ideas, while you lash them with the whip of fancy. Has anything like it been done?' I have already shown what history has told us—it has been done in war-time. 'But in peace-time?' the objector will interrupt. Well, I will take a survey of what has been done in peace-time with farm labourers, free from the restrictions of military compulsion, and without adequate education. The writer took charge of a large property—a model farm and two others, 800 acres, also an estate of 1,500 acres. His first act was to raise pay and increase it for overtime, which is essential in some seasons of farming, forestry, brick-making, and pottery work. His next was to order all implements, carts, waggons, wheels, harness, cottages, and farm buildings, to be made or erected by the men without extraneous aid, except foundry work. Every man was engaged to go on or leave at an hour's notice, and each was to be paid as a mechanic or artisan, if he did that work. Being thoroughly experienced in all these crafts, he took the trouble to teach every man his branch of trade, and the farm work was carried on so efficiently that one year some of the men were able to earn a double harvest, as he could spare them for the in-gathering of a neighbouring farmer. The system was by a gradation of work according to the augmenting capability of each man. The hurdle-maker was made a gate-maker, and then a cart-maker, then a wheelwright and implement-maker. Others from the woods were made pale and lath renders, sawyers, and soon merged into carpenters' or implement-makers' work. The skins of the animals killed on the estate were sent to be tanned and curried, and harness- and collar-making was taught to the man with the pliant fingers. Smiths were made from men who liked forge work, brick-makers and bricklayers and plasterers were made with the aid of one who was not only one of the best farm labourers, but a first-rate bricklayer. Farms and cottages were built, roads made, bridges built, and the crops were augmented in bulk and quality. The stock of animals improved, and in all root crops 'on the ridge' a furrow crop was also obtained. Ensilage was made in large barns packed up to the tie-beams, long before the name was coined for what was then known as salted and packed chaff. Here was work economically done by the will of one man with what some people would have deemed incapable men, with no other constraint than the respect the men bore for one who they knew often worked twenty hours out of the twenty-four in devotion to a principle—that those under him should be as capable as himself in craft work, and be well paid for all they did. Sobriety was one of the main aids to success. The hour's notice to quit was the plain cause of such unfailing sobriety that no man ever had to leave at an hour's notice. Those who did leave went with the highest characters, and to places yielding better prospects in life. What a humble individual could do well on a farm the State could do better for the army and navy."

Quarter Horse-Power Engine.—F. A. M. (*Eastbourne*) writes:—"Replying to the question of G. W. S., on p. 318, I have sent to the Editor a design for a boiler for the quarter horse-power engine, which has been adopted by one of the makers, and have entered with it remarks and suggestions for its improvement. I should like to suggest here to our Editor that a suitable boiler for that engine would be a capital subject for a prize competition; and that it might be within the constructive powers of an amateur, it should be a pipe, or 'sectional' boiler, composed by screwing together steam-piping, the whole to be set in fire-brick in such a way that it might go into an ordinary fire-place when the fire-stove is removed. Thus the amateur would run no risk of an explosion."—[Thanks for the suggestion from an esteemed member of the staff, but our competitions necessarily have to be interesting to all, rather than to sections of, readers.—Ed.]

II.—Questions Answered by Editor and Staff.

Clock Spring.—F. L. L. (*Richmond Hill*).—You do not say what you require it for, or if you have any parts you want to utilise; if not, I should suggest you get one of those cheap American lever time-pieces, take the works out of the case, and take away the balance and pallets; then take off the 'scape wheel from its arbor, and fit a fly or fan on the arbor in its place; keep the fan or fly as large as it can be to free the next wheel and arbor. By doing this you will save a lot of time and trouble, and it will be cheaper in the end. You might pick up an old movement complete from a watchmaker good enough for your purpose for next to nothing, or I may be able to find one for you if you will pay postage, as we frequently throw them away when they will not go.—A. B. C.

Barrow Making.—P. E. B. (*Birkenhead*).—Articles appeared in Work, Nos. 68 and 174.

Cameras.—A. H. S. (*Kelvinside*).—Articles on the construction of cameras appeared in Work, Nos. 13, 23, and 70.

Pedals to Piano.—A Subscriber from the Commencement.—A paper on this subject is in hand, and will shortly be published.—M. W.

Electric Early Riser.—Electro Novice.—There have been many designs and descriptions of electric alarms in Work. Consult back numbers and indexes of volumes, or purchase numbers 32, 131, 160, and 179.

Graphs.—A. W. (*Stockport*).—An article on "How to Make Graphs" appeared in Work, No. 162.

Electric Current Measurement.—J. B. (*Keighley*).—I have several times explained the meaning of terms used in the measurement of electric currents. When the measurements are given in ampères, they relate to the volume of current measured, the pressure being disregarded. When the measurements are given in volts, they merely indicate current pressure, or potential, the latter being the more correct term. When the measurements are given in watts, they indicate both potential and volume, one being multiplied by the other: as, for example, 50 volts multiplied by 10 ampères equal 500 watts. Read in another way, it might be put down as 10 ampères at 50 volts' pressure. This latter method is more definite than watts alone, as will be readily seen by comparing the following multiples:

10 volts	50 ampères	=	500	watts.
20 ,,	25 ,,	=	500	,,
50 ,,	10 ,,	=	500	,,

You will find further information on this subject in Vol. III., p. 221.—G. E. B.

Engine Traction.—WOULD-BE DRIVER.—The only course we can advise our correspondent to take, under the circumstances he names, would be to get employment where such engines are made, or in those places where they are in use, so that he may, by helping, learn as much as he can about them—how they have to be handled, and the other conditions incident to their use; and if persevering, attentive to his duties, careful in his work, above all *sober*, and proves himself trustworthy and capable, he may, in a year or two, fit himself for what he desires. There are no special books that we know of which treat on such matters, but most of the makers publish and send out with such engines instructions for their use and management, but the books alone will not give the necessary ability for the purpose, this only being acquired by practical working and experience under the various conditions they have to encounter in working.—C. E.

Auto-Harp.—MUSIC.—The auto-harp, or chord zither, is an instrument that has only lately come into use, and I believe all the different arrangements for producing the chords are patented. For the rest it is identical in shape and size with the better class of Prince of Wales' harp, and may be made with from twelve to thirty strings.—R. F.

Musical Glasses.—D. B. (*Batley*).—In Vol. II., p. 325, of WORK is an article on the selection and arrangement of a set of musical glasses which you might peruse. To get them perfectly in tune they are partly filled with water, and the liquid used to dip the fingers in is only clean water slightly acidulated. The edges of the glasses must be scrupulously clean, as the slightest trace of grease will prevent the fingers "biting." A great deal depends upon "knack" in producing a good tone, but when this "knack" is once got the glasses respond immediately to the touch. They may also be played with a violin bow, or a small wand covered with leather and resined; but neither of the latter methods give the peculiar liquid tone obtained by "wiping" round the edge of the glass with the fingers.—R. F.

Arc Lamp for Dynamo.—J. W. T. (*No Address*). Had you given me the output of your dynamo in ampères and volts, I could have given you a more useful reply, as I could then have told you the kind of arc lamp suited to the current obtainable from your machine. Presuming that your machine will give an output of from 5 to 8 ampères at a pressure of 50 volts, I think you cannot do better than get one of Messrs. Woodhouse & Rawson's "Diamond" arc lamps, or one of Beaumont's "Equilibrium" arc lamps. The last will cost about two guineas, and may be obtained from Mr. Beaumont, Nunnery Lane, York. Mr. G. Bowron also makes a cheap arc lamp for amateurs. You will probably get even more light from an arc lamp than the figure you quote. Useful instructions and illustrations on making an arc lamp will take up more space than can now be spared in "Shop."—G. E. B.

Bicycle Enamel.—G. T. (*Birmingham*) and A. W. (*Manchester*).—Proceed by scraping off all the old enamel or paint, then rub every part with emery-cloth or glass-paper; wipe with a rag that is free of oil or grease. Get club black hard-drying enamel, and float it on freely with a soft brush. As this enamel is somewhat thin, it will not be sufficiently covered with one coat. Rub down the first coat with fine emery-cloth, then float on another coat. If carefully done, the result will be fairly good, though not equal to stove enamelling. To have the machine properly enamelled, send it out to a professional enameller. Club black enamel is to be had from any cycle depôt. Guest's enamel is pretty much the same as club black; also of all cycle dealers.—A. S. P.

Bicycle Springs. — VIBRATOR. — Springs of almost every kind may be had of Geo. Salther, spring balance maker, Birmingham. The price, of course, depends upon the kind of springs wanted. Our correspondent's letter is indefinite on this point.—A. S. P.

Electro-Motor and Dynamo.—A. F. (*Ovenden*). —Until I clearly know what you and your friends mean by an electro-motor and dynamo combined, I cannot help you. Any small dynamo made to light one or two lamps may be used as a motor when furnished with suitable brushes, and currents sent through it from a strong battery such as a Bunsen or Grove.—G. E. B

Embossing.—S. K. (*Leytonstone*).—To retain the acid on the glass whilst it is etching it, form an edging all round with either wax or putty, the height to be regulated according to the acid you pour on, and that will be determined by the depth you wish to etch the glass. If the acid has been acting on the glass for some time it will be hardly worth while retaining it, but as to that you must decide for yourself. Retain it and try it again, you will soon see whether it answers. For etching needles and gravers try Brodie & Middleton, Long Acre, and if they have not got them in stock, they could soon procure them for you.—W. E. D., Jr.

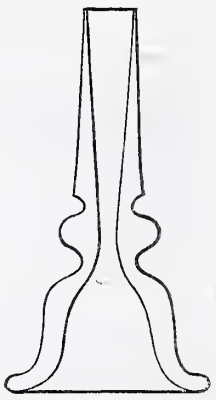
Monumental Work.—WOULD-BE SCULPTOR.—An article on this subject may appear in a future number. Have you read the article on "Masons' Work" in Vol III. of WORK? The accompanying sketch represents a tool for cutting letters. The cutting edge is spread out, and they are made in various sizes from ⅛ in. to ½ in. wide. After the letters are marked, they are cut in with an ordinary chisel of suitable width, then cut with the lettering tool, using a lead mallet. The letters are blacked with the best black paint mixed with gold size; as much gold size must be added as will prevent the oil in the paint from running and discolouring the stone. The stone should be perfectly dry when the paint is applied.—M.

Cutting Tool.

Ladies' Combined Workbox and Travelling Case.—J. E. (*Notting Hill*). —It would be folly to rush haphazard at a conclusion respecting your letter, and give a design which might prove useless. I must place a few questions first. Do you require a workbox with accommodation for toilette requisites and other small items, which ladies know more of than their companions of the opposite sex do? or do you need a case for the reception of clothes and articles of that class? do you wish it to be made of wood or of leather? Say what it is destined to contain, and I shall be in a far better position to tender my advice and a design. Long letters, providing they do not depart from the description of the needs of a correspondent, are preferable to short ones. As an old subscriber, you will see I am taking the best course, at present; so please burry up with your particulars.—J. S.

Bicycle Plating.—NITRATE.—I am quite unaware of any preparation of silver that will take the place of nickel-plating on a bicycle. I am quite certain there is no substitute that will either have the appearance or the durability of nickel-plating. —A. S. P.

Soldier's Trumpet.—ON PLEASURE BENT.—What our correspondent terms soldiers' trumpets are of two kinds—the regulation bugle used by infantry regiments and the regulation trumpet used by the cavalry. The former is of copper, with three turns—that is, the conical tubing is bent into three turns. The cavalry trumpet is a deeper-toned instrument, made of brass, with two turns. The mouthpieces are of cast brass, and are turned as shown in diagram. The penetrating or carrying power of the sound is due to the form and proportions of the instrument, and to the fact that the air column in the tubing is made to vibrate with considerable force by the performer, as the cup of the mouthpiece diminishes in diameter to an opening about $\frac{5}{16}$ in. across, through which the air has to be driven by the player. The long coach or tandem horns referred to by our correspondent are straight conical tubes tapering from ⅜ in. to 4½ in. in the 40 in. coach horn. There is no definite length for these instruments. The method of making these straight horns is to cut from the flat sheet brass or copper a strip of the required size and taper, and with a tool which resembles a punch to throw up on the one edge a series of little teeth, at about ⅛ in. apart, and then bring the edges together, beating down the small teeth to hold them in position. Then solder, clean, and polish. It is usual to solder a piece of half round brass wire round the edge of the bell. The horn sketched by ON PLEASURE BENT is a *signal* horn used by railway guards, bicyclists, etc. The sound in these is produced by a small brass reed, on the same principle as in the concertina.—G.



Trumpet Mouthpiece.

Black Japan.—LEARNER.—I regret that I cannot inform you how to make the black varnish or japan sold by Docker Bros., not being in the confidence of that firm. If there is any specially good quality about it, you may depend they will keep the method of preparation a secret. Besides this, the manufacture of such things is risky and expensive; and I am sure it would pay you better to buy what you require, even if you knew how to make it.—R. A.

Barnes' Saw and Lathe.—C. P. (*London, N.W.*).—I have not actually seen Barnes' scroll-saw combined with circular, but I have seen their lathes, and heard them highly commended. I think you would get good value for your money. The No. 4 lathe is a slide-lathe, very good for small metal work. You do not want a slide-lathe for light cabinet work, for which I think No. 3 would be more suitable. If, however, you wish to work in metal as well as wood, have No. 4. It is impossible to say "what is the smallest amount it is necessary to go to for a serviceable machine," people's ideas differ so much as to what is serviceable; will not my remarks on p. 18 of Vol. I. help you to make up your mind? Your last question—as to motors—is fairly answered on pp. 22 and 23 of Vol. III. You can hardly expect WORK to tell you which maker to go to, because that would be giving a gratuitous advertisement. As writers, we try to be fair all round. You asked about Barnes, I therefore gave my opinion; but to ask me to recommend a maker is another matter. I may say, however, in addition to what you will find on p. 23, if you have a gas engine, have a compression one—say an Otto or Purnell; do not have a non-compression one. Gas engines are cheaper than they were a year ago. Remember, however, that if you must have a motor, you will also require shafting, a counter-shaft for each machine, with crossed and open belt, and striking gear to stop, start, and reverse. Motor may cost £30 and shafting £10.—F. A. M.

Telescope.—H. M. M. (*Bootle*) writes for instructions for making a telescope by which he could read the titles on the back of small books at a distance of 7 ft. or 8 ft. From the question, and also from the size of the writing, I judge H. M. M., like myself, is short-sighted. Seven or eight feet is not a long distance for ordinary sight. I, however, with concave glasses could not see under the conditions named. I think it would be folly in the extreme to make a telescope simply to meet such requirements. What I recommend is a cheap opera-glass or, better still, a pair of good spectacles. If H. M. M. will turn to WORK, No. 142, page 598, he will find the details of a telescope which will do what he wants. But if what he proposes doing is all he needs a telescope for, then I am afraid the results will hardly be worth the labour and cost; besides, from its length, a telescope would be unsteady to view objects so near. The binocular or opera-glass is to be preferred. A cheap one to answer the purpose indicated can be procured for a few shillings. If desired, I would give a few helpful hints for the construction of one.—O. B.

Wax Threads.—R. T. W. (*Leicester*).—You ask for hints on the above subject, and in this column it is all I can give you; but, seeing well the difficulty you are in, brevity shall not rob you of much, though, if you have well read my papers, you should not have bought "machine thread." You had better get a ball of No. 9 patent flax, a ball of wax (soft for cold weather, and hard for warm weather), and a halfpennyworth of bristles, and these you will find out how to put on to the thread when it is made by turning to p. 716, No. 149, Vol. III., of WORK, and reading my answer to A. H. (*Nottingham*). To make the threads, get the end of the flax from the inside of the ball, and hold it about a foot from the end on your right knee (or thigh), and roll it on it till you get to the knee. This, if you do not pull it too tight, will untwist it between the two hands, and by taking the end in the right hand (without letting it twist back again), holding it firm, and giving a sharp snap, it will break in two, leaving both ends flossy and tapered. The odd piece in the right hand you throw away. You then cut off about a yard and a half, and with it, at this juncture, repeat the above process. These two ends you put together, and follow it on till you reach the other end of the yard and a half; there you twist and break again, and also put the ends together. This process you keep up till you have what you want, say, nine cords. (Read up articles; various numbers are given for different kinds of work.) Each time you add one cord or strand to another, let it be a little below or a little above the other. This is to make a fine thin taper to receive the bristle. Now pass the whole through a little water to wet it, and pass it between the thumb and finger, to take away all superfluous water; then put the middle of it over a hook in a window-sill, hold one end in each hand, stand on your left leg, and rest the right on a stool, and twist the end in the right hand the same way as you did the flax in casting off. It does not want to be twisted too tight—about nine or ten times will do, but, whatever the number, count them, and twist the other end the same. Then put the two ends together, and rub them down briskly with a piece of rag. Take it off the hook, so as not to let it get into tangle. Let it dry, and it is ready to receive the wax. Have a piece of wax about the size of a walnut in the right hand, and in the left have the thread wound once round, with one end about 2 ft. long. Hold the left up in the air in front of you, put the right up to meet it, and catch hold of the part of the end near the left hand, letting it pass over the wax; close the hand, so that the thumb will keep it in its place on top of the wax. Hold the left hand firm, and draw the other down until it is liberated by there being no more end; repeat this two or three times till it has a nice thin layer on, and then serve the other part of the thread in the same way. Then wax the tapers (the extreme ends), twist them a little, and fix the bristles on as before described. Put the two ends together, twist

them between the thumb and finger to tell you the centre, and they are ready for use.—W. G.

Two-Inch Spark Coil.—H. B. S. (*Wolverhampton*).—*Core* of soft annealed No. 20 iron wires made into a bundle $10\frac{1}{2}$ in. in length by $1\frac{1}{8}$ in. in diameter. *Primary:* two layers of No. 16 silk-covered soft copper wire soaked in paraffin wax. *Secondary:* 3 lb. No. 38 silk-covered well-annealed copper wire wound in three divisions, the partitions being made of ebonite or of millboard soaked in paraffin wax. Each layer of secondary well insulated from the next by one fold of bank or foreign post paper soaked in paraffin. *Condenser:* 100 sheets of tinfoil, each 7 in. by 4 in. The battery power needed will be, probably, from 4 to 6 quart size Bunsen or chromic acid cells in series. Try four cells first; then add others as required. It is not "necessary to have the break hammer working up against the iron core." The break may be worked by means of a separate electro-magnet in the primary circuit away from the core, but it is usual to employ the magnetism of the cores of small coils to work the break hammer.—G. E. B.

Manchester Dynamo.—TINKER.—Wind the cores $4\frac{1}{2}$ in. by 2 in. with 8 lb. No. 22 cotton-covered copper wire. As the space for the armature is 4 in. in diameter by $3\frac{3}{4}$ in. in depth, it will take a laminated cogged armature $3\frac{3}{4}$ in. in diameter by the same in thickness. The circumference of this will be 12 in., and this will divide into six notches of $1\frac{1}{2}$ in. each, and six cogs of $\frac{1}{2}$ in. each, the depth of the notches being $\frac{5}{8}$ in. each. You will probably be able to get $3\frac{1}{2}$ lb. of No. 20 double cotton-covered wire on this armature, or about forty-seven yards in each division. This, when driven at a rate of 2,000 revolutions per minute, should supply enough current to light one 20 c.-p. and two 16 c.-p. lamps, requiring from 25 to 30 volts each.—G. E. B.

Simplex Dynamo.—C. R. (*Camberwell*).—I wish you could have given me the measurement of the armature tunnel, and also told me the kind of work you wished to do with the machine. The term "large ampèreage current" is rather vague, as you do not say the resistance of the outer circuit through which you wish to get a large volume of current. If you wish to get a large volume of current from your machine at a low tension, you must wind the armature with coarse wire, say No. 18 or No. 16. A drum armature is most favourable to the production of large volumes of current, since the resistance of the coils is lower than that of the shuttle form. In a series-wound machine, the resistance of the wires on the fields must be two-thirds that of the armature coils. In a shunt-wound machine the resistance of the fields must be 400 times that of the armature coils. The resistance of the armature coils should be one-twentieth the resistance of the outer circuit or work to be done by the machine.—G. E. B.

Plumbers' Metal.—AMATEUR.—I do not know of any special mixture for use without irons or blowlamp. If you are making joints in the workshop, it is quite possible to make a joint with only a ladle of metal and a splash-stick, if you have metal enough, and have the knack of keeping up the heat. A mixture of two parts lead and one part tin will make a good solder for the purpose. The best book I know of for practical plumbing is by P. J. Davies (Spon). Watch for papers in WORK.—R. A.

Hot-Water Pipes, Care of.—J. T. H. (*South Shields*).—The only thing you can do is to either keep your fires in or run all the water out. You will find that large pipes are not so likely to freeze as small ones. Any pipes that are not actually in the building you might lap round with felt, as a help towards the desired end.—R. A.

Sheet-Metal Pattern Books.—A. W. (*Warrington*).—There are several manuals for the use of tin and other metal-plate workers, but you will find that none of them are so simple that you will understand them without any study. The best book that I can recommend you is C. T. Millis' "Sheet-Metal Work" (Spon). The one you refer to was, no doubt, Warne's, a book once deservedly a favourite, but not, in my opinion, equal to Millis'.—R. A.

Polishing Gilders' Agate Burnisher.—TIP.—In the removal of the flaw, have you not also altered the shape? And even if you have not, the best and cheapest way will be to get a lapidary to re-polish it; it will cost but a few pence. If you cannot send it to be done in the best way, you might succeed in getting a good surface on it by making a wooden disc to run on a lathe. On the front of the disc should be fixed as much selvage of cloth as will just cover it; the selvage to be coiled up as ribbon is, and glued on; this is called a "list lap." Make another wooden disc, and cover that with leather; this is called a "leather lap." When dry, the agate can be polished by subjecting it to the list lap, charged with powdered pumice and water; then to the leather lap, charged with putty-powder. As a rule, a great amount of friction is required, and a lathe is the only easily available method of obtaining it; but in your case a leather buff charged with putty-powder might suffice. You might try that first. If you make any laps, 3 in. or 4 in. diameter will probably be large enough for polishing the general run of burnishers.—H. S. G.

Model Boiler Lamp.—W. Y. S. (*South Shields*).—You had better send particulars of your requirements to Mr. Caplatzi, who advertises in WORK, if there is no one in your town to sell a suitable lamp. You can buy the right thing far cheaper than you could make something that would prove to be useless.

III.—QUESTIONS SUBMITTED TO READERS.

**** The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Soldier's Box.—W. G. (*Leeds*) writes:—"Could any of my fellow-readers oblige me with a design for a useful box suitable for a soldier to keep his private property in in the barrack-room?"

Almanack.—A. R. (*Moseley*) will thank any reader to inform him of an almanack that would give the difference upon any day of the year between solar and clock time in order to set a sundial.

Auto-Harp.—MUSIC writes:—"Will a kind reader inform me how to make an auto-harp?"

Tobacco Box.—T. P. (*No Address*) writes:—"Will someone kindly tell me how to make a tobacco box of brass, opening with a lid on the top, hinges at the back, and spring in front?"

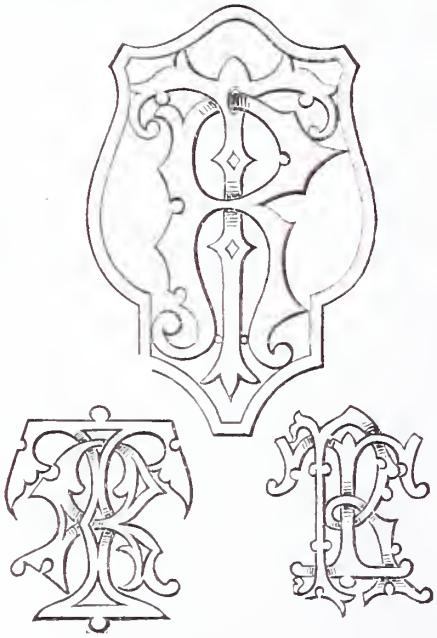
Fowls' House.—B. W. L. (*Leominster*) writes:—"I want to build a span roof fowls' house on wheels. I have some 3 in. square wood for frame. Would some kind reader inform me the best and easiest way to join framework, leaving 18 in. space under floor for shelter; also best wheels to use?"

Boat.—W. J. H. (*Govan*) writes:—"Would any reader oblige by giving me a sketch of a boat, 3 ft. long, built for frames of either wood or light sheet iron? I intend to use steam power."

Polishing Oak Bookcase.—DOC writes:—"Will anyone kindly answer me the following questions:—(1) Best liquid stain, not too dark, for oak? (2) Directions for polishing with beeswax and turpentine, and is it necessary to use a filling for the grain, and if so what material to use? (3) Would the above method of polishing be suitable for a large bookcase?"

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

"R.T." Monogram.—R.D.T. (*Marylebone*) writes:—"I send three designs of monogram, 'R. T.,' as wished for by R. T. (*Glasgow*) (see No. 174, page 286). The larger one of the three is a design which I have



"R. T." Monograms.

used myself and in that size; but our correspondent can easily reduce or enlarge it to suit his requirements. I, however, trust that he will find one of the designs to suit his purpose, but if not I shall be pleased to send further designs of the same monogram."

Telephone Connection.—J. B. (*New Cross*) writes to A. S. B. (*Loughborough*) (see No. 172, page 254):—"The best way, and easiest, to enable your man working outside your building to know if the telephone bell has rung or is ringing inside would be to cut the telephone wire just as it is leaving one of the bobbins of the electro-magnet of the bell, taking great care not to interfere with the switches, drop connections, etc., of the telephone itself, and fasten the two ends of your new line to the two new ends thus made by cutting; carry your lines through the house with, say, No. 16 B.W.G. double cotton-covered wire, and on the outside with the same covered with gutta-percha; to the other free ends of your new line connect up a small bell with a drop indicator, which can be obtained of any dealer in bells, etc. The inside bell and the outside one will now ring in series and at the same time; if your man has not heard the outside bell, the indicator will show him that it has rung. If the line of your telephone is a private one, you will find this all that you require. If the line belongs to a company, well—perhaps, you had better think about it. Only do not say I told you how to do it."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—F. P. (*Birmingham*); J. D. McA. (*Manchester*); PARING KNIFE; F. H. (*Aynho Station*); J. R. (*Canterbury*); H. E. S. (*Chatham*); W. T. T. (*Houghton-le-Spring*); COAT OF ARMS; W. S. (*Chelsea*); J. M. (*No Address*); T. R. (*Ashton*); W. M., JUNR. (*Dundee*); T. B. (*Haydock*); SUBSCRIBER; CANADA; G. S. (*Guernsey*); G. B. (*Elmstead Heath*); L. M. (*Lee*); J. M. (*Nantwich*); J. P. H. (*Hull*); H. S. (*Maidstone*); O. B. (*Wood Green*); R. P. (*Stoke-on-Trent*); DRILLER; H. A. B. (*Middlesbro'*); A. S. (*Epping*); E. E. (*London*); R. J. A. (*Dublin*); G. D. (*Holloway*); PROGRESS; A. E. B. (*Ashford*); GOLD; W. M. (*Bray*); AMATEUR BOOKBINDER; CYCLIST; P. H. Z. (*Hammersmith*); LITTLE JIM; J. B. (*Brigg*); A. S. (*Burnley*); R. S. D. (*Cambuslang*); NOVICE; W. T. (*Southsea*); H. D. (*North Shields*); READER OF "WORK."

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All manuscripts intended for the "Tourists' Travelling Requisite" Competition must be addressed to the Editor of WORK, c/o Cassell and Company, Ltd., Ludgate Hill, London, E.C. They must reach him on or before SATURDAY, OCTOBER 29, endorsed, "Tourists' Travelling Requisite" Competition.

"WORK" WEEKLY CONTENTS.

SEVERAL subscribers have kindly made the suggestion to exhibit a weekly contents bill of WORK in their workshops and elsewhere, for the benefit of fellow-workmen not already subscribers.

Doubtless many others who write expressing their indebtedness to WORK may be similarly disposed. If so, and they will furnish their names and addresses to the Editor, such a bill for exhibition will be sent to them by Messrs. Cassell & Co.

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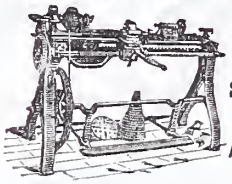

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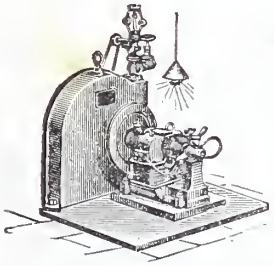

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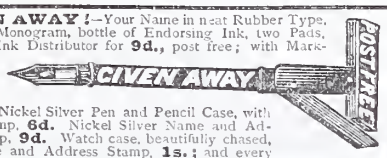

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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Vol. IV.—No. 186.] SATURDAY, OCTOBER 8, 1892. [Price One Penny.

WORK WORLD.

Both Aberdeen and Dundee are to be supplied with the electric light.

* *

Now that the overhead railway system is adopted in Liverpool, other large towns will probably follow the example.

* *

An indiarubber boat has just been brought out, which is inflated with air and is unsinkable. A 12 ft. boat complete, with oars, etc., weighs only 90 lbs.

* *

£3,400,000 will be the estimated outlay on the Chicago Exhibition when the gates are opened, and it will cost about £600,000 to carry on the exhibition during the six months it is open.

* *

In the process of obtaining pearls by boring small holes in the shells of pearl oysters, dropping in minute glass beads, and then hermetically sealing the hole again, it appears that the irritation of the glass bead causes the oyster to deposit around it the calcareous films which form pearl.

* *

A new record-cutting Atlantic steamer will be named the *Gigantic*. She will be 700 ft. long and 65 ft. 7 in. beam, with engines of 45,000 h.-p., and three screws. Her expected maximum speed is twenty-seven knots, crossing the Atlantic in four and a half days.

* *

There is a new method of eliminating sulphur from iron by means of calcium chloride. By the process 78 per cent. of the sulphur can be removed from the metal by ordinary plant. This is a very important discovery, and one which cannot fail to exert a marked influence on the iron trade.

* *

Not only in the yards under the direction of the English Admiralty are faulty ships built. The Japanese ironclad, *Itsukushima*, only got as far as Colombo, Ceylon, before she broke down. Her boiler tube-plates cracked, and the damage was so extensive that artificers had to be sent from Toulon to make the necessary repairs.

* *

Styrian miners used to reject a certain ore as "false copper" (kupfer-nickel), and the metal derived from this is becoming more important. Its resistance to oxidation has easily secured it a place in the market for plated goods. It will be represented at the World's Fair, Chicago, by a solid block of pure nickel, weighing fifty tons, sent thither from Canada.

* *

Between Bagdad and Hamadan deposits of petroleum have been found. The petroleum collects in cavities about 9 ft. deep, and is taken out in pails. It is mixed with salt water, from which the oil is separated; subsequently the brine is evaporated to allow of the collection of the salt. There is also a thin stratum of ozokerite, which is not worked.

* *

A miners' electric lamp has a current obtained from a primary battery of two cells, each containing two carbons and one zinc element. After the battery has run four hours it can be reversed, bringing on a portion of the zinc which has not been immersed. The lamp gives a satisfactory light for ten or twelve hours, with a maintenance cost of about 6d. per week, after the first cost of 15s.

* *

At l'Usine Voad, in the process for obtaining white-lead, lead bars are suspended in a solution of acetate of ammonium, with pieces of non-conducting substance such as carbon at the cathodes. When a current of carbonic acid gas is passing through the solution the acetate of lead is decomposed, the carbonate being precipitated; this is filtered and pressed. The filtrate is reconducted directly to the bath.

* *

There is every probability that the belting of the earth by the electric cable will be completed. The United States Government surveys of the Pacific Ocean, involving over 800 soundings, have indicated a safe route for the proposed cable from Monterey Bay, Cal., to Oahu Island of the Hawaiian group. This cable will eventually be extended to the Asiatic coast. Then the circuit of the world will be complete.

* *

The production and consumption of petroleum is ever on the increase. As showing the growth of this industry, the following accurate figures, copied from official data, will be interesting. The total production in the United States was, in 1859, 2,000 barrels of 42 gallons; 1869, 4,215,000 barrels of 42 gallons; 1879, 19,685,000 barrels of 42 gallons; 1889, 34,820,000 barrels of 42 gallons; 1890, 45,000,000 barrels of 42 gallons. The Russian output was, in 1889, about 21,000,000 barrels; 1890, about 25,000,000 barrels; 1891, about 30,000,000 barrels.

* *

The Royal Commission on the coal supply of Great Britain are of opinion that not more than 146,480 million tons were available at depths not exceeding 4,000 ft. At the present rate of increase of population and of coal consumption, the supply would not last 230 years. Mr. Hall, one of Her Majesty's Inspectors of Mines, calculates the duration at 170 years, and Mr. T. Foster, President of Section F of the British Association at Cardiff, states that the increasing price of coal would be severely felt in fifty years. The find of coal at Ashton-under-Lyne may modify matters.

* *

An important display of the national vehicles of all nations, with types of carriages of early ages, is to be made at Chicago. Amongst the very wide range of conveyances from which to select, the dominant national one of each country will be shown. They will include the dog-sleigh from Lapland, the cariole from Norway, and sedan chair; perhaps the cisium, praised by Tacitus, and the scythed chariot of the Boadicean warriors will be included. There will be the Irish car, Neapolitan cart, Turkish caique, Bombay bullock-cart, Japanese jinriksha, Chinese palanquin, elephant with howdah, and old English travelling chariot. Saddlery and harness will have their representative exhibits. A camel saddle and harness, and even the little-known—except by name—catamaran, will be included, with temples, dahabiehs, and a Nile steamer in models. To carriage and harness makers this retrospective section will be of unique interest, as a comparative estimate of the value of old and new vehicles may be possible.

HOW TO LEARN DRAWING OFFICE WORK.

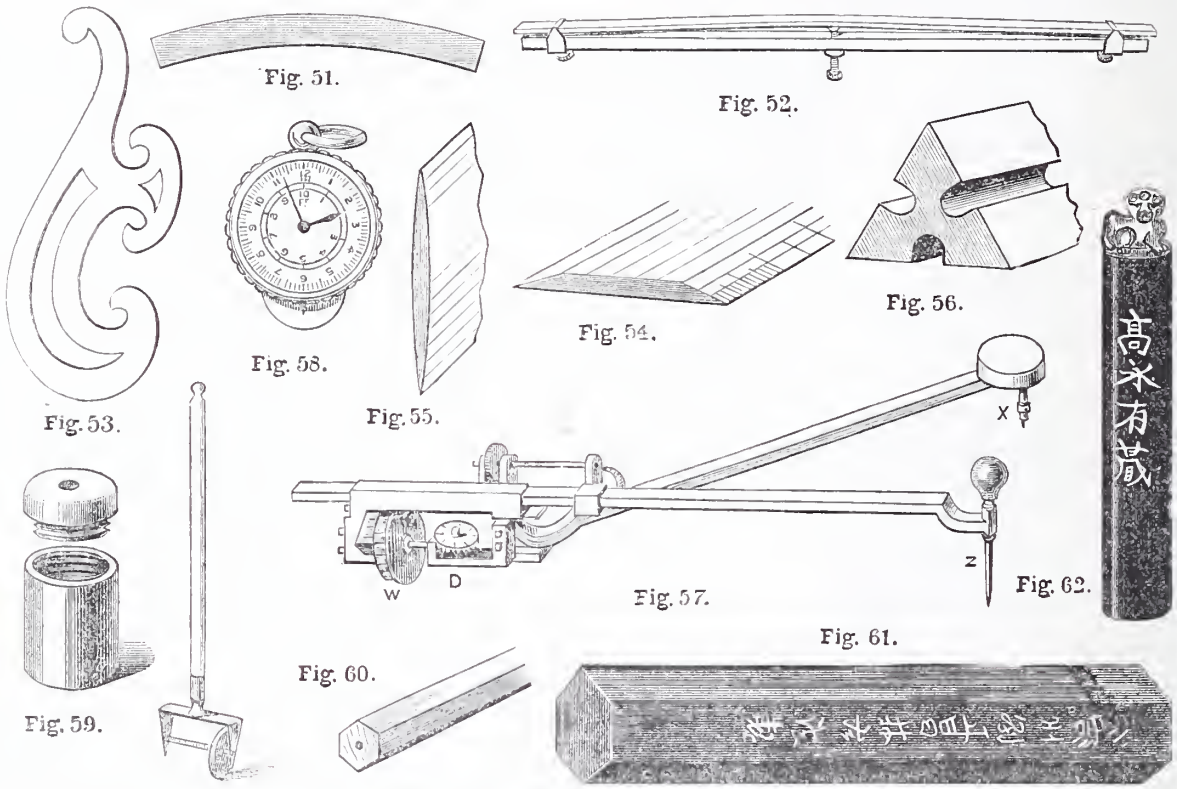
BY ARTHUR BOWES, A.M.I.C.E.

CURVES AND TEMPLATES—SCALES: THEIR SHAPES AND MATERIALS — PLANIMETERS — WHEELMEFNA—OPISOMETER—DRAWING PENCILS—INDIAN INK—TO PREVENT INDIAN INK RUNNING—LIQUID INDIAN INK.

Curves and Templates.—Thin templates of cardboard, wood, or vulcanite, carefully cut to the required curves, are used in certain classes of drawing office work. They may be divided into those which are arcs of circles, and those which are composed of curves struck from various centres. The first or regular curves are used in indicating railway or tramway lines, and for other purposes, and are sold in sets of twenty, fifty, or a hundred, varying in radius from $1\frac{1}{2}$ in. to 240 in. The radius of each curve is stamped on it in figures, and the two edges of the template, instead of being parallel to each other, are both curved to the same radius. Fig. 51 represents one of these railway curves. When a number of these templates are kept loosely in a box it becomes a matter of difficulty to find the one that is wanted without considerable waste of time, especially if the desired curve is already in use, or has not been replaced in the box when done with. To prevent this unnecessary trouble they should be kept in a series of trays, sliding into a cabinet or case, and arranged in regular order according to the radius. A couple of wooden pins projecting from the tray and fitting into holes in the template keep the latter from slipping about, and the contained radii figured on the front edge of each tray make it possible to see at a glance whether any required curve be in its place.

For very flat curves an instrument called a "Curve Bow" is sometimes used. From Fig. 52 it will be seen to consist of two wooden beams, one being a rigid piece of hard wood with a screw working through the centre; the other, a thin, pliable strip, which is bent to a greater or lesser extent by the turning of the screw. Within narrow limits this instrument can be adjusted to varying radii, but if the strip be bent to a moderate extent the curve soon loses its circular character and becomes approximately parabolic.

The most familiar form of template for irregular curves is the well-known "French curve," made in pear-wood or vulcanite. One of the shapes is shown in Fig. 53. There are many varieties of these, and by architectural draughtsmen they are occasionally used in drawing moulds for cornices, brackets, and classical work. Still it should be remembered that a draughtsman who strikes in his curves with a steady freehand sweep saves himself much piecing up of odd lengths of curves selected from the template, and is certain to obtain a more harmonious effect in the end. Similar templates to the above are to be had specially prepared for drawing Grecian, Roman, or Gothic mouldings and Gothic arches.



Drawing Office Work. Fig. 51.—Railway Curve. Fig. 52.—Curve Bow. Fig. 53.—French Curve. Fig. 54.—Section adopted for Scale engraved on one side. Fig. 55.—Scale engraved on both sides. Fig. 56.—Triangular Scale. Fig. 57.—Amsler's Planimeter—X, Fixed Point; Z, Tracing Point; W, Rolling Wheel; D, Dial. Fig. 58.—Wheelmefna. Fig. 59.—Opisometer and Case. Fig. 60.—Hexagon Section of Drawing Pencil. Fig. 61.—Hexagon Indian Ink. Fig. 62.—"Lion" Indian Ink.

In cases where there is much repetition of a complicated detail in drawing, it is a saving of time to make templates out of soft wood, with which the outlines can be rapidly drawn afterwards by passing the drawing pen round them. They can, if small, be shaped with a penknife, the curved portions being smoothed over with a file and glass-paper. As an instance of a case where this expedient is useful, take the drawings for a set of railway points where fourteen or sixteen cast-iron chairs have to be shown, most or all of them with two ends formed to one pattern, to draw which with the compasses may mean describing, in some cases, twelve separate curves to each chair.

Scales.—Although scales are manufactured and sold of various materials, notably, boxwood, ivory, vulcanite, and paper, experience seems to show that for general use the first are to be preferred before the others. Ivory scales certainly are easily read, and are not liable to any serious changes in length due to atmospheric influence, but they are slippery to handle, and are very expensive, and naturally they are becoming more expensive, as the supply of ivory continues to diminish. One of Stanley's boxwood scales, with its cleanly cut divisions, will compare very favourably with the more expensive article so far as legibility goes, and in the matter of expansion and contraction caused by the varying heat and moisture of the atmosphere, there is no fault to be found with boxwood. Both vulcanite and paper are largely affected in this way, and scales made of these materials are useless in very fine work, for they will be found to vary in length from day to day. Paper scales, despite this objectionable characteristic, are clean, light, and very cheap, and for large scale drawings, such as builders' or machinists' details, they are quite suitable. Their tendency to alteration in length may be counteracted to some extent by coating them on both sides with white shellac varnish, which protects the paper from the moisture of the atmosphere. When thus varnished they can be wiped clean with a damp cloth when occasion requires. Messrs. Cassell & Co. publish and supply a remarkably cheap set of eleven of these cardboard strips, containing in all twenty-four scales ready varnished, the price of the set being one shilling. It is hardly necessary to point out that all drawing papers are subject to expansion and contraction, caused principally by the varying amounts of atmospheric moisture. In cases of extreme accuracy it is usual before commencing the drawing to set out a scale near one margin of the paper, and to use this both in plotting the work and in taking measurements from the completed drawing. Thus, any change in the size of the plan will be accompanied, generally speaking, by a corresponding change in the scale, which is drawn on the same sheet of paper. Even this, however, cannot be depended upon to completely counteract this evil, for recent experiments have shown that the contraction or expansion may be confined to one portion only of the paper; or, worse still, while one part of the paper may contract lengthways another portion may contract in the direction of the breadth. It is quite usual to

find, even with good qualities of drawing paper, a contraction equal to one part in two hundred, or a sixteenth of an inch in a foot.

In form, scales of wood and ivory are practically confined to two sections—one, as in Fig. 54, where one side only is engraved upon, though both edges of that side are used. In this form it will be seen that the edges of the scale are bevelled so as to allow of the division marks being brought as near as possible to the drawing. It is evident that with a thick scale, unless the draughtsman is careful to keep his eye directly over the scale, appreciable errors will be made in reading from the graduations. Fig. 55 shows the section adopted where both sides are engraved upon, and as eight scales are generally contained on one of these it is a form very generally met with in the drawing office. Another section, the triangular, shown in Fig. 56, has three edges, and so can be made to carry twelve series of graduations. It is not, however, a convenient shape for use, owing to the sloping surface from which the readings have to be taken.

Special Scales.—There are many other varieties of scales intended for special uses, such as the Computing Scale, Protracting Scales with lines of chords, sines, tangents, etc., Gunter's Scale, Fuller's Slide Scale, and others. These are only likely to enter into the work of the draughtsman in very exceptional cases, and will not be described here. For information with respect to them the reader is referred to existing works of a more mathematical character than these papers.

Planimeters.—Amsler's Planimeter, shown in Fig. 57, is an instrument by which results can be obtained that are astonishing on a first acquaintance, and which are, indeed, a source of admiration even after that familiarity which is supposed to "breed contempt." With this instrument, by simply fixing the needle point, x, in any convenient position on a plan and passing the tracing point, z, round the boundaries of any figure, square, round, oval, irregular, crooked, of any shape whatever, the area of the figure can be read off at once from the dial, D, and the rolling wheel, W. Adjustments are provided by which the area is given at once in square inches or to various scales. For those who wish to investigate the mathematical reasoning of the process, it may be interesting to know that in an article on "Planimeters," in "Spon's Dictionary of Engineering," it is treated pretty fully.

In the Amsler's Planimeter, as described above, the rolling wheel moves directly on the drawing paper or tracing paper on which the plan is made, and some error may occasionally arise from the slipperiness of the glossy tracing linen, or from cracks and wrinkles in old plans. To obviate this difficulty a later form, known as Hohmann Cordi's Precision Planimeter, has been introduced, in which the rolling wheel is provided with a smooth metal platform and does not touch the paper at all.

Wheelmefna.—This is a small and convenient instrument for measuring lengths of lines, either straight or crooked, but particularly likely to be useful in the case of the latter. It consists, as will be seen from Fig. 58, of a metal case measuring in the size shown about three-quarters of an inch across the face, and containing a train of wheels, which are connected with a small measuring wheel and two hands or pointers, which indicate on a dial the distance measured. In the size shown a distance of 12 ft. can be measured with one operation. The measuring wheel projects a little way from the bottom of the case, and when this wheel is rolled along the line to be measured the length is indicated on the dial in feet and inches. It is of great service in measuring routes on maps and small scale plans, as also in girthing cornices for plastering or masons' work. At the back of the case is sometimes fitted a magnetic compass, so that the whole instrument makes a very presentable and decidedly useful pendant for the watch-chain.

Opisometer.—Another instrument suited for measuring curved lines is the Opisometer, which is a simpler and cheaper appliance than the Wheelmefna. Its range of measurement is not so great; with the one shown in Fig. 59, which is about one-half the size of the instrument, a length of about twenty-four inches can be measured. Even with this limited range it is a useful instrument for its purpose, and is said to be much used by continental military authorities for map measurements. It has a handle with a fork at the bottom, supported in which is a finely-cut screw. The measuring wheel runs along this screw. In using the instrument the measuring wheel is brought up to one end of the screw, and is then traversed along the line to be measured. As there is no indicating dial or counting apparatus, the instrument is then lifted off the paper without disturbing the position of the wheel, and the instrument is then passed along a rule or scale in the opposite direction to that in which it was first traversed. When the wheel is stopped by arriving at the end of the screw from which it first started the reading is taken from the scale. In the same figure will be seen the boxwood case which is used to enclose the opisometer, the long handle being allowed to project through the hole in the lid

Drawing Pencils.—It is the best economy to buy the most expensive pencils for use in the drawing office. Either Faber's or Cohen's best Cumberland leads may be depended upon to work smoothly and evenly without any grittiness or inequality of texture. For general use those marked H or HH will be suitable, while for particularly fine work HHHHHH may be necessary. It will, of course, be understood that the number of H's indicate the relative hardness of the pencil. For the rough sketching out of details to full-size or on a large scale, a very soft lead, such as BBB, will be found pleasantest to work with. As to the style of pencil, those enclosed in unvarnished cedar are to be preferred. Pencils of a hexagon section, as shown in Fig. 60, have the advantage of remaining where they are placed, and do not roll off the sloping surface of the drawing board or desk.

Indian Ink.—The genuine Indian ink or Chinese ink is made by the natives of China and the East Indies by a laborious and time-consuming process, the details of which have never been successfully mastered by Europeans. It is a mixture of animal lampblacks with various gums, and when genuine should be perfectly free from grit and should dry with a black, glossy hue. Another important quality—one which it is very difficult to secure—is that when lines drawn with the ink have dried, it should be possible to pass a wash of colour over them without disturbing their clearness or smearing them. This, unfortunately, is an annoyance which cannot be foreseen, even when the highest-priced qualities of inks are used. The writer has known Indian ink for which half-a-guinea per stick has been paid run abominably when washed with a wet brush, although two hours have been allowed to elapse between drawing the lines and applying the test. To remedy this propensity for running or smearing a strong solution of alum is sometimes kept at hand, and a drop or two added to the Indian ink when mixed ready for use. Solution of ammonia is also used by some draughtsmen for the same purpose. When a new stick of ink is brought into use for the first time some experienced draughtsmen prefer to cut off a little of one end before commencing to rub the ink, as it is thought the interior of the stick is more likely to be pure in quality.

In Figs. 61 and 62 are shown two styles of Indian ink which can generally be depended upon for their quality. The first is of hexagon section; the latter is smaller in size, of an oval section, and is ornamented with the figure of something resembling a fat poodle, but which by courtesy is styled a "lion," and accordingly this shape is known as "lion" ink.

The nature of the Indian ink prepared for the draughtsman's use has much to do with the serenity of his temper and the quality of the work turned out by him. It is impossible to do good work with ink that is either too thin or too thick. In the one case the lines will not be truly black; in the other the ink is continually clogging in the instruments. To hit the medium point between these extremes can only be arrived at by experience; and it must not be forgotten that after two or three hours of evaporation a small pot of ink becomes much thickened by the loss of water, and requires thinning down again. Care should be taken in rubbing the ink in the first place not to press too hard on the stick, as small corners are liable to be chipped off, and a cover should be kept over each pot to keep out floating dust and prevent evaporation as much as possible. It is useless attempting to mix up again the remains left in a previous day's inkpots, for the dried ink will not dissolve thoroughly, and, in addition, contains the accumulation of dirt and dust which it is impossible to avoid. When the stick of Indian ink is put away the end should be wiped dry on a duster, or otherwise it becomes friable, and when next used will break away in small fragments. It is thought by some that the colour of the mixed ink is improved by adding a little Prussian blue or indigo to it.

Liquid Indian Ink.—Indian ink is to be bought in bottles, mixed and ready for using. It is, of course, a little more expensive to use in this form as a regular thing, but its conveniences may fairly be thought to counterbalance the extra cost. It is always ready; there is no waiting for ink to be rubbed. It is always fresh and free from dirt, and most important of all, it is remarkably liquid, intensely black, and will stand a vigorous washing without any signs of smearing. At least, this is the writer's experience with Wolff's and Thornton's liquid inks, both of which were subjected to severe tests.

Cement for Marble.—Take plaster-of-Paris and soak it in a solution of alum; pour off the alum, and bake the plaster in an oven, after which grind the mixture to a powder, and use as wanted. When mixed up with water, like plaster, and applied, it sets hard.

JEWELLERS' ENAMELS AND ENAMELLING.

BY H. S. GOLDSMITH.

TRANSLUCENT ENAMELS—METHODS OF PREPARING THE GROUND FOR SAME—BARLEY FLANKING, ENGINE TURNING, CHASING—HENRY VI.'S GOLD CUP—PLIQUE À JOUR ENAMELS—PERTABGHAR OR PURTIPOOR ENAMEL — FALSE ENAMELS—ROCOCO WORK—NIELLO—ENAMEL PAINTING — PROCESS OF PREPARING THE PLATE—THE APPLICATION OF COLOURS, ETC.

THE preceding paper (see WORK, No. 181, Vol. IV.) on "Enamels and Enamelling" was mainly explanatory of the usual classes of enamels. This paper deals with the more uncommon varieties, such as "translucent on relief," plique à jour, and Pertabghar enamels.

It will soon be seen that the difference between the different classes is not very great —in fact, they are mainly refinements of the cloisonné or champ-levé, as we usually see them in jewellery.

Translucent and Translucent on Relief.—The variety called "translucent on relief" is but a natural outcome of the way the ground is prepared for all translucent enamels. For these the ground—being visible through the enamel—is prepared by cutting it into some regular pattern with a round scorper, or else it is engine-turned. One or the other of these is used for the purpose of obtaining all the brilliant effect an enamel is capable of giving when the light is reflected with varying shades of colour from the many surfaces the turning tool or scorper gives.

For opaque enamels very little work is done to the ground, as, not being seen, it would be wasted. Further than some such simple mechanical preparation of the ground as engine turning or "barley flanking," we jewellers do not go, as a rule; but it is evident, on the slightest reflection, that it is quite possible to chase figures or any other subjects in low relief at a suitable depth, and then to cover them with a coloured translucent enamel, just as the usual "engine-turned" or barley-flanked surface is covered. This has been done centuries ago, and, although strictly champ-levé work, still its added artistic qualities have entitled it to promotion into higher class — viz., that of "translucent on relief" enamels.

Henry VI.'s Cup.—This variety of enamel is much spoken of at the time of writing, on account of the great gold cup (Fig. 4).

The *Magazine of Art* speaks of it as follows:—"We are enabled by the courtesy of Messrs. Wertheimer to include a drawing of this cup, which is thought to have belonged to Henry VI.'s Treasury. As a royal relic of the Sacred Treasure of England, it is sought to acquire it for the nation for the sum of £8,000—the price paid by Messrs. Wertheimer. Of this sum the Treasury has granted £2,000, and only about the same amount is unsubscribed. Its history is as follows:—A few years ago a Spaniard in Paris sold this cup to Baron Pichon, from whom the present owners purchased it. The baron ascertained its identity from an inscription on the cup. It is believed to have belonged to Charles V. of France, and through his grand-daughter to have come into the possession of Henry V. of England. The cup was certainly in the Royal Treasury before the days of the Tudors, and is mentioned in the inventories of Henry VIII. and Elizabeth. It is thought that James I. gave the cup to Velasco, the Spanish ambassador, in memory of the peace between his country and ours after the destruction of the Armada. This fine mediæval specimen of the goldsmith's art is enamelled with numerous scenes in the life of St. Agnes, and for many reasons we are glad to say that it has been secured for the British Museum, where it can be seen any week day between 10 and 4 o'clock."

This cup is mentioned here because the enamels are very splendid and extremely rich in colour. This is only what we expect; for fine gold ought to bring out all the beauty and brilliancy of the colours, and the cup is made of fine gold.

Fig. 4.—Gold Cup enriched with "Translucent on Relief" Enamel.

Perhaps the next best example to be conveniently seen is an old Italian casket in South Kensington Museum (No. 706, 1884), but this is in silver parcel gilt, the "translucent on relief" enamels forming a series of quatrefoil plaques on its exterior. It was in a case on the ground floor of the south court, but may be moved from time to time. This casket is rather disappointing, though, for the enamel work does not look anything like so bright as a green-enamelled gold snuff-box in an adjacent case, and is not to be compared with the cup just spoken of. Is not this class of enamel worth reproducing in modern ornaments?

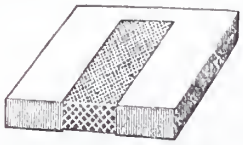


Fig. 5.—Diagram of Enamel fixed transparently, or à Jour.

Plique à Jour.—Both the classes of enamels dealt with in the last paper — that is to say, champ-levé and cloisonné—are for the greater part used with closed backs; but there is a variety (mostly cloisonné) in which the enamel is left *à jour*—that is to say, perfectly transparent. It is shown diagrammatically in Fig. 5. The name given to this class is "plique à jour," and if held up towards a light would have an appearance much like a stained-glass window. There is a cup and cover, about 6 in. high, at South Kensington Museum which shows this class of enamelling very well; it cost £400, and is illustrated in Fig. 6. The enamel forms the Gothic windows and the centre band. There is also lately added, in the south court, Mrs. H. Bolckow's bequest, which contains, among other specimens of jewellery, a pearl and diamond bracelet enamelled "plique à jour," and there are some Russian examples in the collection of modern jewellery in the western galleries. With regard to the Bolckow bequest, we are glad to note that this particular glass case and the articles in it are splendidly placed for inspection. Now, this is, unfortunately, not the rule for jewellery at the Museum. As an instance, take the interesting Waterton collection of rings in the row of cases under the Prince Consort's Gallery; these cannot be properly seen of an evening, when most jewellers are able to attend.

In the same row of cases is the Townsend collection of gems, which alone is worth travelling miles to see; and besides these there are very many articles of interest in those portions of the Museum on the west side of Exhibition Road, which closes at from 4 to 6 o'clock, according to the season.

Pertabghar or Purtipoor Enamel.—To come back to our explanations of the various classes of enamel work, we find that there is yet another kind of translucent enamel produced in India, called the Pertabghar or Purtipoor enamel. This is made in slabs (generally green, sometimes blue), in which gold figures, etc., made from thin pierced plate are fixed. It is usually mounted in settings, so that it can have a bright foil at its back. This particular class, being backed, is not strictly of the "plique à jour" variety, but is interesting as showing a rather uncommon kind of work. In fact, the secret of its manufacture is said to be known to one family only. It is usually seen in bracelets, brooches, and earrings; but, like all other enamel work, it is used for boxes and other larger articles. There is a wall-case full of examples in the Indian section of South Kensington Museum.

False Enamels demand a word or two. There is a kind of mock-antique jewellery often met with. It is usually of chased silver and gilt, set with garnets and turquoises, and is called the "rococo" style. Now this is decorated in several colours with a kind of Aspinall's enamel, or a japan, and therefore is not, properly speaking, an enamel at all. It is more of a paint or varnish—not a glassy substance, as a true enamel is—and if it is exposed to heat at all, then the heat is something considerably less than red heat. At the first glance it looks like an enamel, but it is not, and will come off when being washed out sometimes. The gilding solution clears it right away, leaving no trace behind of its former beauties.

Better than this, but still not an enamel, is the so-called "soft enamel," which is used to repair articles that must not be made red-hot.

Niello.—Another sort of decoration which may be mistaken for enamel is Niello work. This is much like a dull black enamel. It is used mostly with silver ornaments made in Russia and India. Its composition is silver, copper, lead, and sulphur—borax afterwards being added. Now, this is not a mixture, as anyone can judge, at all resembling glass, as a true enamel does. It does not require, nor must it be subjected to, great heat, for the lead in it would burn and destroy the silver surrounding it. It is wrong, perhaps, to class Niello among false enamels, for it is a genuine production, and once seen will not be mistaken for enamel.

Enamel Painting.—It would be difficult to obtain higher authority on matters with reference to enamel painting than that of Mr. W. B. Essex. In a paper published in the *Art Journal* he says:—"The plate should be

$\frac{1}{18}$ in. to $\frac{1}{16}$ in. in thickness, and covered with two coats of enamel and one coat of flux" (flux being an enamel just as the other is, but melting at a lower temperature). "Every colour is mixed with a small quantity of flux, then, when fired, it mixes with the flux of the plate. The colours are made from certain metallic oxides; for some

Fig. 6.—Cup with à Jour Enamels, from South Kensington Museum.

metallic oxides are useless, on account of the great heat required to fuse them. The colours are ground up, and applied by camel-hair brushes, oil of spike being used as the vehicle. The plaque is fired after each layer of enamel paint is applied."

On this one may remark that the plate seems very thick, and the enamel would be much more likely to remain free from flaws if a much thinner one were used. Silver is

Fig. 7.—Pertabghar or Purtipoor Enamel; a Transparent variety of Enamel, with Inlaid Gold Figures, etc.

left out on account of its tendency to warp and blister, either gold or copper being used.

In the Bolckow bequest, at South Kensington Museum, there are two good specimens of enamel painting—one (No. 750, 1890) a portrait of Her Majesty the Queen by W. Essex, and a ring (No. 746, 1890).

Perhaps the most instructive illustration of enamel painting, always on view, is in a series of examples at Jermyn Street Museum of Practical Geology, London, W.

They were prepared by W. Bone, and consist of eight examples illustrating the preparation of an enamel plate, as follows:—

(1) Copper plate annealed previous to receiving the enamel.

(2) Enamel in the block (two qualities).

(3) Plate coated on both sides with enamel applied in a state of powder and then fused.

(4) Enamelled plate, ground to a surface before receiving a coating of flux.

(5) Venetian glass beads and pipe used as a flux.

(6) Enamelled plate, coated with flux applied in a state of powder and then fused.

(7) Enamelled plate, coated with flux and the surface afterwards ground and polished.

(8) Enamelled plate, finished with an enamel painting; the portrait of H. Bone, R.A., by W. Bone.

With two such noted men's opinions before us, there is nothing further to be said by one who has only occasion to use enamels in their simplest forms, as jewellers mostly do. However, we can and do appreciate the beautiful paintings which have been produced, and are being produced, in this art.

There are also at Jermyn Street Museum many other specimens of enamels in their unapplied and applied states. In museums and to libraries must the student seek for further information. This paper is only written for an elementary stage of a subject just taken up by the City and Guilds of London Institute, for a class of apprentices and journeymen. It is intended to do but little more than give some idea of the various items mentioned in the syllabus.

There are many specimens in cases devoted to enamels at each of the museums which are interesting to such as are making a deeper study of enamels than we are at the present stage. In the whole of the papers, hardly anything but an explanation of the simple every-day terms used in enamelling has been attempted.

Of the artistic employment of painted enamels, one word may be said to recall to mind the unalterability of the colours in enamels; for a painting in enamel is as fresh when one hundred years old as when it was first done. It is this permanence that gives enamel painting its separate and distinct place in the temple of art; and, providing no physical damage is done to the fragile vitreous substance, there is no reason why the pictures produced by its aid should not last for all time.

In the next paper the preparation of work for enamelling will be considered.

HOW PERFUMES ARE MADE.

BY J. C. KING.

Perfumes are mainly foreign products, but many are genuine English. Lavender water made in England is superior to all others. Nice, Algiers, and many Eastern cities have special fame for their perfumes. Fruits are also largely used for scents. In England, sometimes flowers are grown in orchards under the trees, and have been known to yield as much as the fruit crop above them for scent. There is no material difficulty in florists and farmers, with profusion of flowers in their fields and hedges, adding scent-making to their by-industries. Most flowers contain a volatile essence; these yield the most lavish perfume.

The process by distillation is as follows:—The flowers are boiled in hermetically sealed copper vessels, and the steam as it condenses in its passage through the spiral coil exudes the essence drop by drop, which is collected in a small glass receiver—if of roses, this is the "attar of roses;" the water is a trade product known as rose-water. Flowers vary greatly in the quantity of essence they yield. Lavender and eucalyptus are more bounteous in yielding than most other perfumes; the rose and orange flower the least. These are mostly mixed with alcohol for sale.*

They are mixed with alcohol for commercial supply, forming Eau-de-Cologne, toilet-vinegar, etc. Some flowers have not the volatile essence, and the scent is got from them by a cold process, as follows—say of freshly gathered violets, tuberoses, jonquils, jessamine. They are laid on pure lard in $\frac{1}{4}$ in. layers in glass trays, and the flowers are changed from every twelve up to twenty-four hours, until the lard is sufficiently charged with the perfume. With some flowers, as jessamine and tuberose, the flowers are renewed fifty times.

A hot process is to place the lard or grease in a copper with the flowers, and boil them slowly till the operator thinks the fat is permeated with the odour of the flowers. This may be distilled, and the condensed extract of the scent obtained. But many scents called pear, apple, citron, etc., are from chemical organic compounds unconnected with these fruits.

FAC-SIMILE DUPLICATES OF COINS.

BY W. W.

Dissolve isinglass glue with brandy, and pour it thinly over the medal, coin, etc., so as to cover its whole surface; let it remain on for a day or two till it has thoroughly dried and hardened, and then take it off, when it will be fine, clear, and as hard as a piece of Muscovy glass, and will have a very elegant impression of the coin. It will also resist the effects of damp air, which occasions all other kinds of glue to soften and bend if not prepared in this way. Here is a material not too expensive and easily made, for all that is wanted is the glue and brandy put together into a suitable bottle and allowed to mix itself, the proportions being regulated by either adding more brandy if too thick, and if too thin add more glue.

Anyone wishing to form a collection, either for his private pleasure or to help in forming one for public view, can do so with little cost except time, and very often it is easy enough to borrow a coin to take a fac-simile, while to buy it would in most cases be impossible.

WRINKLES.

Wall-Paper Vermin.—A hint to paper-hangers to prevent vermin breeding after the paper is hung: Put a little alum in the paste.

Outhouse Whitewash.—To keep outhouses used for cattle, rabbits, or poultry healthy, whitewash them with a whitewash made of lime, in the proportion of 1 lb. of sulphate of lime to one bushel of lime, and mix well so as to remove all lumps.

Glue.—A good liquid glue, that is always ready, may be made by dissolving shellac in naphtha in a wide-mouthed bottle.

* For rose essence, it takes 25,000 kilos of flowers to yield 1 kilo of essence; neroli, 1,000 kilos to yield 1 kilo; geranium, 1,000 kilos to yield 1 kilo; orange leaf (bitter), 1,000 kilos to yield 1 kilo; mint, 1,000 kilos to yield 0·750 kilo.

HOW TO MAKE AN ELECTRIC BELL WITH ONE COIL.

BY J. T.

As no description of an electric bell of this class has appeared in this magazine, it may be of interest to some of the readers to know how it is constructed.

Fig. 1 shows the bell complete, from which it will be seen that there is only one coil of wire, instead of two, and that the cast-iron ends of the core form the poles of the magnet. In other respects it is the same as an ordinary electric bell. The frame is of cast iron, in one piece, the core and ends of the magnet being in the centre, as shown in Fig. 2, which is a side elevation of the frame. A projection is cast on at the top end, for fixing the spring which carries the armature to, and another at the lower end, on which the gong is screwed. Fig. 3 is a plan of the frame.

The frame, gong, armature, hammer, and spring, also the wire and case, may be purchased for 2s. 3d. Two binding-screws or terminals will also be required.

The core and inner faces of the magnet ends should be covered with tape, to insulate them. If the tape is steeped in melted paraffin wax, it can be fixed by applying a hot iron to it. A hole is drilled in the end of the bell-pillar, tapped, and a screw fitted, to hold the bell; also drill two holes in the frame for screwing it to baseboard, and two holes in the projection for carrying the armature spring. These must be tapped, and have two set-screws fitted into them. The positions of these holes are shown in Figs. 2 and 3.

Then commence to wind the wire on the core. It should be No. 28 silk-covered wire. It should be closely and evenly wound, and as many turns should be put on as will bring the wire to the level of the ends of the core, leaving about 3 in. at each end for connections.

The spring must next be fixed to the armature by two small set-screws, the armature being drilled and tapped. The spring is a piece of springy brass, which is platinised, and will require a piece of platinum soldered on the end. The end is bent outwards to meet the contact screw, and two holes must be drilled in the end of the spring to fix it to the frame. A reference to Fig. 1 will show the spring in position.

The hammer and shank are screwed into the end of the armature, and the shank is bent, as shown, in such a manner that, when the armature is against the poles of the magnet, the hammer-head touches the bell. The bell is fixed on the pillar by a set-screw.

A baseboard of mahogany, $\frac{1}{2}$ in. thick, and cut to the form shown, must be provided, and the frame screwed down to it.

Then make the contact-pillar out of a piece of L-shaped brass, $\frac{3}{16}$ in. thick and 1 in. high. Fix a brass screw, with milled head on it, at the level of the centre of the spring. The end of the screw must have a piece of platinum soldered to it, or a small hole may be drilled in the end of the screw and a piece of platinum wire soldered into it, the end of the wire projecting. Fix in the pillar, at right angles to the brass screw, a small steel set-screw to keep the brass screw in position. It is fixed to the baseboard by a screw, but it must not touch the metal frame. Fix two binding-screws at the top end of the baseboard, and also fix under them two strips of thin sheet-brass, $1\frac{1}{2}$ in. long, as shown in Fig. 1. The wires from the ends of the magnet must have the covering stripped off $\frac{1}{2}$ in. at the ends, and cleaned with emery-cloth, and formed into a ring, one of which is screwed down to one of the brass strips, and the other on one of the screws in the end of the spring; also solder a short length of wire to the contact-

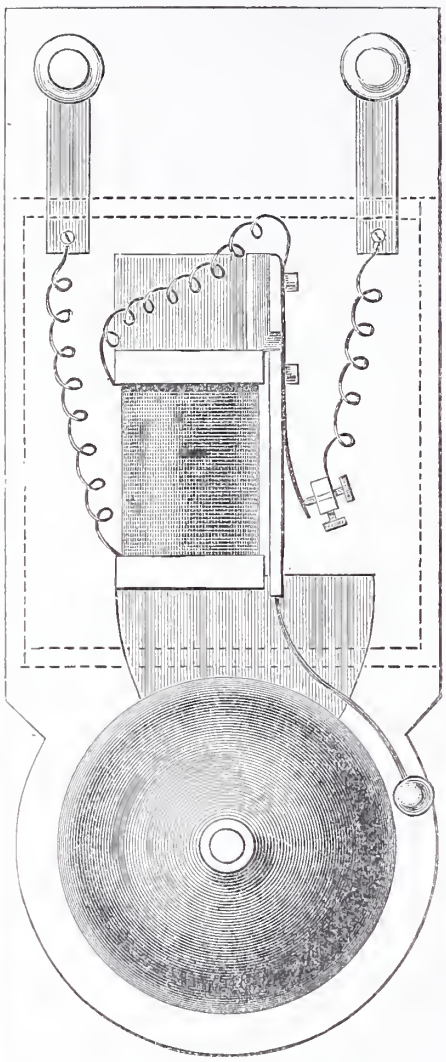


Fig. 1.—Electric Bell with the Coil.

pillar, and fix the other end to the brass strip from the other binding-screw. These wires should all be made into coils on a piece of round stick, as shown. The spring should be made to touch the end of the screw, when the armature is $\frac{1}{16}$ in. from the poles of the magnet.

A wood cover, shown by the dotted lines, may be fixed with screws, or two small hasps, as shown.

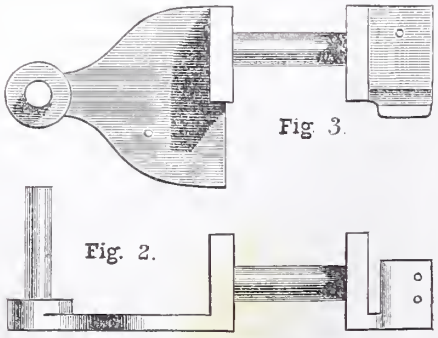


Fig. 3.

Fig. 2.

Fig. 2.—Side Elevation of Frame. Fig. 3.—Plan View of Frame.

AMATEUR'S PANELLED DADO.

BY MARK MALLETT.

Panelling a Dado by a Simple Method—Materials — Construction — Decorative Panels—Finishing—Fixing.

Panelling a Dado by a Simple Method.—It must often occur to the amateur decorator, when he pastes up a paper dado against his wall, that he is producing but a flimsy substitute for the real thing. A proper dado should, of course, be in wood; yet to make one in panelled wood would be a serious, if not an impracticable, undertaking for the ordinary amateur, whose tools will be few, and whose skill limited. This is supposing the panelling to be of the usual and orthodox kind. There is, however, a method by which a wooden dado may be set up which shall have the effect and the strength of genuine panelling, but which offers no difficulties of construction; and this method it is proposed to explain. Fig. 1 shows the manner of work which may be produced by it.

Its principle is simply this: Two layers of thin board are used, laid with the grain of the one crossing that of the other so far as may be practicable, and these are fastened together with a liberal allowance of screws. These screws are driven from the front; no attempt is made to hide them, and they are, in fact, so disposed as to assume a decorative character. The manner in which this plan is carried out in the example before us is clearly illustrated in the sections which accompany the elevation. Fig. 1 is on a scale of 1 in. to the foot; the other diagrams are on a 2 in. scale.

Materials.—It is presumed that soft wood will be used, and, in preference, pine. There is certainly no reason why hard wood should not be used if desired, except that that class of workmen for whose benefit this design is specially intended will find their difficulties much increased thereby; whereas if they use pine, and buy their boards ready planed, they may get on easily and rapidly. The skirting-board at bottom is of $\frac{3}{4}$ in., and the surbase at top of 1 in. stuff, all the remainder is $\frac{1}{2}$ in., that which forms the panels being of matchboarding. Thoroughly seasoned board is essential for this work. No nails or brads of any kind will be used, and only a very few of the ordinary flat-headed screws; black screws with round, projecting heads will be the sort required, and these will be wanted in considerable numbers.

Construction.—Our dado has a height of 4 ft. 3 in. Along its bottom is a skirting-board which projects $1\frac{1}{4}$ in. from the wall. Above this is a range of larger panels 1 ft. wide and 2 ft. $2\frac{1}{2}$ in. high, which are separated by stiles 4 in. wide and 1 ft. $9\frac{1}{2}$ in. high. Higher is a smaller range of panels $4\frac{3}{4}$ in. square. The surbase at the top projects 2 in. from wall.

Each pair of matchboards at back of the panels is 15 in. wide. In the sections they are drawn 4 ft. 2 in. long—that is, long enough to reach from surbase to floor; if, however, circumstances should render it desirable, their lower ends may be shortened by 6 in. without materially weakening the work. Upon these the skirting-board is screwed down as shown.

The stiles, when screwed in place, do not project so far by $\frac{1}{4}$ in. as the skirting-board on which their bottoms rest. Their sides should either be chamfered, or worked with a gouge to a hollow moulding. In the diagrams the latter plan is shown, as adopted here and in most other parts of the work.

On the heads of the stiles comes a horizontal board 9 in. wide, its lower side being sawn out to form ornamental heads to the panels. On this rest the short stiles of the small panels. The row of panels is divided into pairs by stiles of the same width as those below, and the panels forming each pair are separated by a narrower stile of 2½ in. Between these panels and the surbase is a second cross-board 5 in. wide, and to this and to the heads of the panel backs the surbase is screwed with flat-headed screws.

The surbase is a strip of 1 in. board 2 in. wide. In Fig. 2 we have it in section, with its lower front corner chamfered off, as it is above the panels. Above the stiles the corner is retained and notched into an ornamental zigzag. The decoration of the surbase is shown on the larger scale in Fig. 8.

Panel Decoration.—The smaller panels may be left plain like the larger ones, and probably will be so if the whole dado is painted; or they can be made more ornamental by backing them with gold-lacquered Japanese leather paper—the paper being inserted before the two layers of board are screwed together. Should the whole dado be ebonised, this treatment will have an excellent effect.

Or, again, these small panels may be backed with tiles. A correspondent of WORK (E. R. A.), who has asked for a design for a dado, has suggested that he would like it to include a row of tiles near the top. His idea was too good to be overlooked; these panels will hold 5 in. tiles, the front layer of wood overlapping just sufficiently to hold them in place. If, however, tiles are used, the ornamental scollops should be omitted and a chamfer substituted, as in Fig. 9. E. R. A. will find all the measurements in this design tally with his space.

Finishing.—If the situation and surroundings admit of so much black, our dado will look well ebonised throughout. In this case, the ebonising will be done before the final screwing together, the pieces being put under weights till dry to prevent warping, and polished before being re-screwed. Otherwise, the dado may be stained to a lighter or darker shade, or it may be painted, and should this be done, a good scheme of colour for it will be: black for surbase and skirting-board, dark sage-green for stiles and cross-boards, and a lighter sage-green for panels—that is, if the surroundings will permit of these colours.

Fixing.—The woodwork will, of course, be screwed together before fixing to the wall. At intervals of about a yard, the skirting-board should be dowelled to the floor. The wall should be plugged with a row of elm plugs opposite to the skirting-board, and another opposite to one of the cross-boards. These plugs should be put into the brickwork at regular intervals, so that the large round-headed screws to be driven into them may have a part in the decorative effect, as is shown in Fig. 1.

Fig. 6

Fig. 7

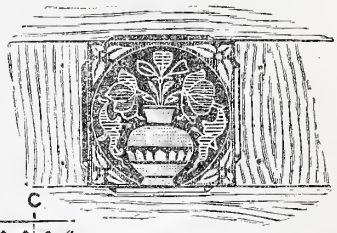


Fig. 9

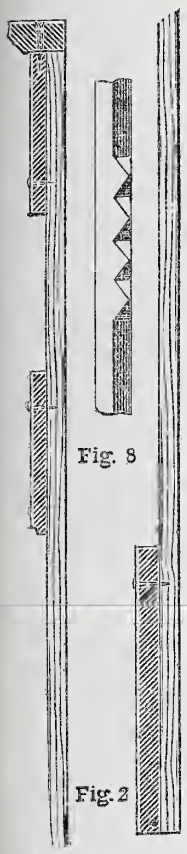


Fig. 8

Fig. 2

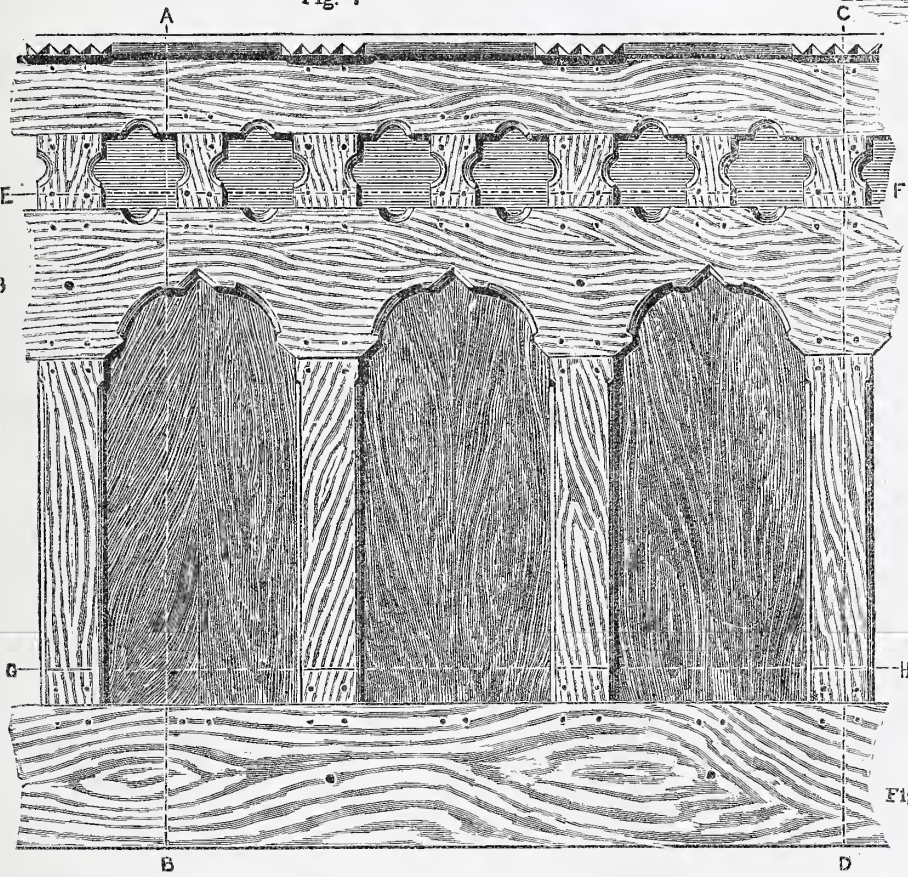


Fig. 3

Fig. 1

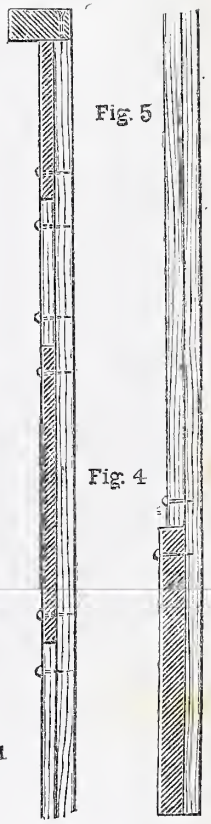


Fig. 5

Fig. 4

Panelled Dado. Fig. 1.—Elevation of Dado. Fig. 2.—Upper Half of Section on Line A B. Fig. 3.—Lower Half of Section on Line A B. Fig. 4.—Upper Half of Section on Line C D. Fig. 5.—Lower Half of Section on Line C D. Fig. 6.—Section on Line E F. Fig. 7.—Section on Line G H. Fig. 8.—Ornamental Details of Surbase. Fig. 9.—Alternative Small Panel with Tile.

NOTES FOR WORKERS.

THE subscription for the use of a telephone in London is £20 a year.

THERE has been an extensive subsidence of the ground of the Barrier silver field in New South Wales, Australia.

THE Austrian Minister of War intends to found an aeronautic institution for purposes of war.

A BLACK enamel for wood:—Prime the wood with linseed oil, turpentine, and white lead; give it two or three coats of black, mixed with copal varnish and turpentine; rub it down dry with pumice-stone and water, and varnish with copal. To obtain a perfect smoothness, again rub down, and polish with oil and rotten-stone.

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GOG AND MAGOG DECORATION.—The Gresham Committee have decided to decorate the internal walls of the Royal Exchange, by depicting on the twenty-four panels scenes from the history of the City. The plan adopted is to call in the aid of some of our leading English artists to paint the panels. Why could not the committee also let some other professions have a turn as well as painters?—say, some of our workers in mosaic, in metal, in *repoussé* work, in marquetric, pottery, and other decorative arts—and then the panels would not only illustrate the history of the City, but also be examples of the progress of many departments of art in the nineteenth century. For instance, scenes in mosaic would possibly be more durable, and stand the ravages of time better, than paintings in oil.

WORKERS' AMUSEMENTS.—There is something pathetic, if not tragical, about the life of the working man. He builds magnificent mansions that he is fated never to occupy. He constructs luxurious lounges for others, less tired than himself, to recline on. He makes the metal or shapes the timber out of which musical instruments are ultimately formed, yet the only music that his life is set to is the hum of the workshop machinery. Adequate provision is made for the recreation and enjoyment of other classes, but for the working classes no one cares to cater. For them there are few light recreative pursuits of an elevating kind, and they are usually left to their own resources in the ale-house taproom. While there are many who are jaded with a continual round of pleasure and know not which way to turn for a new excitement, there are others jaded with work, and in a constant worry over the necessaries of life. This latter class is by far the most numerous, and is now in possession of great power in the community. That it should have the leisure and the opportunity of healthful enjoyment is a matter of the greatest national concern. It ought not to be an uncommon sight for a working man to be seen taking a free and independent stroll in our principal thoroughfares; now he is occasionally to be seen there, but hurrying on with a bag of tools on his back, and evidently anxious to disappear. Toil is honourable, and there is no reason why the workman in his corduroys should hold his head less high than the wearer of broadcloth. Suitable amusements for working men are much wanted.

BRAIN-WORK.—For perfect vigour and activity of the brain it is necessary that it should be well supplied with blood—well fed, in fact—and when the circulation slackens mental force will diminish. Dr. Lauder Brunton has found that when through exhaustion he is unable to write an article in the usual sitting position, that his ideas will flow freely if he lays his head down on the writing-table, thus facilitating the course of blood to the brain. We do not think, however, that he is justified in concluding that he has discovered the secret of how to have ideas at will. A tired man employed in any kind of work, mental or physical, may, by stimulant of some sort, or its equivalent, prolong his time of labour, but it is at the cost of his reserve of strength. To follow out Dr. Brunton's method of getting the blood to the brain by obviating the resistance due to gravitation under which the wearied heart flags, we may assume that after a while it will not maintain active circulation even in the recumbent head, and ultimately to get a flow of ideas to the last it would become necessary to be suspended head downwards—but what does this all mean if it is not a suggestion for wearing out the recuperative force of the system? Under the influence of alcoholic or other stimulus an abnormal amount of work may be done, but it will be followed by a period of exhaustion, and work so done is never so good as that performed under natural conditions.

CHAIN OVERHAULING.—Among important things, the regular overhauling of chains, chain-slings, and crane-hooks, as well as shackle-bolts, is one that demands the regular and prompt attention of engineers and others in charge of cranes, etc. All parts should be taken into the blacksmith's shop and passed through the fire carefully—that is, they should be allowed to attain a blood-red heat and then to cool of their own accord. Each link should be carefully looked at, and if worn, a fresh link made and put in. Flaws may be more easily detected by adopting this method. The process of annealing will cause a flaw to open, and be more distinctly seen than when the iron is cold, with, perhaps, a coat of tar smeared over its surface. Connecting-rod keys, cotters, etc., should be also annealed every time an engine is overhauled. The reason for observing this simple custom is that by the constant tensile strain on the links of chains, etc., the fibre of the wrought iron becomes more and more crystallised, and in time closely resembles the grain of cast iron at its fracture. By heating the chain or other article for treatment, the annealing process loosens the strained molecules, thus enabling the wrought iron to regain its lost qualities. Chains that are at work every day should be annealed once every three months to prevent accidents. The cross-head key of a large mill engine, after having been annealed in this manner, has been known to reveal a deep flaw extending halfway through the key. This would have caused great damage had it broken when the engine was running, to say nothing of loss of life.

HOW TO MAKE A XYLOPHONE.

BY MUNIO.

In accordance with a promise made to several correspondents in "Shop," I now give a description of a Xylophone which I have had the opportunity of constructing. It consists of a number of pieces of rosewood, arranged in the manner shown in Fig. 1, which form the notes. These pieces of wood are slung together with whipcord. They are laid on three straw ropes to insulate them, and these straw ropes are generally fixed on a frame. The notes are played by two beaters of boxwood, the player standing in front of the naturals, and playing the air with the right hand and the bass with the left hand. It may be played as a solo instrument, or with piano or other accompaniments; and in the hands of a skilful player some very good effects may be got from it. The notes are made of rosewood, $1\frac{1}{8}$ in. wide and $\frac{5}{8}$ in. thick, rounded on the top side as shown in Fig. 2. The lengths of the two lowest and highest notes are marked on the drawing, which is one-fourth full size. I should recommend the addition of five notes at the lower or left-hand end down to C, and five at the top end up to D. This will give it a compass of two and a quarter octaves, making the lower notes correspondingly longer and the top ones shorter. If rosewood cannot be procured, oak or pitch-pine may be substituted, and to make the tone more even they should all be cut from the same plank; they should also be free from knots. A hollow $\frac{1}{2}$ in. wide and $\frac{1}{8}$ in. deep is cut across the under side of each note in the centre, as shown in Fig. 3. Bore holes $1\frac{1}{2}$ in. from the ends of the longest notes, and 1 in. from the ends of the shortest notes, for the cords to pass through, as shown by the dotted lines in Fig. 1.

Three pieces of whipcord are passed through the holes, and the centre one may have knots made between each note, to keep them apart. The ends of the cords are put through a small washer or button, and knotted.

The straw ropes are about $\frac{7}{8}$ in. diameter, and are made in the following manner:—A quantity of good clean long straw is procured and the heads cut off; then draw it through the hands to straighten it, and take out the short straws. Then bore a $\frac{7}{8}$ in. hole in a piece of wood, and fill it tightly with the drawn straw; push it through for 3 in. or 4 in., and wrap it with narrow red tape (as shown in Fig. 4), winding the tape on as the straw is drawn through the hole, and tie the ends as shown. If the straw cannot be got in long lengths, the ends may be cut angular and the pieces joined together.

Then make a frame as shown in Fig. 5, the joints being mortised or half-lapped together; it may be 2 in. wide and $\frac{3}{4}$ in. thick. The straw ropes are fixed on the top by small wire nails or staples, and the heads should be below the top of the ropes. The arrangement of the frame, straw ropes, and notes is shown in Fig. 3.

The frame is not absolutely necessary, as the straw ropes can be laid on a table or box; but it is better, especially if the straws are in two pieces, and the instrument is always ready for use.

A case may also be made to hold it. The case should be 3 in. deep inside, and the width of the lowest notes; it may be made narrower at the top end. $\frac{1}{2}$ in. pine

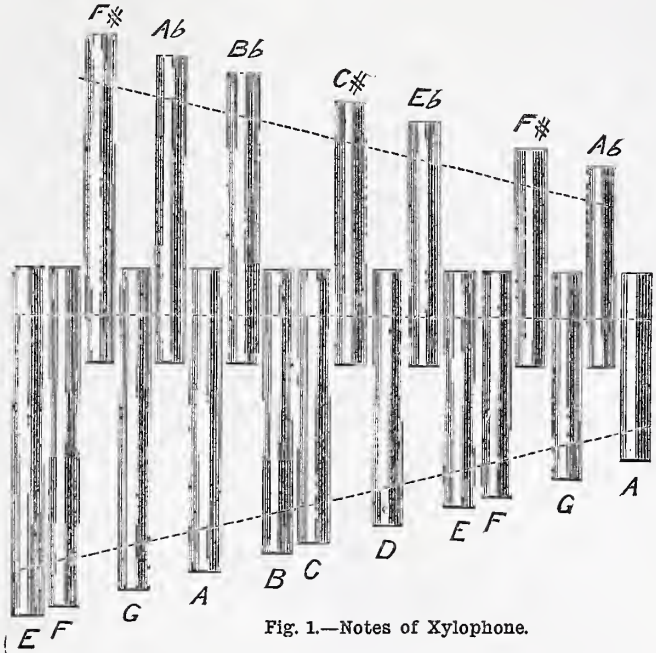


Fig. 1.—Notes of Xylophone.

will do for the case, and it may be hinged at one side and fastened by two hasps, or a lock. In playing, the frame may be laid on the case, which will improve the tone.

The beaters are shown half full size in

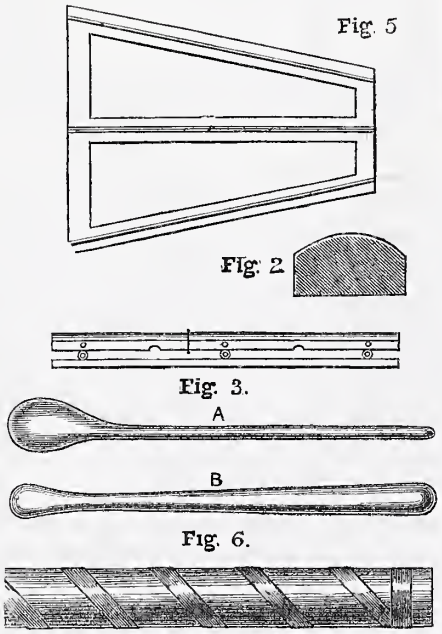


Fig. 2.—Rounded Shape of Notes. Fig. 3.—End View. Fig. 4.—Straw Rope. Fig. 5.—Frame. Fig. 6.—A, Side View of Beater; B, Plan View of Beater.

Fig. 6. They are made of boxwood, or, if this cannot be procured, lancewood may be used, which can be got from a broken gig-shaft. They are cut as shown, with chisel and rasp, and smoothed with glass-paper.

The notes are tuned to a piano or harmonium. They should be cut rather longer than are shown, and raised in pitch by cutting a piece off the ends; but this must be carefully done, as if too much is cut off the note will be too high in pitch. It will be best to tune them before fastening them together, and, if one is made too high, it can be moved a note upwards. The rounded tops of the notes are varnished, to improve their appearance.

RE-TINNING KITCHEN UTENSILS.

BY R. ALEXANDER.

This brief paper is written in response to G. S. (*London, W.*) and numerous other correspondents, anxious to know about re-tinning common utensils. It is too long for "Shop." First, the articles to be re-tinned must be thoroughly freed from grease. This may be done in two ways: either by washing them with a strong solution of soda or potash, or by burning. This is the way usually adopted by the trade, and is the best. It is done by placing the articles on a fire and letting all grease melt and flare off—altering their position, of course, so as to allow every part to be acted on by the fire. They must not be allowed to get red-hot. After this they must be "pickled" and scoured. The pickling may be done in two ways; first, by immersing the articles in a tank containing diluted hydrochloric acid, and allowing them to remain a few hours; secondly, by taking some strong spirits of salts (same thing as hydrochloric acid) in one of the vessels, making a mop by tying some hemp tow round a stick, and well rubbing the spirits all over the articles, inside and out. Do them all like this and then rinse them well with water.

To scour them, place an old sack on a table or bench, get some "scale" from the blacksmith and some silver sand, take a piece of sacking or old Brussels carpet, wet it and dip it in the "scale," and well rub the article with it; you must rub hard and go well into the corners, or rather, angles, where the bottom and sides meet. After a good rubbing, rinse out and have a look at it; you will then see what parts require more rubbing. All black streaks and marks must be got out, but it is not necessary to scour off all the old tin. When you have got the parts, as you think, clean enough, take a handful of tow, wet it, throw in the stewpan, or whatever it may be, a little silver sand, and give a good rubbing with that; you may then reckon the parts clean. You may say this is all very dirty and troublesome; so it is, I must admit, but there is no getting out of it; the things will not "tin" if they are not perfectly free from grease and dirt.

Tinning the Articles.—First powder up a few ounces of sal-ammoniac; next procure some strips of block tin—that is, pure ingot tin—run out into sticks for convenience in using; a "tinning" iron will also be required. This is made out of a piece of $\frac{1}{4}$ in. wire bent into a series of rings till it is about $1\frac{1}{2}$ in. diameter; have it about 16 in. or 18 in. long; turn one ring at the other end to hold it by; also bend a piece of sheet iron to form a sheath to slip over the handles of the stewpans and covers, so that the hands may not feel the heat so much;

they should project beyond the handles 3 in. or 4 in.

Light the fire, place a stewpan or cover on it—if it is a forge blow gently (the fuel should be charcoal or coke)—throw in a little sal-ammoniac, and, as the tin melts, rub it round with the tinning stick; the articles must be warm enough for the tin to run freely, but if you see the tin change colour to a sort of pink you may know it is too hot, and will burn and spoil the tin, unless you draw it quickly away and sprinkle a little sal-ammoniac and put a little more tin on the hot place. When you have got it well tinued all round, warm it thoroughly all over, by turning it rapidly about on the fire, then withdraw it, and with a handful of tow wipe round it, drawing the superfluous metal out on to the floor, or into au iron pan to prevent waste of metal. The surface then should be bright and clean; if it is otherwise, you have either not scoured it sufficiently or else the foregoing directions will not have been carefully carried out. I omitted to state that the outsides should be rubbed over with a mixture of salt and whiting made into a paste with a little water; this keeps the fire from damaging the outsides. After tinning well, scour both inside and out with silver sand and clean water.

I shall be pleased to give further information if this is not sufficient.

CARPENTRY FOR BOYS.

BY McDONALD.

THE BENCH—ITS CONSTRUCTION AND MATERIAL—THE VICE AND OTHER ADJUNCTS.

HAVING finished the trestles, our next job is the bench. The stuff for this can be cut quite conveniently upon the trestles, and, as in their case, it does not require to be dressed, with the exception of a slight touch on the top and front to straighten them after the whole is put together. Good work can be turned out upon a rough bench as well as upon the most smoothly planed one, provided that it is straight and out of twist.

The dimensions for a bench depend pretty much upon circumstances. The length and breadth should not be too scrimp to afford accommodation for bench tools and freedom for working, unless scarcity of room demands such. The height should always be regulated by the stature of the worker. If too high or too low, it gets very uncomfortable during a long spell of work, and, moreover, tends to give a permanently stooping set to the back and shoulders—things which some of our strapping youths would not care about. In this example we have what may be considered a suitably sized bench for a young operative. The dimensions are figured on the drawings (Figs. 5 and 6), but these are not to be rigidly adhered to, unless found quite answerable.

Construction and Material.—Like the trestles, the bench is simply nailed together at the joints. There are, however, many methods for fixing the joints in both—better than this, but more complicated—and which the learner will see, as he advances, applied to other things. At this stage we will content ourselves with the easiest, which, for our purpose, is quite good enough, as far as strength and efficiency are concerned. I have seen benches—aye! and worked at them—nailed together like this stand the tear and wear of a regular joiners' shop for years.

In commencing this—or, for that matter, any job—the first step is to take stock of the material required. This is readily obtained from the drawings which usually accompany the same. And here it may be said that beginners, professional and amateur, should spare no effort to acquire expertness in sketching out their work for that purpose, and also in measuring from sketches supplied by others. Any piece of work ought to be clearly understood and seen through before being started. According to the drawings, the sizes of stuff for our bench are as follows:—Three boards for top, 7 ft. long by $1\frac{1}{2}$ in. or $1\frac{3}{8}$ in. thick, and of sufficient breadth to make up together the entire width—2 ft. 9 in.; two sides, 7 ft. by 11 in. by 1 in.; two top rails, 2 ft. 7 in. by 3 in. by 2 in.; two bottom rails, 2 ft. 7 in. by 4 in. by $\frac{3}{4}$ in. or $\frac{7}{8}$ in.; one centre rail, 2 ft. 9 in. by 3 in. by 2 in.; four legs, 2 ft. $2\frac{1}{2}$ in. by 3 in.

Fig. 7

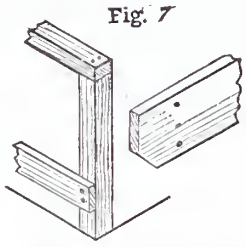
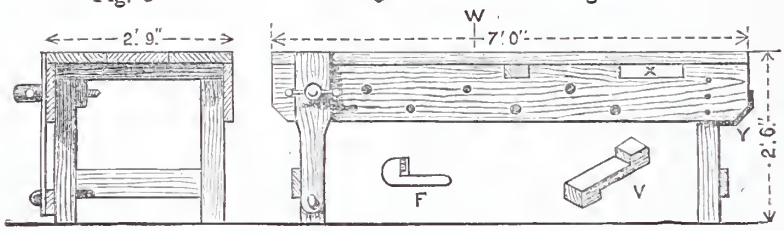


Fig. 6 Fig. 5



Carpentry for Boys. Fig. 5.—Side Elevation of Bench—F, Bench-pin; V, Saw-stop. Fig. 6.—Section at W. Fig. 7.—View of Corner.

A pair of legs, a top rail, and a bottom rail, nailed together as shown at Fig. 7, form an end. After the two ends are constructed the sides are nailed on; then the centre rail is checked or housed into the sides, and the top boards are firmly nailed down on the end and centre rails. As already mentioned, the top should be planed straight, and also the front side and edge of top. Before doing this the nails must be punched in, of course. The material may be the same as that in the trestles—white pine or third quality yellow pine. The latter is preferable for the top, as it is not so liable to warp as the former.

The Vice and other Adjuncts.—There are several varieties of the bench-vice or screw in use, all of which are supplied by ironmongers at moderate prices. Some have horizontal cheeks or jaws; that here shown has a vertical one. The fixing of it to the bench is not at all difficult, but to ensure its smooth and efficient action some care is necessary; and the young tyro might be the better of an experienced workman to assist him, particularly with the boring for the screw. This, as will be seen from Fig. 6, passes through the cheek, side, and leg, with the nut at the back of the leg. At the bottom, the cheek is fixed to a stout rectangular pin or guide, also let through the leg. To co-operate with the screw in working different thicknesses of stuff, the guide can be moved in or out at the leg, and held at any point by a small portable pin, bored transversely through the latter, and fitting a series of holes in the former. A glance at this or any other form of bench-vice in operation will render its working, mode of attachment, and use quite clear to the most uninitiated.

A simple contrivance for holding small pieces of wood upon the bench for sawing is the saw-stop shown at V (Fig. 5). There should be a pair of them. They may be made out of a solid piece, or the projecting ends may be nailed on. When in use, one end holds the piece to be cut, while the reverse cheek butts against the bench. Another little thing is shown at F. This is a small, rounded pin for holding long stuff in the vice. It will be seen that there are a number of holes in the front side of the bench, into any of which it may be inserted, as occasion requires. At X (Fig. 5) a slit is cut in the side for holding wood while being cut; and at Y the end of the bench is partly lined or boarded, to form a box for keeping tools or other small articles. For keeping tools off the bench, and, at the same time, convenient to hand, a rack should be set up against the wall or window close to the bench. It is constructed of double rows of rinds, laid horizontally, the rinds in each row kept sufficiently apart to allow of chisel blades, etc., to get down between, and so suspend them by their handles. Saws may be put in the rack or hung on nails. There are other articles handy about the bench—such as hand-screws, a cramp, and a holdfast—but as they are not indispensable for a start, we will only call the young reader's attention to them, and recommend him to see them in use and examine them before he decides to purchase them. Last, but not least, the bench-stop must be noticed. It is for holding timber on the bench when being dressed or planed. It is a small, rectangular or rounded piu, bored or mortised through the top near the front and vice end. It should not be fitted too tight—so as to be easily knocked up or down, as may be required for different thicknesses of stuff to be dressed. There is a patented bench-stop in use, but, like the preceding articles, the reader should see it before he buys it. All these requisites are sold by tool merchants advertising in WORK.

GILDING ON GLASS.—Dissolve in boiled linseed oil an equal weight of either copal or amber, and add enough oil of turpentine to thin sufficiently to apply to glass. Make the glass quite hot. Apply the size; put on the gold leaf, sweeping off superfluous portions. When quite cold, lay a piece of Indian paper over the work, and polish with a burnisher.

CEMENT FOR WOODWORK.—1 oz. of resin, 1 oz. of yellow wax; melt in a pan, and stir in 1 oz. of Venetian red; use hot. This adheres firmly to wood.

PAINT TO DRY IN HALF AN HOUR.—Mix the colours in gold size and spirits of turpentine; let each coat dry before the next is applied. Varnish over to give a gloss.

MOULDING WAX.—To make wax for moulds, add flake-white to the wax and melt it in the oven. Proportiou—a tablespoonful of flake-white to 4 oz. of wax.

MAKING MODEL BOATS RIDE ARTIFICIALLY.

BY R. W. COLE.

Making Sea—Machinery for producing Heaving Motion—Arranging several Ships—Making Clockwork.

Many others there may be who are in something of the same predicament as "Reader of Work," who has a case of model ships, and wishes to know how to make the ships heave and the sea rise with the ships the same as at sea. He can effect this in the following manner:—

A piece of oiled silk of the requisite size is loosely nailed across a wooden frame, of a square or oblong shape. It should be so loose that it can easily be puckered up into waves. If not of a sea-green colour, it should be painted and touched up with white to represent foam. This frame is then placed over the top of a box, inside which the machinery is fixed. A small hole, less than ⅛ in. in diameter, is bored underneath each of the ships, and they are fixed on to the oiled silk in the positions that they are intended to occupy. The machinery for making the ships heave must now be fixed underneath. A side view of this is shown in Fig. 1.: A is the ship; C is a brass rod which is fixed into the hole bored underneath the ship, and passes through two eyes, C, C, until it reaches a connecting-rod, D, which fastens it on to the crank, E. A small pulley-wheel, shown by the dotted lines, is fixed on to the axis of the crank, and is connected by a belt with a larger pulley-wheel, F, fixed on to the clockwork. Fig. 2 is an end view of the arrangement, the same parts being denoted by the same letters. Several cranks may be fixed on to the same axis, and inclined to one another at various angles. When the clockwork is set in motion, the ship will have a heaving motion. By making the rod, B, slant, a backward and forward motion may be imparted to the ship, as well as an up and down one. If there are several ships nearly side by side, they may be worked by several cranks placed on the same axis, but when they are in front of one another each will require a separate axis, pulley-wheel, etc. Before commencing the construction of machinery of this kind, a careful plan should be made of the sea, showing the place of each ship and the position which it is to assume with regard to the rest. The clockwork is made from an old clock, by taking out the escapement and either the first or the first and second cog-wheels, according to the power of the spring. A small wooden or brass pulley-wheel is then fastened on to the axis of the wheel which is at the end of the train of mechanism, and pieces of bent brass are fastened on to the side of the framework so that the clockwork can be screwed down in its proper position. The most powerful clockwork, however, is that which can be made at home, and which is driven by a weight. Fig. 3 is an illustration of this. An axis, A, having one end squared for the key to fit on to, is fixed on to a ratchet-wheel, B, and passes through the centre of the large cog-wheel, C. A drum, over which a cord attached to a weight, D, is wound, is attached to the ratchet-wheel. A detent, E, is pressed by a spring into the teeth of the ratchet-wheel, and is fastened on to one side of the cog-wheel. The teeth of the cog-wheel work against another very small cog-wheel having about eight teeth, and this is fastened on to the pulley-wheel, F (Fig. 1). To reduce the speed sufficiently, a large fan must be mounted on a separate axis and connected with the clockwork by gearing, so that it is made to rotate at a great rate.

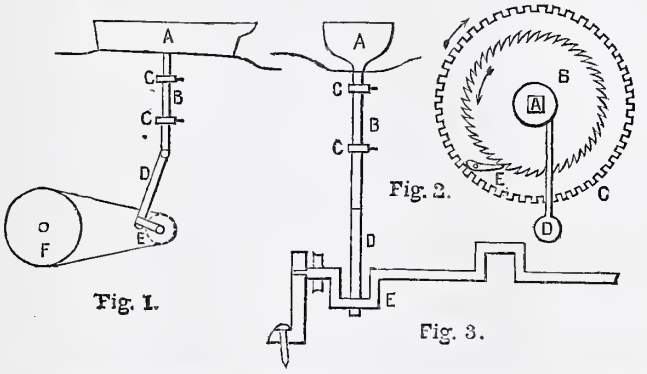


Fig. 1.—Heaving Machinery: Side View. Fig. 2.—End View of Heaving Arrangement. Fig. 3.—Clockwork Arrangement.

SCIENCE TO DATE.

Silicate of Cadmium.—A silicate of cadmium, of the composition $2(CdO.SiO_2)3H_2O$, is said to have been prepared by heating cadmium nitrate in sealed glass tubes to 300°. If so, it is the first silicate of this metal known to chemists.

Specific Heat of Aluminium.—Mr. J. W. Richards has made a re-determination of the specific heat of aluminium, and obtains the following results:—At 0° it is ·222; at 20°, ·2240; at 100°, ·2320; at 625°, the melting point, ·2845. These figures give 6·13 as the atomic heat of aluminium, using the mean specific heat between 0° and 100°.

Cartridge Gas.—The gas produced by the combustion of the powder in the cartridge chamber of our modern breech-loading ordnance on their being fired amounts in many instances to 14 tons per square inch. This is equal to over 2,090 times the pressure of the atmosphere, or nearly 523 times the pressure of an ordinary land boiler working at 60 lb. per square inch.

Alloys by Compression.—Specimens of brass produced by compression of the constituents at the ordinary temperatures were lately shown at the Amsterdam Royal Academy of Sciences, and observations thereon were made by M. Behrens. One specimen was of a reddish colour, and was prepared from 9 parts copper and 1 part zinc; another, pale yellow, from 7 parts copper and 3 parts zinc. The specimens had been filed up twice, and consolidated by pressure. Both contained a uniform, finely granulated yellow alloy. Thus zinc and copper can be actually united by repeated filing and compression, and it has been suggested that, by the union of metallic powders by compression, new alloys may be produced which it is impossible to get by fusion.

New Indiarubber Substitute.—Manilla gum is diluted with benzine, and 2 per cent. of Auvergne bitumen, mixed with benzine, is added. They are thoroughly mixed, and 5 per cent. of resin oil added, when a product is obtained which is said to have all the suppleness, elasticity, solidity, and durability of the best rubbers. If the product is too liquid, 4 per cent. of sulphur dissolved in carbon bisulphide may be added. The material can be vulcanised in the usual way.

Mean Annual Temperature.—The mean temperatures of the air on each day of the year at the Royal Observatory, Greenwich, on the average of the fifty years, 1841—1890, were given in a recent paper before the Meteorological Society by Mr. Ellis. The mean annual temperature is 49·5°. The lowest mean temperature, 37·2°, occurs on January 12th, and the highest mean summer temperature, 63·8°, on July 15th. The average temperature of the year is reached on May 2nd, in the spring, and on October 18th, in autumn. The interval during which the temperature is above the average is 169 days, the interval during which it is below the average being 196 days.

TRADE: PRESENT AND FUTURE.

Rail Trade.—Large orders for steel rails have been secured from America, Australia, and the Congo by a Sheffield firm.

Coal Trade.—Sheffield coal trade is dull. House coal has advanced. There is a good demand for foundry coke.

File Trade.—File-making trade is dull.

Glass Bottle Trade.—The Mexborough glass bottle trade is fairly prosperous, the hands having settled the recent dispute, and working full time.

Timber Trade.—There has been a large sale of wood at the Liverpool Docks, including the following lots of mahogany: 559 logs and curls Tabasco, 70 logs African, 19 logs and 136 curls St. Domingo, 118 logs Cuba Sabicu; 980 planks Sequoia; 51 tons Honduras rosewood; 10,706 pieces oak spokes; 26,386 pieces pick, sledge, and hammer handles; 455 logs birch; 2,539 pieces American sugar pine boards; and others.

Silver Trade.—The Sheffield silver trades are busy. One large house would work day and night. Overtime is the order of the day.

Edge Tool Trade.—This is busy. Skate makers have also plenty of work.

Cycle Trade.—Makers are looking forward to 1893 for orders. In this they are gratified to find much activity, many of the dealers having already booked largely for their '93 wholesale business, which is expected to be better than the '92 season.

Iron Trade.—In Lancashire little business is being done, buyers anticipating a fall in prices. In Derbyshire the finished iron trade continues fairly active. In the pig iron market there is more business being done, and work at the foundries is steadily maintained. In the Midland pig iron trade a revival of activity is now being experienced. Prices are being advanced to keep off pressure.

Engineering Trade.—The Lancashire engineering trade is growing steadily worse, and almost all the works are exceedingly slack. The locomotive branch is in a deplorable condition, and the boiler makers, who have had little cause for complaint during the recent depression, are now decidedly short of work. In the Midlands engineers report a steady slackening down, but machine tool makers are fairly well employed, as are also makers of gas engines and electrical machinery.

Marine Engineering Trade.—The outlook in the marine engineering and shipbuilding trade in Lancashire is still most unsatisfactory. For months no new machinery has been ordered from the marine engineering firms on the Mersey. There are very few vessels now in hand, and these are being completed, with no prospect of orders for new vessels.

Steel Trade.—The steel trade in the Lancashire district shows no signs of improvement. Prices for raw material continue to fall, while in the manufactured material orders are only being secured at unremunerative rates. The crucible steel industry has improved its position, the more valuable brands being in fair request. Rolling mills, tilts, and forges are more fully employed.

Cotton Trade.—The crisis continues. Employers are loth to adopt a reduction of wages, which the *employés* would oppose.

Cutlery Trade.—The Sheffield cutlery trade is extremely depressed, hostile tariffs causing the mischief. The American market is closed, except for the highest grades of cutlery. Some of the best German makers of cutlery are known to be importing larger quantities of Sheffield steel, and several important orders for ivory and pearl hafts have lately been received. The commoner classes of cutlery are difficult to dispose of. A large number of workpeople are idle.

Shipping Trade.—A recent development in the shipping trade of Liverpool is the importation of New Zealand mutton direct to this port instead of through London; a large quantity of Californian fruit is also now being imported. A launch in Liverpool is a novelty, but Messrs. Royden & Sons have just successfully launched a four-masted barque of 2,420 gross tonnage, called the *Fannie Kerr*. A strike of flatmen is threatened, when 700 men will be affected. Freights, especially for Danube ports, have shown a sudden rise. American grain and cotton are better.

SHOP:

A Corner for Those who Want to Talk It.

**** In consequence of the great pressure upon the "Shop" columns of* Work, *contributors are requested to be brief and concise in all future questions and replies.*

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of Work *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given.*

I.—Letters from Correspondents.

Engineering Pupils. — Tangyes, Limited, write:—"We have not for many years taken apprentices to the engineering."

South Kensington Art Library.—H. S. G. (*London, W.*) writes:—"A retrograde step has been made here since the new librarian has taken over his duties. For many years (over twenty I can speak of from my own experience) it has been the custom to leave the new books on a certain table, so that all readers could examine them. By a cursory perusal oftentimes an idea of their contents has been gained. A bit of knowledge this, not, perhaps, of importance at the moment, but none the less useful when reference is wanted at a later period; besides, a note can be made of their contents for reference, which we know has often been done. It is useless to multiply examples of the advantages this method gave to all students, for the benefits are, or were, palpable enough. What has the new chief been up to, then? Why, for the last eight or ten months the new books have been catalogued and put away at once. All that has been done for the assistance of the students is to write out a list of the new acquisitions. Now, who among ordinary mortals wants to unnecessarily trouble the very courteous attendants by asking for all new publications *en bloc*, in order to see if, by chance, one of them contained an article or chapter bearing on our own particular study. We all know the proverb about a 'new broom,' but for the one now at South Kensington to sweep all the new books clean away like this is an instance of misdirected energy, which we hope to see rectified when we next visit the place. We may say that there has been no question of misuse of the new books, as far as we can gather. Why, even local free libraries do better than this, for some of them, at least, expose the backs of the new-comers."

Wheel Keys.—P. B. H. (*Southport*) writes:—"There is a paragraph on 'Wheel Keys' (see Work, p. 328, No. 177) which is by no means correct. The first part is about the wood key, which should be made a tight fit, and then sent to the blacksmith's to make a key a little larger. This is correct, and what, in all good shops, is usually done; but when the writer speaks about a blacksmith working to the thickness of a piece of newspaper, it is absurd. If such a smith could be found, he would be another of the great wonders of the world. The blacksmith should make the key at least $\frac{1}{16}$ in. bigger than the wooden pattern, which key and pattern should then be taken to the grinder, who should grind the iron key till it only remains slightly larger than the wooden pattern, as in fitting the key to its place a great deal more allowance is necessary than 'the thickness of a piece of newspaper.' Another reason why the key should first go to the grinder's is that the skin on the iron when it leaves the smith's hands is so hard that a new file would with great difficulty touch it."—[This correspondent says that the paragraph is by *no means* correct. Let us see. He contradicts himself directly after this by saying that I am *right* in making a wooden pattern for the smith to make the key to. Now, with regard to the thickness of a piece of newspaper, if he will look at the paragraph again, he will see that it is only metaphorically written—thus: "Say, to the thickness of a piece of newspaper"—meaning that he should set his callipers so that the key should have as little to file off as possible. This only to be done when a *good black job* is required. He says, "The blacksmith should make the key at least $\frac{1}{16}$ in. bigger than the wooden pattern." He is now speaking of highly-finished work, most likely. Well, in *all good shops* they make it a rule to work to *plans*, and would make the key forging $\frac{1}{16}$ in. larger than the plan size, perhaps, before the keyway was cut, and not use a wooden pattern, the key being afterwards milled down to a proper gauge, its keyway cut to a gauge also, proper decimal allowances being made when these gauges were made. In "all good shops," again, the keys are not made of *iron*, as he states, but of key steel or mild steel, which is soft enough; a second-cut file half worn will cut it easily. In conclusion, I may state that I have worked in *good shops* years after I was out of my time, holding the posts of fitter and erector in charge, general foreman, and head engineer in charge, but I am always willing to learn in a trade where there are none perfect. Our correspondent should never so far lose his temper as to stake an unpublished article against a paragraph; a cool head is also indispensable in a workshop.—T. R. B.]

II.—Questions Answered by Editor and Staff.

Division-Plate.—R. N. (*Grays*).—I have seen a division-plate about ¼ in. thick, which was made to slip on to the mandrel-nose when required, and then the chucks went on over it and secured it as by screwing it fast by a nut. If this is the plan you think of adopting I would strongly advise you against it. It seems as though the interposition of a perfectly flat plate between the chuck-face and the mandrel-face would have no effect on the set of the chuck, but practically it would require screw-threads of a most uncommon degree of accuracy to attain such a result. Suppose you turned up the face-plate chuck when screwed on as usual and then took it off, and, after putting the division-plate in position, screwed the face-plate upon the nose again: on bringing up a tool to touch the surface of the chuck, it is almost certain that it would prove slightly untrue; take off the two and put on the chuck alone, and it would run true again. The division-plate should be in the usual place; if not, it may be placed on the tail-end of the mandrel of a screw-cutting lathe, in place of the first change-wheel, since change-wheels and division-plate are not used together; but it must, of course, be firmly fixed so that it cannot turn on the mandrel in the slightest. You may find information on how to divide the division-plate in Vol. I., page 153; also in Vol. III., page 29, first column.—F. A. M.

Overhead for Lathe.—R. R. T. (*Frome*).—If you have a countershaft to drive your lathe, and wish for an overhead which will enable you to cut screws by bands from it to pulleys on the slide-rest, you are trying to do what most turners will tell you is impossible, on account of the difficulty of getting the pulleys exactly the right size; and, still more, on account of the stretching of the bands, or of the possibility of their sinking more or less deeply in their V grooves, and so altering the diameter on which they work. To cut screws by bands from the overhead is such an obvious plan, that it is no wonder many have tried (and tried in vain) to accomplish it. Still, it can be done if only the difficulties are well understood, and how to meet them; and when it is accomplished, it is, for the short screws which can be cut with the slide-rest—say, not more than 5 in. in length—a very convenient method indeed, more so probably than the usual way of employing a long leading screw. The difference between the two plans lies in this: that with the long screw and change-wheels, owing to the number of revolutions being determined by the number of teeth, the screw must always turn an exact proportionate number of turns with the mandrel—say, equal turns, or two to one, or half to one *exactly*; it cannot make for one turn of the mandrel two turns and one-hundredth part of a turn; but this is exactly the sort of thing that may occur, and, without great care, must occur, in sizing the pulleys for bands. Suppose, *e.g.*, one pulley is to be twice the diameter of another exactly, and, by neglecting to reckon into both the half thickness of the band, the workman makes the proportion as 1 is to $2\frac{1}{100}$: the error might be imperceptible in one thread, but in two it would become double, and in ten threads—say, an inch of a ¾ bolt—you would have an error of $\frac{1}{10}$ in. I hope it will now be clear that any error arising in the size of the pulleys is *cumulative*, and that, owing to the effect of the thickness of the band, the diameters of the pulleys can only be obtained approximately by calculation, and must be subsequently corrected by trial. It follows from this that the *change-pulleys* (if I may so call them) must be so mounted in the overhead frame that they can easily be taken out and mounted on their spindle between the centres of the lathe, so as to turn off a little more as may be required. The grooves, too, must not be V's but half round, and should fit the size of the belt used. Now as to the general arrangement. If you have a countershaft over the lathe, but a little behind it, say over the treadle bar, I think you should make a swing frame, so that it may swing round the countershaft, and this frame would carry two or three shafts to be driven by a pulley on the countershaft; one of them would carry the sized change-pulleys driving down to a pulley on slide-rest screw, and one of the other shafts would be arranged to run fast, so that it might drive flying cutters, drills, etc. The frame would be held up in front by a counterweight to keep the bands tight; the bands should not be longer than necessary on account of the liability to stretch, so let the front of frame come about 6 in. above the head, say, 6 ft. 6 in. above the ground. You will see that with this arrangement, whenever you wanted to match a screw you would only have to make a new pulley; also there would be one or two suited to give a feed of, say, 60, 80, or 100 cuts to the inch; also some to give a very quick feed for cutting twists of, say, 6, 8, or 10 in. rise in each turn; whilst another shaft of the overhead, running rapidly, might drive the flying cutter in a universal cutting frame to cut out the twist. If you further wished to make such an overhead as I have here sketched out, the Editor would, doubtless, entertain it.—F. A. M.

Phonograph.—W. C. (*Harlow*).—This querist has been just a trifle too hasty. The articles on the above were not finished when I received his letter. I daresay by this time he will have found how to put the tinfoil on his cylinders. We do not answer by letter. "Shop" columns are *pro bono publico*. Writing an answer direct to one querist takes the same time, and, of course, only one is benefited.—W. D.

Phonograph Mould or Casting.—C. C. (*Glasgow*).—I am very sorry that I cannot help C. C. to make his ebonite tubes with holes.—W. D.

Phonograph.—A. B. (*Bournemouth*).—This is simply a matter for experiment, if A. B. thinks the phonograph would speak better by fixing the needle direct to the diaphragm. The cork or wood no doubt deadens the sound, but then you must not allow the diaphragm to vibrate too much, or your sound will be all jumbled up and you will hear nothing but a dull, grating, or rasping sound.—W. D.

Mandoline.—Factorian.—The old proverb says, "You cannot make a silk purse out of a sow's ear;" neither can you make an excellent mandoline from such unsuitable material as you name. I do not say it would be impossible to make one, "using half a cocoanut for the bowl (or body);" but such an instrument, when completed, would, however good the workmanship, be little better than a curiosity, as, owing to the limited area of the sounding-board, the tone would necessarily be thin, poor, and unsatisfactory. If, however, you still think it worth while to exercise your ingenuity on such an idea, write again.—R. F.

Phonograph.—Phono.—If you have cut your standards to the sizes given in the articles, there should be no difficulty with the top. The brass knob, G, is for regulating the pressure of the needle, which is, of course, fixed to the top on the tinfoil, consequently they must project through. I cannot give the measurements you ask, as I am writing away from home, but you will get them by reading over the article again. The tinfoil you will get in any respectable chemist's or optician's.—W. D.

Bells for Model Church.—J. T. (*Middleton*).—I should advise you to buy some bells of the makers of model ships—say, of Bateman, in High Holborn.—J.

Enamelling.—S. H. (*Cardiff*).—You can obtain information respecting the process of enamelling the inside of steam boilers from Messrs. Holtzapffel, composition makers, Newcastle-on-Tyne.—M.

Teak for Boats.—A Subscriber (*Akyab*).—The length of time required to keep the teak in the steam-box depends upon the pressure; if you have a good pressure about twenty-four hours will be sufficient. Of course, you will understand that the bending must be done immediately the wood is taken from the box. Try a piece first and you will see what pressure you have, and can then be guided how to proceed with the rest. Select your wood, and take the longest-grained and straightest.—A. J. H.

Moulds for Casting Silver.—H. B. W. (*Cairo*).—Silver may be poured into moulds made of iron, of plumbago, of fire-clay, or of plaster-of-Paris, well dried and baked. I employ iron moulds if the silver is to be afterwards worked under the hammer, or rolled in a rolling-mill, or flatted. The mould should be coated with blacklead, and made hot enough to scorch paper before pouring in the molten metal. If you will tell me what the silver castings are to be used for, I will tell you how to make the moulds.—G. E. B.

Telephone *v.* Bells.—W. E. H. (*Deptford*).—As the bells ring faintly, and the telephones are not loud enough, you may not be employing a sufficient number of cells. Try adding another cell to each battery. It will be useless putting an isolated extra cell near each bell. The extra cells must be employed to increase the force of the existing batteries and be connected in series with the other cells. The bells can be rung by a separate battery to each, connected by relays to the main circuit; but I do not think this necessary over only a mile of line wire. A microphone may also be included in the circuit if you care to have one, and this may increase the loudness of the speech from the receivers; but try the extra cell first, and then report results.—G. E. B.

Notes for Electro-Platers.—H. B. W. (*Cairo*).—In consequence of the demands upon our space, these notes must give place to constructive electrical matters of more varied interest.

Incubator.—Chick.—Do not be dismayed at the sight of my incubator. It really is not so difficult of construction as may appear at first sight. Although I have detailed a lot of finish, this is by no means absolutely necessary. If you must have "hot water," get No. 89, and also No. 109, and read one with the other. If any point wants further elucidating, I shall be pleased to help you. All or any fittings for my machine can be had of Mr. Stevens, 7, Selhurst Road, South Norwood, London, S.E.—Leghorn.

Magic Lantern.—F. S. (*Old Swindon*).—"Have any articles on constructing a magic lantern appeared in Work?" In Nos. 83, 87, 91, 96, 100, are articles on the construction of a triunial lantern of a first-class kind. Should that be too large an affair, then I may say that an article on the construction of a good mahogany body single lantern has appeared in the present volume (see Nos. 174 and 179). This will possibly meet F. S.'s needs, as it is less pretentious than the triple referred to.—"What is the best oil to use in a magic lantern?" Paraffin oil is largely used, and with a properly constructed lamp is perfectly safe. Such a lamp with three or four wicks is undoubtedly the best light to be got, short of the limelight.—"What is mixed with the oil to cause it to burn more brightly?" With mineral oil, nothing. If sperm oil is used, then

camphor dissolved in it will improve the light. This oil is non-explosive, and does not require the same kind of lamp, is simpler in construction, and, consequently, cheaper.—"Where could I best obtain magic-lantern slides?" The number of dealers is legion; their advertisements appear in WORK. There is such keen competition that there is not much to choose between the various dealers. To give names where there are so many would seem invidious; still, if F. S. cannot learn by any other method, I shall be pleased to give names and addresses.—O. B.

Bromide Plates.—J. S. Q. (*Paris*).—The manufacture of good gelatine bromide plates depends quite as much on the way a formula is worked out as on the formula itself, and to give precise directions—that is, entering into details—would occupy too much space in these columns. It would, in fact, fill a good many pages of WORK to go exhaustively into the matter. The following is an excellent formula, and will produce first-rate results, providing it is properly worked out: (1) Bromide of potassium, 80 grammes; iodide of potassium, 1 gramme; water, 350 c.c. (2) Silver nitrate, 100 grammes; distilled water, 350 c.c. (3) Gelatine (hard), 15 grammes; water to soak; then heat to about 160° F. Dissolve these, and then, in the dark room, mix very gradually Nos. 1 and 2 with No. 3, and boil in an opaque jar or bottle in a water-bath for about half an hour, or until, when a little is placed on a strip of glass, it looks blue by transmitted light. When this takes place, add 100 grammes more of gelatine, previously soaked in water. Mix well, and allow to cool and set. The jelly is then forced through a coarse strainer into cold water and worked for eight hours. It is then remelted, and 5 c.c. of carbolic acid and 80 c.c. of alcohol stirred in, cooled, and allowed to stand three or four days to ripen. It is then filtered through swan's-down calico, and is ready for use. It goes without saying that *all* these operations must be conducted in a non-actinic light during and after the mixing. To coat the plates, sufficient of this emulsion is warmed till it is thoroughly melted; a little is poured on the middle of the plate and made to run to each corner, then poured off into a jar. The plate is slightly rocked to equalise the coating, and then laid face upwards on a perfectly level table until quite set, when it may be placed edgewise in a rack to dry in absolute darkness, the temperature of the room being between 70° and 80° F. Scrupulous attention must be paid to cleanliness in all the processes, and avoidance of dust. The foregoing is a sketch of the process, which will enable anyone to make his own plates if worked intelligently. There are many handbooks in the market that give full instructions for plate making. J. S. Q. will do well to purchase one and make himself thoroughly acquainted with the minutæ before commencing operations.—D.

Silhouette.—W. P. (*Glasgow*).—The process of taking a silhouette is precisely the same on ferrotype plates as on ordinary collodion. The lighting of the figure is the principal thing. The figure must be in shadow, reclined against a light background and the exposure short. No special chemicals are required; such that will produce a good position will produce a good silhouette. Ferrotype plates prepared by Neivsky, and sold by Fallowfield, Charing Cross Road, will answer your purpose.—D.

Half-Plate Camera.—J. O. (*Leeds*).—If J. O. will refer to Vol. I. of WORK, No. 23, he will find full instructions for a whole-plate camera. For a half-plate he will, of course, reduce the dimensions, and may use somewhat lighter materials; otherwise, the instructions may be carried out without alteration.—D.

Hand Camera.—SNAP SHOT.—Instructions to make such a camera as you require would occupy too much space. Some of the most useful are little else than small cameras enclosed in bags or cases, with a cord or other contrivance for liberating a snap-shutter without opening the case or bag, and the plates are contained in simply made ordinary double dark slides. There are hundreds of different kinds in the market at the present time. A small hand-bag with a ¼-plate camera *fastened firmly* inside, with an aperture through the leather for the lens, will produce as good work as the most complicated. The precaution must be taken of adjusting the focus before fitting it into the bag, as there is no opportunity afterwards.—D.

Christy Bread Knife.—J. H. (*Bradford*), G. A. F. (*Pontefract*), and others.—This is not to be had in this country yet. It is an American idea.

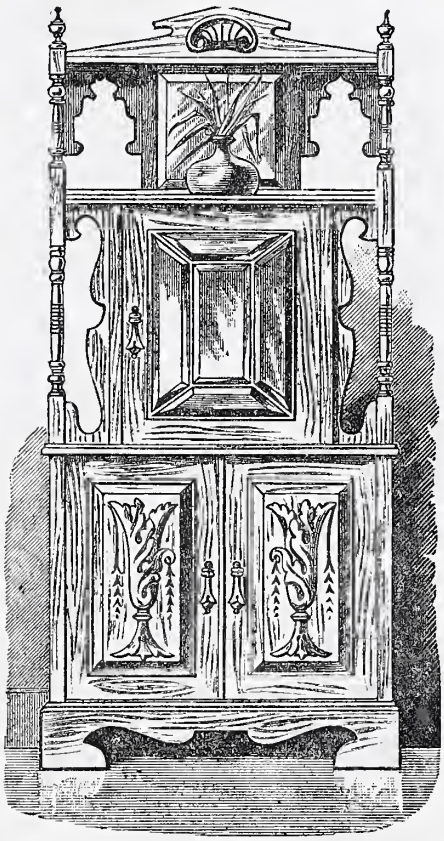
Metal Plate Circle.—P. B. H. (*Southport*).—You do not seem to understand the matter whereof you write. You quote—correctly—from page 226 of No. 171 of WORK as follows:—"When it is required to divide a circle into an indivisible number of parts," and then ask, "How can an *indivisible* circle be *divided?*" In the paragraph quoted, as you show yourself, there is no mention of "an *indivisible circle.*" An *indivisible number* is a prime number, such as 23, mentioned in the paragraph. Prime numbers are abundant; 3, 5, 7, 11, 13, and 17 are other examples, and if a line is to be divided into any of these numbers it must be done at one operation, as the numbers have no divisors, but the *line is divisible.*—F. C.

Experimental Science.—RUGBY SCHOOLBOY.—It is our intention to deal with experimental science in all its branches in WORK directly suitable plans and methods of treatment are before us from writers qualified to treat the different subjects in an interesting and thorough way.—ED.

Hives.—V. B. (*Egham*).—In the second volume of WORK are found instructions for making two different kinds of extractors. My copy of the paper is lent to a friend, so I cannot refer you to the number; but if you mean to take up bee-keeping, I would strongly recommend you to purchase the entire volume, and read the articles on Hives, etc., running through it.—APIS.

Inventors.—J. W. H. (*Bracklcy*).—The association for developing inventions is called the London Commercial Association, and has offices at 47, Holborn Viaduct, London, E.C. As to the Pahang mahogany, you should inquire of some importer of foreign timber—say A. J. H., of WORK.—F. C.

Music Cabinet.—W. B. (*Howdon-on-Tyne*).—The design which is here appended will be found a trifle fresh, and one which may be materialised with a comparatively small amount of labour. I cannot enter into constructive details further than to advance the few notes following:—The upper and lower cupboard should be made in one carcase, whilst front columns and back uprights square above the top board, and turned below it, are cornered into the said top board, and carry a shelf. Between the middle back-column posts should be tenoned a wide rail, the top board being reduced in



Music Cabinet.

width to allow it (the rail) and the posts to properly abut against the job, in which position it may be permanently screwed. Applicable details relative to plinth and the construction of the carcase will be found, as perhaps you may know, in many past numbers of WORK.—J. S.

Hairspring.—LEO.—To be able to pick up and pin in a hairspring that will suit the first time requires a great deal of practice and experience, and I do not think any tool will be really of much help. The little tool you mention is useful for holding the spring while counting the vibrations, and I know of no other, except one just brought out and used with a selection of springs with it, where you weigh the balance and the indicator shows the number of spring; but this is very expensive, and I have no personal experience of it, so cannot say how it works in practice, though it looks nice on paper. The only advice, under the circumstances, I can give is, "Try, try, try again."—A. B. C.

Feed-Water Heating.—J. W. M. (*Birmingham*).—I should think you would get the particulars of the heating apparatus from the Whitehead Torpedo Co., or they would direct you to the makers. Your ejector condenser appears identical with that brought out by Mr. Ledward, of Brockley, London.—F. C.

Sanitary Engineer.—C. W. S. (*London, S.E.*).—To become a fellow or a member of the Sanitary Institute you would have to pass two examinations. The fee for the preliminary one (paid in advance) is, I believe, 3 guineas. If you fail in this you can be re-examined after a stated period for half fee. The examination is a pretty stiff one, and comprises a knowledge of plumbing, sanitation, chemistry, and hygiene. As a practical plumber you would, I should think, be able to pass if you thoroughly get up the theoretical requirements, especially if you are a registered plumber. With regard to its being any use to you, all knowledge is of use, as I have proved myself many times; knowledge that I had thought would never be the least use to me has been, when I least expected it, of the utmost service. I think such a degree of knowledge as the attainment of this certificate would show you to possess would aid you very materially in your trade and profession, and, perhaps, help you to rise above it. The post of sanitary inspector is, in many places, a lucrative and honourable one, and you are as eligible for it as anyone else if you possess the capabilities. Therefore, "Go in and win" is my advice. Apply for full particulars and examination papers to the Secretary, Sanitary Institute, 74A, Margaret Street, London, W. Examinations are also held for diplomas of proficiency as sanitary inspectors by the Council of the British Institute of Public Health in April and October; fee, 3 guineas. The address you want is—Francis Allen, M.D., Medical Officer of Health, Shoreditch, Hon. Sec.—R. A.

Bronzing Gun Barrels.—J. A. (*Manchester*).—You will find the following method answer very well if applied properly. Make up the following preparation:—Dissolve 2 oz. of sulphate of copper in about 1½ pints of water, add ½ oz. of perchloride of iron, ½ oz. of aquafortis, and ½ oz. of sweet spirits of nitre. Wash the barrels with strong soda water to thoroughly free them from grease—some use powdered lime and water for this, but I prefer the liquid—apply the preparation to the barrels by means of a soft brush or piece of rag, let them stand till next day, then brush them with a stiff brush, and give another coat of the preparation. Let this stand as before, brush well again, and then polish them by rubbing with a smooth piece of wood. The barrels are usually further protected by a coat of shellac varnish; ¼ oz. of shellac dissolved in between ½ pint and 1 pint of spirits of wine will make a very suitable one for the purpose. N.B.—The sulphate of copper and the perchloride of iron will dissolve better if powdered and put in hot water.—R. A.

Tire Protector.—C. L. M. (*Glasgow*).—The tire protector in question is to be had of T. Edens Osborne, 10, 12, and 14, Lombard Street, Belfast.—A. S. P.

Grandfather's Clock.—TRY AGAIN.—My reply to this appeared in WORK, No. 178, page 349.—J. T. V.

Galvanising.—F. McG. (*Dublin*).—I am not aware that any mixture is used in galvanising. The sheets or articles are, after "pickling," dipped in a bath of molten zinc, which is covered with sal-ammoniac to prevent oxidation. Some may, perhaps, add a little lead or tin, but I cannot say if this is so for certain. You might experiment with small quantities.—R. A.

Bicycle Design.—H. S. A. (*Crewe*).—What you require is a diamond-frame safety with an additional bit of frame, having pedal-shaft, handle-bar, etc., attached for the second rider. The change from the one to the other could be effected, by the fixing of three bolts, in about fifteen minutes.—A. S. P.

Carpenters' and Joiners' Tool.—F. B. (*Greenwich*).—Call with, or send, the tool, and we will see what can be done with it.—ED.

How to Make Gas Engines and Oil Engines.—J. S. and J. H. (*Beith*).—I am sorry I cannot give you any satisfaction in the "Shop" column. I think if you consider you will see you could not be told how to make a complicated and difficult engine by means of "a few hints." I should advise you to read up the books enumerated in middle column of p. 364; and then buy a set of castings of a ½ horse-power gas engine and of an oil engine, if they are to be had, but I think not at present.—F. A. M.

Dry Battery for Electric Lamp.—W. D. (*Wellingborough*).—Procure some sheet zinc ⅛ in. in thickness, and construct six cells, each 8 in. in height by 5 in. square. Divide each cell into two equal compartments by zinc partitions. Cut pieces of sheet glass to fit the bottom of each compartment and cement them therein with hot paraffin wax. Next, get sixteen carbon plates 8 in. by 4 in. by ¼ in., and cap them at one end with a lead head and binding-screw, as for a Leclanché cell. Also solder a binding-screw to each zinc cell. Now prepare the mixture for packing the cells. Get some spirits of salts, and add scrap zinc to it until the acid will not dissolve any more; then add crushed sal-ammoniac until the liquid will not take any more of this. Now get enough plaster-of-Paris and zinc oxide to make a mixture of 1 part zinc oxide and 2 parts plaster to fill the cells. Put a thin layer of this in each compartment, then put in the carbon plates, make the rest of the mixture into a paste with the prepared liquid, and pack the carbons with this paste to within ¼ in. of the tops of the cells. Allow this paste to set, bore two small holes in the paste in each cell, insert in these some fragments of glass tube, then run in a seal of pitch or marine glue over the plaster. Six such cells in series will light a 5 c.-p. 8 volt lamp for ten minutes at a time at intervals.—G. E. B.

Mathematics for Electric Engineers.—THEORY.—As electrical engineers have to do with most intricate arithmetical calculations worked out with algebraic signs, it becomes necessary for a

student to master all the branches of mathematics relating to the measurements and calculations of solids. You will find the following books helpful to you: "Plane Geometry," 1s. 6d.; "Solid and Spherical Geometry and Conic Sections," 1s. 6d.; both obtainable from John Calvert, Great Jackson Street, Hulme. There is also a book on "Practical Plane and Solid Geometry," price 3s., published by Messrs. Cassell & Co.—G. E. B.

Blackleading Plaster Cast.—A. L. (*Dewsbury*).—To do this well you must proceed much as with bronzing. "Satisfy" the plaster with linseed-oil, and then give a coat of japan gold-size, in which it will be well to mix a very little lead-coloured pigment; or, as some prefer, the plaster may be "satisfied" with patent size, and then varnished with two coats of copal varnish. But in either case the blacklead will have to be dusted on when the gold-size or the second coat of varnish is sufficiently tacky—which will be a little less dry than for gold-leaf. Dust on with a bob of cotton-wool or a bit of new wash-leather. The best graphite is that which rubs to a fine powder, and looks black till its brilliancy is brought out by friction when dry.—M. M.

Waste Fluff from Irish Linen Manufacture.—J. W. (*Banbridge*).—From the sample sent, I imagine this "fluff" might serve for many of the uses of cotton-wool. There is a widely spread impression—how far correct I cannot say—that linen fibre is less irritating to wounds than cotton fibre. This suggests that your material might possibly make a surgical dressing preferable to the cotton-wool now employed. It would, probably, be less expensive than pine fibre. Very careful preparation would be needed to fit it for this purpose; and it would need to be rendered antiseptic, which I understand is usually done by slightly impregnating with corrosive sublimate. It might perhaps be worth while to submit a sample to Messrs. Macfarlan & Co., manufacturing chemists, Southbridge, Edinburgh, who are, I believe, specially known in connection with the preparation of such dressings.—S. W.

Cycle Tangent Wheel, etc.—ÆOLUS.—(1) I presume your tangent wheel has nipples at the rim; if so, cut the spokes as near the length as can be ascertained by a drawing of the wheel showing the direction of each pair of spokes. Proceed by putting in four pairs of spokes; they should have half an inch screwed, and the end should just appear through the nipples when the spokes are nearly taut. If you find the eight to be correct in length, cut all the same length; screw all up until the ends appear flush with top of nipples. Have the wheel to revolve in a stand for the purpose, with a piece of wood or an iron rod extended to the rim; revolve the wheel and see what parts come nearest the rod, and screw up spokes on the *off* side. Assuming that the spokes have all been cut alike in length, the wheel should be true when they protrude equally through the nipples. (2) The quickest way to solder the crossings is with a tinman's bolt, but they are about as well only tied with fine wire. (3) Brazing may be done with the blowpipe alone if the pipe is large and the gas supply and blast powerful. Brazing is usually done with the fire and pipe combined. The work is brought up to a red heat with the fire, the under side, of course, being hotter; the pipe is then applied to the upper side until the spelter flows. Brass wire is tied round joints where spelter cannot be got to lie. There are no joints about a cycle frame where spelter cannot be got in, as in all cases it is put in either before the parts are put together or through the vent-hole, which is always provided in tubes and forks that are shut at both ends.—A. S. P.

III.—Questions Submitted to Readers.

**** The attention and co-operation of readers of* Work *are invited for this section of "Shop."*

White Wood Articles.—A. M. R. (*Golden Square*) writes:—"Will some of your readers tell me where I can procure, for my wood-carving school, white wood articles—such as bread platters, handkerchief boxes, picture frames, paper racks, etc.—ready for carving, and at wholesale prices?"

Electric Light.—J. B. (*Ashton-under-Lyne*) writes:—"Will you kindly inform me, either by letter or through the means of your valuable paper, whether there is anything in the electric lighting way that could be made to supersede the old paraffin lamps now in use at markets and fairs—something that would not easily get out of order, and that would lie in small compass, so that it could be carried about from place to place? I shall be very thankful if you can inform me of such a light, either electric or any other means of producing light."

Meerschaum.—J. W. B. (*Castleford*) writes:—"I have a valuable cigarette holder made of meerschaum and amber, which has come to pieces, the meerschaum and amber having parted company. Will any brother reader kindly tell me how to mend it? Being a valuable article, I have not tried experiments upon it for fear of spoiling it. Would plaster-of-Paris do?"

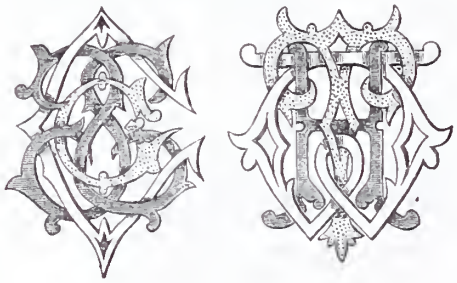
IV.—Questions Answered by Correspondents.

Refuse Destroyer.—M. (*Bishop Auckland*) writes to Colonist (see No. 178, page 350):—"One form is made with an arch over the firebars, in which is an opening, or openings, into which the refuse is tipped; a high chimney is required. Another method is to use a disintegrator and reduce it to powder, when it can be used for manure. This requires an engine or power to drive it, and is suitable for dry refuse. I might be able to get you more particulars if I knew your requirements."

Mason's Marking Red.—M. (*Bishop Auckland*) writes to Mason (see No. 178, page 350):—"This will be hematite iron ore, which is mined in the Furness district in Cumberland. You might procure it there, or from some iron-works where it is used."

Country Carpentry.—Chopstick writes, in reply to Heathfields (see No. 169, page 197):—"I will take your questions in the same order as you put them. First, the prices will be about as follows:—Wood for framing—oak, 3s. 6d. per foot cube; ditto, yellow deal, 2s.; tiles to cover roof, 32s. per 1,000; bricks (clamp), 25s. per 1,000. The height of lodge is given as 8 ft. up to the plate, and 2 ft. of brickwork. This will leave 6 ft. for posts, or allowing for tenons, 6 ft. 6 in.; the teazle posts will have to be 7 ft. 6 in. These measurements could have been obtained from the drawings, the elevation being to scale. The sizes of timber are as follows:—Front plate and teazle posts, 6 in. square (the latter 12 in. by 6 in. at top); corner posts, back and end plates, sills, and intermediate posts, 4½ in. by 4½ in.; ties, about 8 in. by 6 in.; principal rafters, 4½ in. by 3 in.; common rafters, 4 in. by 2 in.; purlin, 4½ in. by 2½ in.; collars, 8 in. by 2 in.; hip rafters, 6 in. by 2 in.; quarterings and bracings, 4 in. by 2 in. The front posts, sills all round, and also padding sills, should be of oak; and it would make a better job if all the timber were oak, but the remainder will do of yellow deal; in fact, I have built many a one of English fir and alder, and they are still standing. The foundations will do if they are 12 in. in the ground, if it is a firm bottom. If you are doing without brickwork altogether, simply level the ground, and lay a brick or two at intervals of about 3 ft., to lay the sills on. In my second paper, which you will most likely have seen before this is printed, you will find instructions how to cover the sides, or walls, as you call them. Tiles would not do; board is the proper thing; neither do I recommend either slates or thatch for the roof. The former are too expensive, and the latter is nearly as bad, besides forming a harbour for vermin, etc. I think I have answered all your questions in a satisfactory manner, and I hope you will understand how to proceed with the building. If not, write again, and I will have another try to put you right, as it is a pleasure to answer anyone who states what he wants to know in a straightforward manner, as you have done. It is far different with some whom I have had to deal with. In case you may not know how to find out the number of bricks and tiles required, I will just mention that a 'square'—that is, 100 square feet—of 9 in. brickwork will take 700 bricks, and the same size space of tiling will require 1,100 tiles. This number is sufficient to cover waste."

Monograms.—R. D. T. (*Marylebone*) writes:—"In reply to H. T. W. (*Cardiff*) (see No. 170, page



"S. S. G. C." and "H. T. W." Monograms.

222), who asks for 'S. S. G. C.' and 'H. T. W.' monograms, I beg to submit one of each, which I trust will suit H. T. W.'s requirements and fancy."

Hydraulics.—M. (*Bishop Auckland*) writes to Driver (see No. 174, page 286):—"The following book treats on hydraulics and cranes: 'Hydraulic Machines,' by Frederick Collyer, 18s., published by Spon, Strand."

Magic Lantern Sheet Frame.—M. (*Bishop Auckland*) writes to B. N. (*North Seaton*) (see No. 175, page 302):—"You might fix the sheet on two rollers; when rolled up it could be carried in a wooden case."

Racing Cutter Yacht.—M. (*Bishop Auckland*) writes to F. C. B. (*Glasgow*) (see No. 175, page 302):—"There is a book published by L. Upcott Gill, 170, Strand, entitled 'Model Ships and Yachts.' The price is, I think, 5s. See also Nos. 160, 165, 166, and 171 of Work."

Half-Plate Camera.—M. (*Bishop Auckland*) writes to A. G. (*Lambeth, S.E.*) (see No. 175, page 302):—"You will find instructions in Vol. I. of Work for making a full-plate camera. By altering the size you can adapt it to a half-plate. There are also instructions for making dark slides, folding tripod, etc. Vols. II. and III. also contain a great deal of information on photographic apparatus."

V.—Letters Received.

Questions have been received from the following correspondents, and answers only await space in Shop, upon which there is great pressure:—Clericus; Victor Supply Co. (*Grimsby*); J. L. (*Wexford*); E. W. (*Sheffield*); Solder; J. R. (*New Brompton*); L. V. & H. (*Smethwick*); P. Bros. (*Dulwich*); W. P. (*Pendleton*); A. W. McC. (*Belfast*); F. A. S. (*Hampton Wick*); J. V. M. (*Manchester*); W. J. R. (*Lambley*); Camera Obscura; C. W. (*Hackney*); A. J. S. (*London, N.W.*); L. P. (*Stafford*); Cymra; E. J. (*Peckham*); A. E. (*Birmingham*); T. P. (*Stroud Green, N.*); T. H. H. (*London, W.*); H. H. (*Sheffield*); Anxious; E. F. W. (*Maidstone*); Economes; W. G. B. (*Eastbourne*); M. A. T. (*Farnham*); T. L. E. (*Cardiff*); W. M. (*Leek*); W. C. (*Nottingham*); Constant Reader; H. J. D. (*Norwich*); H. S. (*Ripley*); R. A. C. (*Poole*); E. W., Junr. (*Walsall*); C. H. (*Deptford*); Constant Reader; T. D., Junr. (*Todmorden*); Crown Hotel; Musician; G. H. (*Kings Langley*); W. P. W. (*Newport, Mon.*); A. J. W. (*Upper Tooting*); Totteridge; Improver; A. G. (*Pulborough*); M. J. M. (*Southsea*); New Reader; F. R. H. (*Coventry*); Linseed; M. F. H. (*London*); Rossendale; Bronzes; C. W. L. (*North Tawton*); E. N. (*Bristol*); Axe; Eroo; J. B. (*Burton-on-Trent*); C. A. (*Leyton*); W. W. (*Putney*); P. J. B. (*Clapham*).

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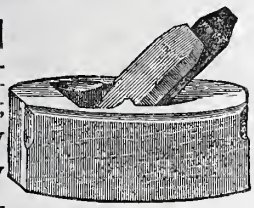

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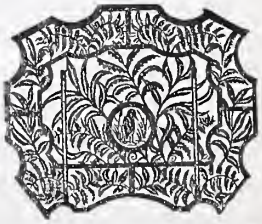

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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WORK WORLD.

A RAILWAY from Tanga, on the east coast of Africa, to Kwa Abdallah, is to be commenced this autumn.

* *

On a year's work of the Steel Company of Scotland a loss of £13,653 appears, due to "strikes of workmen, high cost of production, and reduced prices of products." Such results must affect wages in the future.

* *

A wooden bridge for Alcaig Ferry is proposed at a cost of £8,000. We are inclined to think that it would be more advisable to erect an iron or steel bridge to secure durability and immunity from fire.

* *

The new printing types, made of malleable glass, preserve their cleanliness, and are said to wear better than metal. They can be cast with a sharpness of outline that will print more distinctly than is possible with the old style of type.

* *

Fireproof floorings for hospitals are now so constructed that the wards can be ventilated through tubes embedded in concrete in the flooring, these tubes being in communication with the external air by means of air bricks in the walls. The principle has been adopted for ventilating stables.

* *

Vertical milling machines, constructed on the pantograph principle, are being employed in the engraving of name plates, doing away with hand engraving to a great extent. The machine accomplishes in a few moments what it would take a good engraver the greater part of a day to do.

* *

Calculating machines are finding favour in the drawing offices of large engineering and shipbuilding firms. Where long calculations are to be made, the machines do away with mental labour. The work of two days' ordinary calculating is done by the machine in three hours.

* *

In the electric light installation at Ardrossan Harbour there are seventeen arc lamps erected at equal distances apart round the east and north sides of the Eglinton Dock, and in the Caledonian Railway Station on Montgomerie Pier. Each lamp has an illuminating power estimated at 3,000 candles.

* *

Electric instead of steam traction is to be used on the South Staffordshire tram lines. The overhead wire system will be employed. Each car, with its motor gearing and all appliances, will weigh only six tons, and accommodate forty passengers. The existing locomotives and cars weigh sixteen tons, and carry fifty-four passengers.

* *

When crude petroleum is heated, various oils distil over at different temperatures. Those which give with the least amount of heat are known as petroleum-spirit, naphtha, benzoline, and gasoline. The next to come over are the paraffin oils used for lighting purposes, while the heaviest of all are the oils used for lubricating and heating purposes.

* *

In a new method of photographing on wood the face of the block is whitened with a mixture of albumen and zinc white. The block is then coated with a solution of nitrate of silver in collodion, dried by heat, and the coating dissolved off by ether and alcohol. Another coating of the collodion is applied and dissolved off, after which the block is again dried and exposed under the negative. The print is fixed with hyposulphite of soda, washed, and dried.

* *

The largest order for rails that has been given out for months has been secured by the Barrow Hematite Steel Company; it amounts to 25,000 tons of rails and other railway materials for the Government of Western Australia. Messrs. Cammell & Co., of Workington, have orders for 5,000 tons of rails for South Australia; 7,000 tons for Norway; and 3,000 tons for the Congo. This last order was obtained after a sharp competition with the Belgian Rail Syndicate, who quoted 115 f. per ton against 107½ f. accepted by Messrs. Cammell.

* *

A new form of accumulator plate of some promise has been invented. A perforated ribbon of lead is entwined with an asbestos cord, and the strands thus formed are woven into a loose cloth. Several squares of this cloth, cut to a suitable size, are lightly compressed together to form a plate, and this is held in a lead frame. Four such plates, composed of three squares of cloth, 6 in. by 8 in., and each having a thickness of ⅜ in., only weigh 8 lb. The E.M.F. of each pair is the same as that of ordinary accumulator plates, but a discharge rate of 1 ampère hour per square inch of surface is claimed for the new plates. The disastrous effects of buckling, and consequent short-circuiting, are entirely avoided, and an unusual long life is claimed for cells fitted with these plates.

* *

Time has a material effect on the strength of cements. Bricquettes, two days old, having a tensile strength of 147 lb. to the square inch, showed, after thirty days, a strength of 318 lb. Other cements, showing a strength of 157 lb. at two days, increased in strength to 661 lb. in thirty days. Storing cement causes a loss of weight and strength. One cargo weighed on delivery 111 lb. per bushel, and its breaking strains at two, five, and thirty days were 96 lb., 236 lb., and 371 lb. respectively. After six months' storing the cement weighed 106 lb. per bushel, and its strengths at two, five, and thirty days were 109 lb., 178 lb., and 332 lb. respectively. After being stored a year the weight was 106 lb., and the strengths at five and at thirty days were 73 lb. and 250 lb. respectively.

* *

Tests of incandescent electric lamps prove that the resistance of the carbon filaments in these lamps increases with their use, and the candle-power of the lamps suffers a corresponding decrease. As a consequence, more power is needed to light the lamps as they increase in age. Lamps of high initial efficiency, taking only 1½ watts of energy per candle-power when new, deteriorate more rapidly than those requiring from 2½ watts to 3½ watts per candle-power. At the end of fifty-five hours a 16-c.p. 1½-watt lamp gave only a 2½-c.p. light, and consumed 4·26 watts of energy per c.p. A 2-watt 16-c.p. lamp gave a light of seven candles at the end of ninety hours, and consumed 3·99 watts per c.p. A 2½-watt 16-c.p. lamp gave a light of ten candles at the end of 150 hours, and consumed 3·58 watts per c.p.

THE COACHMAKERS' COMPANY.

BY A COACHBUILDER.

The old Chartered Guilds of Industry of London, inaugurated by our ancestors with intelligent forethought for the welfare of craftsmen of the trades prominent in the then small City of London, and endowed with funds to maintain and extend them in their beneficent influence on trade and the workmen's welfare, gradually lapsed from their sacred duty, and became moribund in all except lavish festivities for the exclusive few that controlled the funds of the Companies. Meanwhile, the sources of their incomes expanded with force and vitality, augmenting wealth, which remained dormant, except mainly for speculative purposes of profit, until within recent years, when some of the conscientious and enterprising members of those Guilds and Companies sought and obtained a partial application of the vast wealth accumulated to the intended purposes of the founders—to instruct and develop the technical industries nominally represented by those Guilds and Companies.

If the other seventy-five Guilds would emulate the Coachmakers' Company, reproach and obloquy would be obliterated from these old bodies. No institutions in the world are so well equipped by wealth, prestige of ancient authority, central position, spacious halls, and a numerous body of skilled craftsmen and learners anxious to participate in the good intentions of the founders of these companies. Well directed, their efforts would neutralise the narrowing of the craftsmen's minds by the effect of division of labour restricting the workman's energies and enlightenment to the section of toil upon which he is incessantly engaged.

The thoughtful members of the carriage trade in this Guild strive to broaden the men's ideas of the various branches of a trade that has such diversity in its composition: as working in various woods, leathers, cloths, silks; in metals like steel, iron, copper, bronze, tin, gold, and silver; in pigments, oils, varnishes, spirits, and lacquers; and other things, as ivory, indiarubber, and electric lighting. Of course, an education corresponding to these varied manipulative requirements must form the basis of the craftsman's work.

As demonstrative tests of the Guild's zeal and the workmen's capacity, for many years past annual exhibitions of drawings and specimens of work have been held in the Company's Hall, Noble Street, City. Each passing year shows increased ability of the competitors for prizes and honours awarded to successful aspirants.

At these exhibitions of the brain and handwork of the ambitious and capable men of every branch of this high-class trade, the strength and weakness of the present system of divided toil are both conspicuous.

One year the prize was for foliage drawings, to show freehand drawing. Some excellent specimens were sent, drawn on paper; but one worker, who could not only draw on paper, but on wood, had, by his assiduity at the craft, carved an ornamental back-rail for a park phæton, such as was done in times when men made themselves masters of nearly all branches of the craft. It was not understood, so was put outside into a lumber-room; yet, when it was sent back to the carver, he was offered £20 for it, for its artistic merits, by an admirer of such work. That was in the early days of the Coachmakers' Company's exhibitions. He was before his time, for carving has since been accorded a place.

Recently, at a display of drawings of half-size views of a "Sociable," nearly all were exceptionally good, and by very young workers; but the evil of restricted knowledge was obvious in parts of the carriages to which the draughtsmen were strangers. Thus, the hind wheels of some had sixteen spokes, some fourteen, some twelve, and one only ten spokes. Thus, ignorance of how many spokes should be in a wheel for a carriage of fixed size and weight was obvious.

In others, the notion of a splinter-bar socket to uphold the pole of an open futchell carriage did not enter the draughtsman's head. Other blunders marred the completeness of otherwise very beautiful and excellent drawings.

Members of various branches of the trade competed, and the errors were most noticeable in men employed in big shops, where they are far more ignorant of the allied branches of the trade than in the small four- or six-handed shop, where there is more identity of feeling for the trade as a whole system of crafts than is fostered by the factory with many hands. Mark the word "hands," used by employers, as if brains were a matter not to be bothered about if they interfered with profits.

The judges who award the prizes should point out errors. They are themselves on their trial by their awards, when reviewed by capable workmen afterwards.

To G. N. Hooper, Esq., one of the late masters of the Coachmakers' Company, is due the credit of carrying forward so successfully and honourably these trade exhibitions at Noble Street, City. To all the judges during many years must be awarded high praise for their discrimination and impartiality in their awards for drawings and work.

The prizes of the Company are generally from £1 to £6, with supplementary prizes by munificent donors, for special exhibits, up to £20. Certificates for craft ability are added to the prizes, and to some the freedom of the Company.

To eradicate the evils of isolation of crafts, a cross-purpose prize of some value should be given for the display of handicraft of a worker in a branch not generally his regular work: as a wheel by a bodymaker, a spring by a wheeler, a painted panel (fine-lined) by a trimmer, an undercarriage (in the wood only) by a smith.

These workmen, when in trade afterwards as master coachmakers, are expected to know all about every branch of the trade. How few do know practically! In early times in England one man could roughly do all branches. Even in this century men are known who can make every part of a carriage from the drawing—wood and iron-work, painting, lining, to the leather-work.

With the fewer hours of labour in the carriage trade—two work days a week less than prevailed fifty years ago—men have the leisure to learn more, but really learn less. This is partly due to a foolish notion of workers themselves—that each man should stick to his branch, so as not to interfere with the labour earnings of another branch. This frivolous, selfish feeling should be eradicated; but it is more difficult to get perverse views out of men's minds than it is to get profit-making knowledge into them. If men thought for a moment of the prospect of their becoming masters, or of emigrating, where often all branches have to be taken, as required, by a worker, they would feel their narrow-minded action recoil on themselves with merited severity; and masters of big factories would not have the discredit for ignorance far beyond the masters of some humble shops, who by perseverance have made themselves all-round craftsmen.

DESIGN AND DECORATION OF ALL AGES.

BY M. H. C. L.

Arabic.

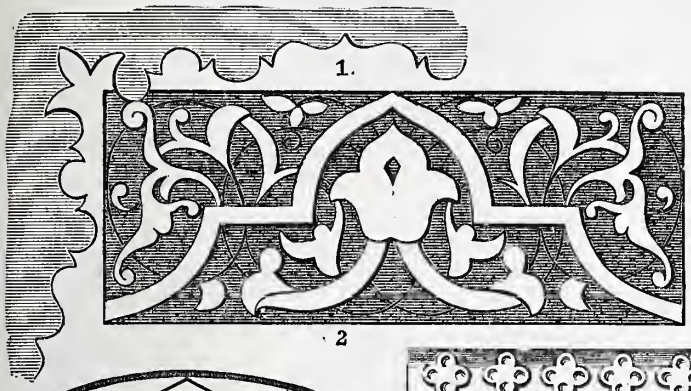
In the seventh century after Christ a new power came into the world, which spread rapidly, and at this day has hold of a very large proportion of the human race—Mahometanism. Mahomet, the great prophet and leader, was born at Mecca in 569 or 570. At about forty years of age he announced himself as a prophet, and preached the unity of God, the immortality of the soul, and a higher and stricter morality than was in practice at that time by any of the neighbouring nations, of whatever belief. He gathered round him a band of trusted followers, who accompanied him when, in 622, he was forced to fly from his native land. In the following years he gained many victories over his enemies, was acknowledged sovereign, and on his death, left behind him a body of ardent and warlike men to spread the faith which he taught, according to their principles, by means of the sword. This was the beginning of Mahometanism, and with Mahometanism began Mahometan Art.

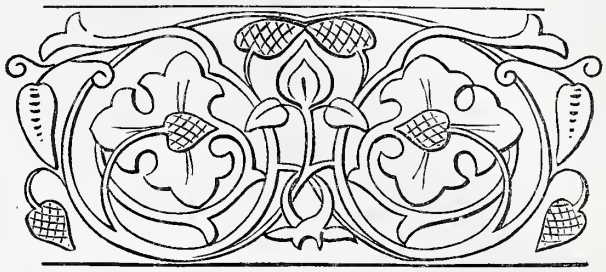
The term is a wide one, for the followers of Mahomet pushed their way the whole length of the southern shore of the Mediterranean and along the northern shore, excepting the Italian coast, as far as to Spain, where they founded an important kingdom. They also conquered Persia and a great part of India; and wherever they came they more or less transformed the native art.

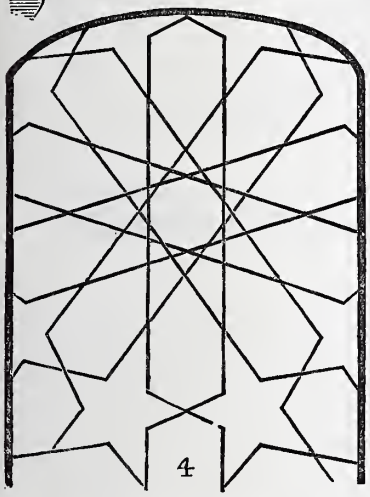
The principles of their religion were severe and narrow, and can only be adequately judged from a study of the Koran—the book which Mahomet wrote, as he believed, under the direct inspiration of the Angel Gabriel. A very superficial idea of Mahometanism is founded on the latitude it allowed in the matter of wives.

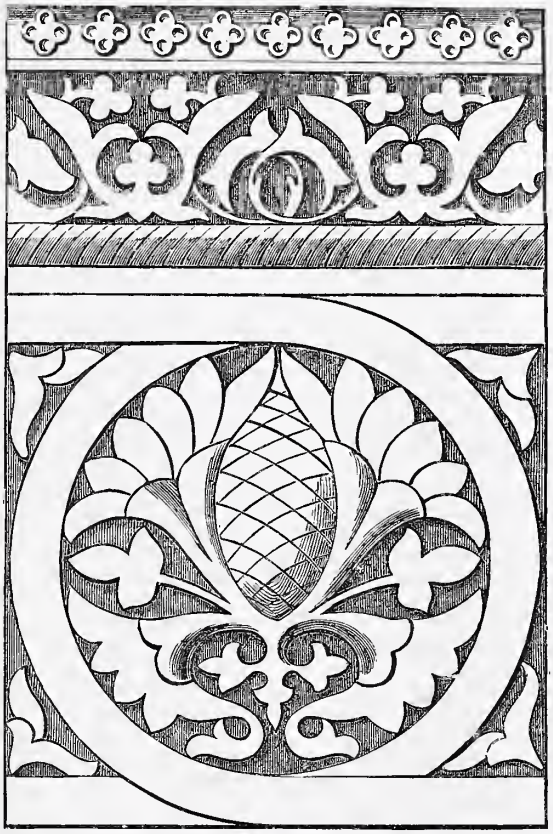
Amongst the strict rules laid down for the conduct of life was the prohibition to make any representation of the living form. Not only was the human figure to be thus regarded as sacred, but the figures of animals, and even of vegetable forms! These were the strict principles with which Mahometan Art began. Its first exponents were the ex-Byzantines, who, it will be remembered, had always looked on the production of "graven images" of persons as wicked. The cutting off from the production of all plant and animal forms, however, would have reduced the artists to a sorry state. What was there left for them to do? Obviously to make use of the only elements of decoration left to them: geometrical forms. Accordingly geometrical decoration is the leading feature of Mahometan Art—the art, that is to say, in its purest state, confined to the restrictions imposed by the faith it was called upon to represent. The Arabs were the inventors of what is called practical Geometry, though the theoretical principles had, of course, been laid down long before by Euclid, and are supposed to have been discovered by the Egyptians.

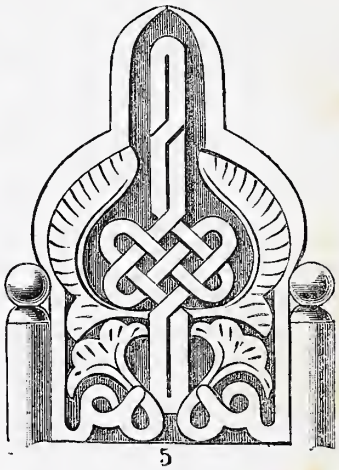
The tendency to employ repeated geometric forms for ornament is innate in the human race, as has been shown in the paper on Savage Art. Indeed, for surface decoration it is impossible to produce any design, not distinctly naturalistic, which is not based upon geometrical forms, though the geometric basis may be so hidden as to appear only as a suggestion, or altogether escape

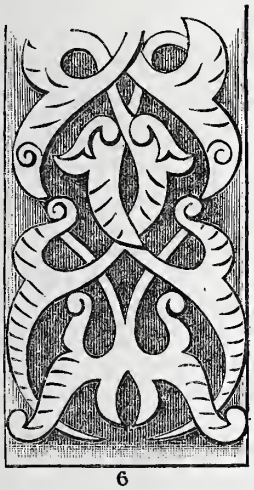


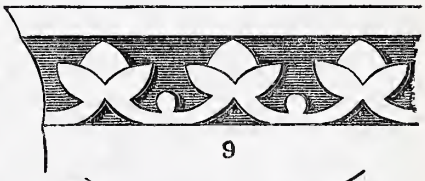


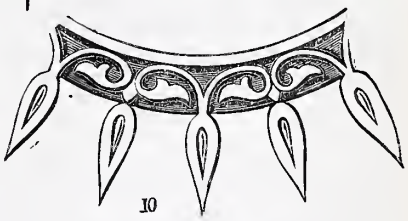


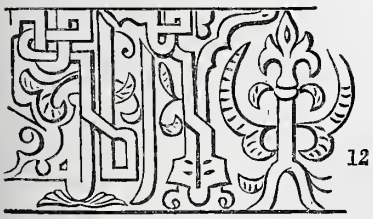


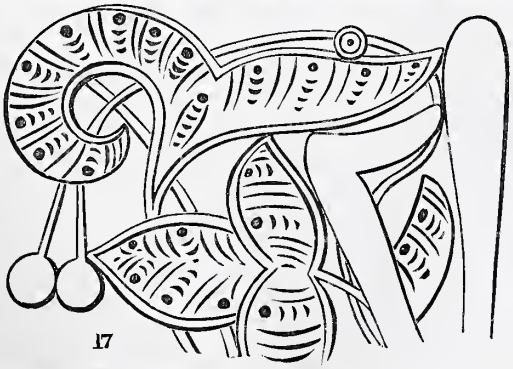


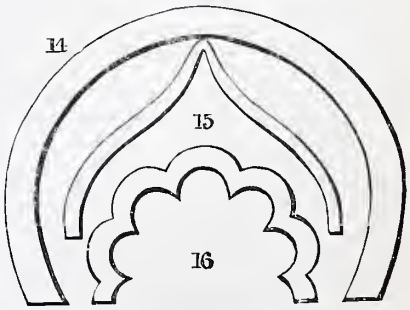












Arabic Design and Decoration. Fig. 1.—Canopy Edge, Fifteenth Century: Cairene Pulpit. Fig. 2.—Arab Ivory, Thirteenth Century. Fig. 3.—From Kal at El-Kebsch, Cairo. Fig. 4.—Pulpit Door: Cairo, Fourteenth Century. Fig. 5.—From Alhambra: Spain. Fig. 6.—Arabian pierced Work. Fig. 7.—From Court of Lions: Alhambra. Figs. 8 and 9.—From Alhambra. Fig. 10.—Inside of Mass Bowl, Fourteenth Century. Fig. 11.—From Alhambra. Fig. 12.—Kufik Writing. Fig. 13.—Cursive Writing. Fig. 14.—Horseshoe Arch. Fig. 15.—Ogee Arch. Fig. 16.—Cusped Arch. Fig. 17.—Detail of Ornament intermixed with Kufik Inscription: Alhambra.

the perception of eyes unaccustomed to analysis.

But the use the Mahometans made of geometry was definite and direct, far removed from the simplicity of the savage repetition of lines and curves, and entirely inscribed. These geometrical patterns were produced in great variety, and so intricate are many of them that it is a weariness to the eye to attempt to disentangle them, and a long contemplation of them gives one something of a nightmare effect! Fig. 4 is a comparatively simple form from the door of a pulpit, Cairene, probably of the fourteenth century. The repeated stars produced by this pattern are a favourite effect in Arabic Art. Besides purely geometrical forms, the Mahometans used strap-work—flat bands with intersecting lines, though quite a different kind from the Celtic strap-work. The next development in their art was the employment of letters in a decorative way. They had an alphabet to their hand at once beautiful and sacred. This was the Kufik, a writing invented for the inscribing of the Koran, and in which alone for some centuries the Koran was written. Later again the curious Arabic writing was used as ornamental design. Sometimes one word or sentence was repeated over and over again, which shows how distinctly the lettering was considered in itself decorative; but as a rule the subject of the inscriptions was a text from the Koran on moral precept. Fig. 12 is part of a Kufik, and 13 of a cursive inscription from the Alhambra. With these the walls of Arabian palaces are adorned as well as the mosques.

The spaces between the letters were filled in with Arabesques, the last of the distinctly Arabian motives in decoration. This kind of scroll pattern running over a large space is familiar to every student of art. The word is now rather largely applied, but the true Arabic scroll-work had but only a conventional leaf; that shown in Figs. 2, 5, 6, 7. It was probably not intended for a leaf at all, though vegetable forms were the first to creep into the system which forbade the representation of any living thing. The markings are not midribs and veins, but seem especially designed to contradict the impression of natural foliage. The frequent little curl where the leaf joins the stalk, and the alternating row of dots and lines, seem expressly intended to distinguish it from any portion of a plant. At the same time, the law of growth is carefully followed: every leaf grows from a stalk, every stalk from a stem, which can be traced out to its root, however elaborate its windings and interlacings.

The Arabs were originally dwellers in tents, where the only works of art used as house decoration must have been woven or embroidered hangings. When they came to have an architecture, the old idea of decoration clung to them. Their admiration for hanging things is curiously shown in the stalactite ornamentation of their roofs with ornaments hanging from above: one sees sometimes what is precisely like the canopy over a saint's niche, but no saint, not even a niche, is beneath it. It appears again in the curious valance hangings in wood or plaster, where the edge has an irregular and broken effect, bearing the conventional suggestion of the edge of a hanging drapery. Straight lines and long curved lines without a break were unpleasing to the Arab taste, and they ornamented the edges of their arches to avoid this effect. Fig. 1 is the edge of the valance to a fifteenth-century pulpit. The Mahometan arches—examples of the three principal types of which are given in Figs. 14, 15, 16—were an important feature in their buildings. The borders and spandrels of these arches were chief points for decoration, and the designs were so adapted as exactly to fill them. Diaper patterns covered the walls, and friezes, generally containing inscriptions, ran above them. While the exteriors of the buildings were generally very plain and only beautiful by the grandeur and simplicity of their outlines, the interiors were brilliantly and profusely decorated. The Arabs were great masters of colour, and invented several colour combinations which were a revelation to the Art world.

The first conquests of the Mahometans were in Syria; hence, as has been said, the first workmen were Byzantine, and the stamp of Byzantine influence is seen throughout Arabic Art. No doubt the scroll-work entitled Arabesque originated with the system of design so nearly akin to it, referred to in the paper on Early Christian Art, where a surface was covered with a running plant, the sprays of which curved round in a regular manner, forming a pattern of repeated spirals. The Byzantine decoration was almost entirely surface work, and so was the Arabic. There was no relief carving, properly so called, in the latter, only a system of a mixture of incising, and what is called flat-carving when applied to wood-work.

The Arabian palaces were built rapidly, as the rulers followed each other in rapid succession; and the materials used for their decoration were such as could be most quickly worked. Plaster was a favourite substance; stucco was not disdained; tile-work came to supplement the more elaborate glass mosaics, which still, however, held their own for the noblest purposes, and were very carefully and elaborately executed.

The Mahometans, as has been seen, penetrated to Persia and later to India, but the arts of these countries must be treated separately. They took possession of Egypt, where the solemn character of the inhabitants gave its impress to the development of Arab Art. They appropriated Turkey, and there their art, among an inartistic people, has become debased, and finally effete. In Sicily, on the contrary, where they had an important settlement, it attained a high degree of development in ceramics, in metal-work, and especially in the beautiful silk fabrics mixed with gold and silver, and with Kufik inscriptions interwoven, for which Sicily became famous.

But the most characteristic and the finest blossoming of Arabian Art was in Spain. The Moors held possession of a great tract of that country lying to the south-east, till dispossessed by Ferdinand and Isabella in the fifteenth century. After this they still remained in the country, working at their old arts for more than a hundred years, and immensely influenced Christian Mediæval Art. They were adepts in the minor arts, leather embossing, glass-making, metal-work, etc. The Alhambra, at Granada, built in 1253, and beautiful monuments of their work in Seville and other Spanish towns, remain to show the high degree of perfection attained by the Moors in their artistic productions.

The richness of the decoration strikes the eye at once. Where bold designs are used, which are effective at a distance, the broad outlines are found, on a nearer approach, to be filled in with minute decorations, so that not an inch of surface is left plain.

This paper is entitled Arabic Art; another name for the same style is Saracenic, as the Arabs who followed Mahomet took the name of Saracens. It deals only with the early opening stages of Mahometan work; the later developments will be treated in the papers on Oriental Art.

INDUCTION COILS: HOW TO MAKE AND WORK THEM.

BY G. E. BONNEY.

Shocking Coils—Their Use—Their Abuse—Medical Coils—Construction of a Medical Coil—The Core—The Primary—The Secondary—Various Powers: How Obtained—Switch-board for the Various Powers—Breaks for Medical Coils—Commutator for Coils—Use and Abuse of Medical Coils.

Shocking Coils.—Any of the coils mentioned in previous papers may be regarded as shocking coils, as the smallest spark coil will give a most disagreeable shock to the nerves of persons handling it incautiously. The larger spark coils are really dangerous

Fig. 26.—Brass Regulating Tube for Medical Coil.

if handled in an improper manner—that is, so as to receive the current from the secondary coil through the body, as from arm to arm. If we span the secondary terminals of a small spark coil with the thumb and little finger, a smart and painful shock will be sent through the hand.

The Use of Shocking Coils.—These are generally in use to provide amusement for

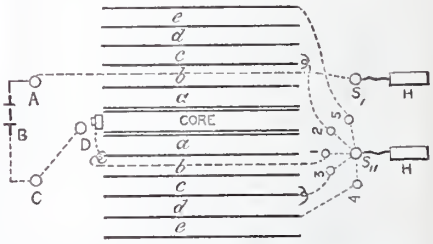


Fig. 27.—Diagram of Medical Coil Connections—A, Primary Terminal Pillar; B, Battery; C, Contact Terminal Pillar; D, Break or Rheotome; H, Handles or Rheophores; S_I, Secondary Terminal; S_{II}, Pivot of Switch; *a*, Primary Coil; *b*, First Secondary Coil; *c*, Second ditto; *d*, Third ditto; *e*, Fourth ditto; 1, 2, 3, 4, 5, Switch-studs.

young folks on long winter evenings. One places one hand on a metal plate connected to a terminal of the secondary coil, and holds another child with the other hand. A string of youngsters then join hands with the first, and the last of this string touches the disengaged terminal of the coil, or a metal plate in connection with it. The result is more or less merry screaming and laughing as each feels the electric shock. From a very small spark coil a smart shock may be obtained, and I should advise such experiments to be restricted to the smallest coils. Much has been said and written about using these coils as traps for meddlesome people, but a deal of this is pure fiction, since very elaborate details would have to be carried out in arranging the trap so as to give a shock to the meddler, who would most likely detect and suspect the arrangements, even if he or she did not hear the merry hum of the instrument.

The Abuse of Shocking Coils.—These

useful little instruments are abused when employed to give surprise shocks to unwary females and persons of a delicate nervous organisation. Heart and nerve troubles may follow as a result of shocks given from coils, hysteria and paralysis not infrequently being the result of a fright or sudden shock to the nerves. It is, therefore, from this cause alone, not safe to play with spark coils in giving shocks to children or delicate

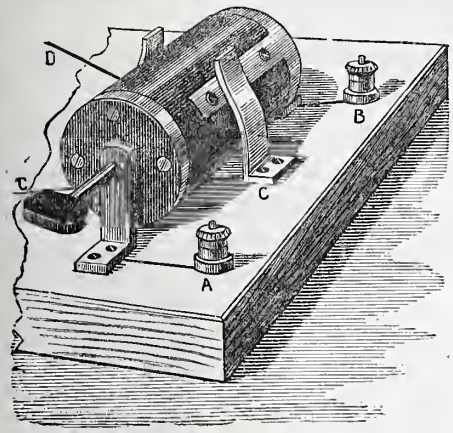


Fig. 28.—Commutator for Medical Coil.

persons; and this warning should be specially observed in dealing with coils giving more than a ¼-in. spark. There are other reasons, both physiological and medical, so to speak, which will receive attention further on.

Medical Coils.—This is the name given to induction coils constructed solely for the purpose of producing physiological effects, by indueed electrical currents, in human beings. They differ from the spark coils in some very important particulars, although following the principles observed in the construction of spark coils. The same care must be exercised in selecting the materials and in insulating the various parts, and even greater care in proportioning them. This will be seen as we proceed.

Construction of a Medical Coil.—A medical coil is made up of: (1) The core; (2) the

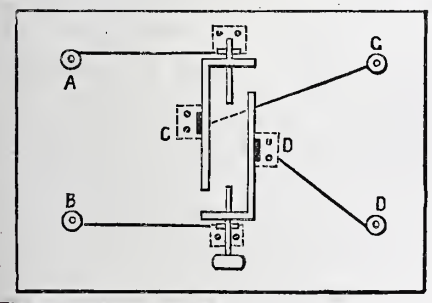


Fig. 29.—Plan of Connections for Commutator of Coil. Reference Letters correspond with Letters on Fig. 28. A, B, Terminal Pillars for Battery Wires; C, D, Wires from Ends of Primary Coil.

regulating tube over the core; (3) the primary wire and bobbin; (4) one or more secondary coils of wire; (5) the rheotome, interrupter, or current breaker; (6) the commutator; (7) the rheophores, or instruments for conveying the induced current to the patient; (8) a switch-board for applying the various powers.

The Core.—This may be made of solid soft iron, well annealed, but will be best if made as for the core of a spark coil, with a bundle of fine iron wires soaked in melted paraffin. Before making up a core with a bundle of iron wires, it is advisable to select the regulating brass tube mentioned in the next section, and to fill this with the wires to form the core, packing them in side by side tightly. This done, bring all the ends level with each other, bind a scrap of fine wire around the ends to keep the bundle round, dip the extreme end in a strong solution of copper for a few minutes, then in some chrodide of zinc soldering solution, and finally in some melted solder. This will solder all the wires together in one mass. Then draw out the wires, and bind the bundle as it is being drawn out with some twine or stout cotton. Treat the last end, like the first, to a dip in the melted solder, then fit on it a brass cap, ½ in. deep—a piece of the same brass tube as that used for the regulator will serve the purpose—then sweat it on the soldered wires. This cap will fit tight into the tube of the primary bobbin, to hold the core in it firmly whilst the regulating tube is passing over it. The core, being prepared, must now be soaked in melted paraffin for several minutes, then drained and the twine unwound, leaving a smooth round bundle of wire.

The Regulating Tube.—In a former paper I cautioned the coil-maker against the use of metal tubes as bodies of bobbins for coils, and then stated a reason for so doing. This reason will now become more apparent as we consider the use of a regulating tube for a medical coil. This tube must be of thin brass, and will cover all the iron core of the coil. When the core is thus covered, its inductive effects will be absorbed in the brass tube instead of being transmitted to the primary wire outside. It will also absorb some of the primary induction as well. As the tube is drawn out of the coil, and the core becomes uncovered, the full inductive relation of core and coil is gradually restored, and the full power of the coil is felt. The tube must be selected to suit the coil about to be made—that is, in relation to diameter and length—and should be nicely smoothed and polished inside and outside. A brass knob should then be soldered to one end, when the finished tube will appear as shown at Fig. 26.

The Primary Bobbin.—This may be all in one with the secondary bobbin, as in a small spark coil, or may be made as a separate bobbin. When made in this way, and the secondary bobbin made to slide over it on rails placed outside the coil, the power of the coil may be regulated by sliding the secondary on or off the primary coil. Some coils imported from the Continent are made in this way. The bobbin ends may be made of hard wood or of ebonite, as for a spark coil. The body or tube in which the brass regulator will slide, and on which the primary coil will be wound, should be built up of tough paper, glued together with good thin glue. First cover the regulating brass tube with one fold of paper coated with soap; this will allow the tube being drawn out when the body is finished. On the soaped paper roll several folds of tough paper, well smeared with thin hot glue, until a tube has been made quite $\frac{1}{16}$ in. thick. Bind this tight with soft cord, and set aside to get hard. The regulating tube can now be slipped out, and the bobbin ends glued on to the paper tube. When this has dried and become quite hard, the whole bobbin should be soaked in hot melted paraffin.

The Primary Coil.—When the bobbin has cooled and again become hard, we may wind on the wire for the primary coil. In choosing the wire for the primary of a spark coil, we had to use as few layers as possible, so as to lessen the evils of self-induction of the turns of wire on each other. But in choosing the primary of a medical coil, we need not be hampered by any such considerations. Indeed, it may be desirable to have several layers of wire on the primary coil, so as to get a self-induced current in this coil. This primary current can then be taken off by suitable wires, and used as a mild current of the lowest power when occasion requires its use. No. 18 silk-covered copper wire will be quite large enough for the primary of a medical coil, and four layers of this may be used. Nos. 20, 22, and 24 may also be used as the primary wires for small medical coils, but it is not advisable to occupy more space than can be taken up by four layers, although six may give good results. The same care respecting insulation and winding must be exercised in medical as in spark coils, and the finished primary coil must be covered with a few layers of paraffined paper before winding on the secondary coils.

The Secondary Coil.—The wire for this should be several sizes smaller than the wire employed for the primary coil, but wire of the same gauge may be used if the bobbin is large, and an induced current of low tension only is desired. If No. 16 is used for the primary, we commence with No. 20 for the secondary, using Nos. 24, 28, and 30 afterwards. If No. 18 is used for the primary, start with No. 22 for the secondary, and follow on with Nos. 26, 28, and 30, if a variety of powers are desired. These are good proportions, but the gauge may be varied to suit the fancy of the maker or the requirements of the coil. If a full current of high tension is required, the secondary may be wholly of No. 30. It is not desirable to have a finer wire than No. 32, although Nos. 36 and 40 have been employed in the construction of medical coils. The current from finer sizes is sharp and irritating to the nerves, and the beneficial use of this is doubtful. All wires employed for the secondary must be of best copper, well annealed, insulated with silk covering, and run through hot melted paraffin, as for spark coils. In fact, the same care must be exercised in winding the secondary of this coil as recommended for winding spark coils.

Various Powers from One Coil.—It is frequently desirable to have at command the means for altering the tension of current from one of these coils. This is partly provided for by the brass regulator, the tension of the induced current rising as the core is uncovered by drawing out the regulating tube of brass. But higher or lower tensions than this will give may be desired, and this wider range of powers may be obtained from one coil by varying the winding of the secondary wire. I will suppose this to be desired in a small coil, and give an account of its construction as an example.

Suppose we wish to construct a small coil, 4 in. in length by 2½ in. in diameter, having a ⅜ in. core. The primary for this may be four layers of No. 18 silk-covered copper wire. Over this, first wind ¼ lb. of No. 22 silk-covered copper wire. When the finish end of this is reached, leave enough free wire to pass out through the bobbin end, and connect to a stud on the baseboard of the coil, then lay 1 in. of the wire, just where it passes out through the bobbin, bare of its insulated covering; twist the bared and cleaned end of the next length of secondary around this bared spot, solder the junction of the two wires, and cover it with a layer of paraffined silk thread to restore the insulation. The next length of secondary will be composed of about 2 oz. of No. 26

silk-covered copper wire. When this has been wound on, bring out the finish end, as in the first length, and join the third length to this second length, as at first, then wind on 2 oz. of No. 28 in like manner; then finish off with 2 oz. of No. 30, bringing out the finish end of this to be connected to a separate stud. As a guide to amateurs, I give herewith a diagram (Fig. 27) of the several coils, just to show how they are connected and the ends carried to the studs. On referring to this diagram, it will be seen that the coil *a* is the primary, connected at the ends to the battery terminals, A and C, through the break-stud at D. $s_{,,}$ shows the position of a switch connecting one of the handles with the studs 1, 2, 3, 4, and 5. $s_{,}$ shows a stud connecting the other handle and one end of the primary coil. The other end of this coil is connected by a short wire to the stud No. 1, and this forms the primary induced circuit, or lowest power. The commencement of the first secondary, *b*, will also be connected to this wire, and terminate in the stud No. 2, forming the second power. To this same wire the commencement of the coil *c* will be soldered, and this coil will terminate in the stud No. 3, forming the third power. All the others may now be easily traced. The switch need only be the ordinary form, made of spring brass, turning on $s_{,,}$ as on a pivot, and sweeping with its other end the semicircle of studs.

Breaks, or Interrupters, for Medical Coils. — In the spark coil, it is desirable to have a slow-acting break, to give the core a chance of being fully magnetised. In a medical coil the opposite condition is most desirable, so as to avoid jerks and twitches in the nerves of the patient when applying the induced current. The break-spring should therefore be short, the adjusting screw made to work easily in a split contact pillar instead of with a lock-nut, and the whole made to work smoothly and regularly. The ordinary form may be employed, using the core as a magnet, and in this case the break must be fixed at the fixed end of the core, which must be left protruding a little for the purpose; or the horizontal form of break may be employed, with a separate horseshoe magnet to work it, as described in the last paper on this subject; but in this case the spring must be short, and all parts made to adjust easily.

A Commutator for Medical Coils.—As it is sometimes most desirable to have the means at command of changing the direction of the current without giving the patient the trouble to change the position of the rheophores, or handles, a commutator for this purpose is a useful adjunct to a medical coil. This little apparatus is shown at Fig. 28, and consists of a cylinder of ebonite, boxwood, ivory, or similar insulating substance, about 1 in. in length and the same in diameter, furnished with two plates of German silver, one on each side, and two short spindles, one at each end, running in two small brass brackets fixed to the baseboard of the coil between the terminal binding-screws and the break. Two springs of brass or of German silver are also fixed to the board on each side of the cylinder, so as to press on both sides and make good contact with the metal strips on the cylinder. The two spindles must be soldered into circular plates, and these fastened by screws to the ends of the cylinder. One of these ends must be connected to one metal strip on the cylinder, and the opposite end to the opposite metal strip. It is also advisable to have one of the spindles longer than the other, and fix to this a milled head or a flat thumb-piece of metal or of ebonite, for convenience in turning the cylinder.

To connect this commutator with the coil, lead a wire from one of the terminals on the baseboard to one of the brass brackets supporting the cylinder; then another wire from the other terminal to the other bracket. Connect one spring to one end of the primary coil, and the unoccupied brass spring to the opposite end of the primary, or to the break-pillar of the coil, as shown at Fig. 29. It will then be seen that a half-turn of the cylinder will change the direction of the current in the primary coil, and a quarter-turn (leaving the springs resting on the cylinder without touching its metal strips) will cut off the current from the coil.

Use and Abuse of Medical Coils.—I could write a whole volume respecting the use and abuse of medical coils, were it in my province to do so. It is, however, no part of my duty to invade the domain of electro-therapeutics by showing how those coils should be used for the relief and cure of disease. Electricity is a curative agent. It is a powerful means, in the hands of a trained man, to cure disease, to injure health, or to kill. Its action is as potent as that of the poisonous drugs aconite, belladonna, and strychnine, and it demands an equal care in its application for the cure of disease. A medical coil in the hands of an experienced medical electrician is a power for good; but the same coil in the hands of an ignorant man may result in irreparable injury being done to the person placed under its influence. Although a person in good health may play with a coil with impunity, it is not a safe plaything for an invalid or one out of health. The sphere in which an induced current of electricity may be beneficially employed as a curative agent is a limited one of small extent. Much harm may be done by using too large a dose of electricity, sending the current in a wrong direction, and applying it to the wrong parts of the body.

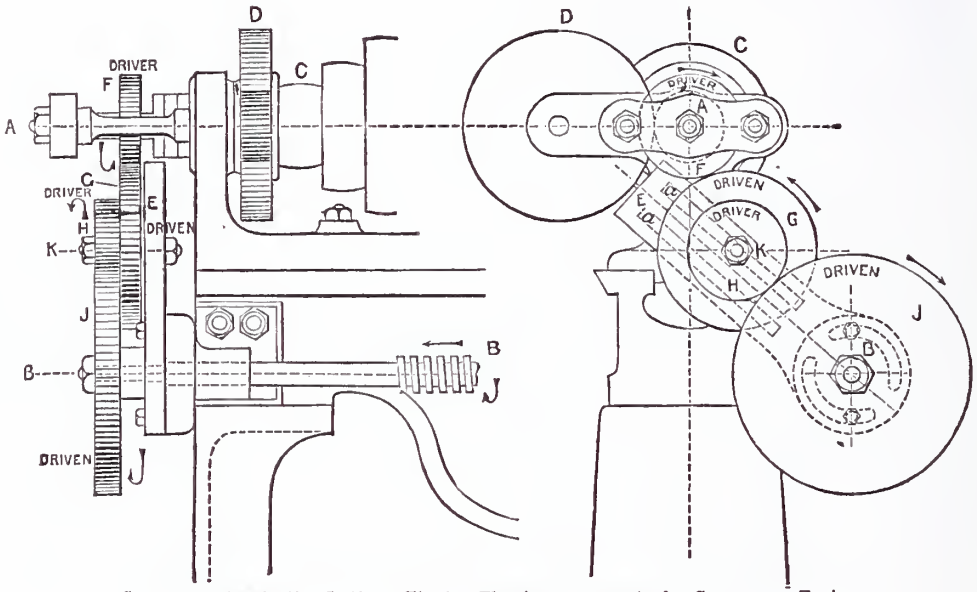
SCREW-CUTTING IN THE LATHE.

BY J. H.

Compound Trains and Examples in Calculation.

Description of a Compound Train—"Stud" Wheels—The Illustration Explained—Recapitulation of Principles—Methods used in Practice.

Description of a Compound Train.—Let us now try to get a clear idea of the use and arrangement of a compound train impressed upon the mind. Suppose we want to cut a screw having twenty-four threads to the inch in a lathe whose leading screw has two threads to the inch. The ratio is $\frac{24}{2} = 12$, and consequently, if a single train were used, the driver wheel—that is, the wheel on the lathe mandrel, as explained in my first paper—would have to make twelve revolutions to each revolution of the driven, or guide-screw wheel. Wheels of 240 and 20 teeth, therefore, would give this ratio, thus: $\frac{240}{20} = 12$, and the 20-toothed wheel would be the driver, and the 240-toothed wheel the driven. But as there is no wheel of 240 teeth in any ordinary set—and even if we had one, it would probably be too large for gearing-up between the centres of the lathe mandrel and the guide screw—we must necessarily break up the supposed 20 and 240-toothed wheels into factors, the ratio of whose *products* will have the ratio $\frac{240}{20}$, and in that case we make use of the intermediate stud on the rocking plate. The numbers are broken up, and the details of the process are as follows: $\frac{20}{240} = \frac{2 \times 10}{20 \times 12} =$ adding cyphers, $\frac{20 \times 10}{200 \times 12}$. As we have neither 10, nor 200, nor 12-toothed wheels, we try again; add cyphers to 10 and 12, and then halve 200 and 100, thus: $\frac{20 \times \overset{50}{\cancel{100}}}{\underset{100}{\cancel{200}} \times 120}$, the same ratio between the numbers above and below the line being preserved, until we come to numbers which are not duplicates of one another, and which are included in the ordinary sets of change wheels. So that if



Screw-Cutting in the Lathe. Fig. 5.—The Arrangement of a Compound Train.

20 and 50 drive, and 100 and 120 are driven, we shall have the ratio $\frac{100 \times 120}{20 \times 50} = 12$, which is the ratio required.

"Stud" Wheels.—One of the drivers and one of the driven must be placed upon the stud of the rocking plate. But to use the term "stud wheel," except when it happens to be an idle wheel employed for changing the direction of motion, as in cutting left-handed screws, causes confusion; and I shall only employ the terms "driver" and "driven."

The Illustration Explained.—The relative arrangements of these wheels are shown in Fig. 5, together with just so much of the headstock gear as is necessary to illustrate the arrangements of a compound train. In these figures, A is the lathe mandrel; B the guide screw; C the cone pulley through which the lathe mandrel is driven; D the large wheel of the back gear; E the rocking or quadrant plate, pivoted upon the end of the guide screw; F the first driver wheel; G the first driven wheel; H the second driver wheel; J the second driven wheel; G and H are commonly termed the stud wheels; K is the stud. As driver and driven wheels of various diameters are used for cutting screws of various pitches, the quadrant plate is provided with curved slots, to permit of free pivoting around the end of B. The wide range of radius permitted by these curved slots, and the choice of any position in the two straight slots in the rocking plate, permit of such range of location for the stud K, that all the wheels from 20 to 120 teeth, and even higher, can be geared up for compound trains.

It does not matter which of the drivers goes on the lathe mandrel and which on the stud. Neither does it matter which of the driven goes on the stud nor which on the guide screw, because this only amounts to a transposition of the numbers, and does not affect the *products* or the *ratio*. Thus, in the example last given 20 might go on B, and 50 on A, and 100 might go on C, and 120 on B.

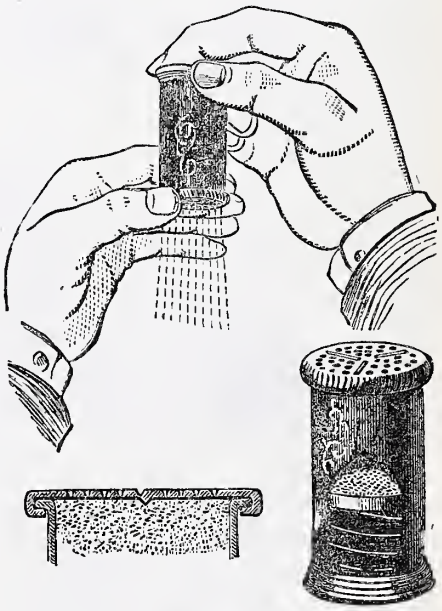
Recapitulation of Principles.—Certain fundamental or axiomatic principles have now been demonstrated in a graphic fashion. Those principles are, in brief, as follows:—The same ratio that exists between the guide screw and the screw to be cut must also exist between the driver and the driven wheel in a simple train; or, in a compound train, between the *products* of the drivers and of the driven wheels. This, therefore, is the fundamental principle of *inverse ratios*. Again, to cut pitches finer than that on the leading screw, the smaller wheel or wheels will drive, and the larger be driven. To cut pitches coarser than that on the leading screw, the larger wheel or wheels will drive, and the smaller be driven. When arranging wheels of a compound train, one driver will be put on lathe mandrel, one driven on the guide screw, and one driver and one driven upon the stud. I will now proceed to apply these principles to some of the rules which are made use of in screw cutting.

Methods used in Practice.—In practice, the common method employed is to write down in the form of a vulgar fraction the number of threads per inch of the guide screw and the number of threads per inch of the screw to be cut, and deduce suitable wheels, having the same ratio as the numerator and denominator of the fraction. The numerator then corresponds with the driver, and the denominator with the driven wheels. This method covers all possible cases that can arise in practice, and is in harmony with the principles just laid down. Thus, with a leading screw of $\frac{1}{4}$ pitch, *i.e.*, with four threads per inch, we want to cut screws, say, having respectively $1\frac{1}{2}$ threads, 2 threads, $6\frac{1}{2}$ threads, and 20 threads per inch. The vulgar fractions expressing these relations will be as follows:—$\frac{4}{1\frac{1}{2}}, \frac{4}{2}, \frac{4}{6\frac{1}{2}}, \frac{4}{20}$. The relations being clearly set down, we now proceed to deduce suitable change wheels from these fractions. In two of these cases we have integers and fractions combined, and we cannot work with these, but must turn them either into whole numbers or into decimals, thus:—Multiply the entire vulgar fraction by the denominator of the fractional number, or turn the latter into a decimal. In this way, $\frac{4}{1\frac{1}{2}}$ becomes $\frac{4}{1\frac{1}{2}} \times 2 = \frac{8}{3}$; or, as a decimal, $\frac{4}{1{\cdot}5}$; and $\frac{4}{6\frac{1}{2}}$ becomes $\frac{4}{6\frac{1}{2}} \times 2 = \frac{8}{13}$; or, as a decimal, $\frac{4}{6{\cdot}5}$. Wheels are deduced from ratio relations of this kind either by the addition of cyphers or by multiplying by 5 (because the numbers of teeth in the change wheels advance by fives), and then by halving, doubling, or otherwise breaking up or increasing the number first obtained, in *equal proportions*—that is, care must be taken to increase or diminish the numbers in numerator and denominator in exactly the same proportions. Now, taking each of these ratio numbers in succession, we can say, Writing:—$\frac{4}{1\frac{1}{2}} = \frac{8}{3} \times 5 = \frac{40}{15}$; or, adding a cypher, $\frac{8}{3} = \frac{80}{30}$; or, further increasing by one-half, $\frac{120}{45} = \frac{\text{driver.}}{\text{driven.}}$ Again, writing:—$\frac{4}{1{\cdot}5} \times 5 = \frac{20}{7{\cdot}5}$, and, multiplying by $2 = \frac{40}{15{\cdot}0}$; or, adding a cypher to $\frac{4}{1{\cdot}5} = \frac{40}{15{\cdot}} = \frac{\text{driver.}}{\text{driven.}}$ Again, writing:—$\frac{4}{2} \times 5 = \frac{20}{10}$, and multiplying by $2 = \frac{40}{20}$; or, adding a cypher to $\frac{4}{2} = \frac{40}{20} = \frac{\text{driver.}}{\text{driven.}}$ Again, $\frac{4}{6\frac{1}{2}} = \frac{8}{13} \times 5 = \frac{40}{65}$, or writing:—$\frac{4}{6{\cdot}5}$, and adding a cypher $= \frac{40}{65{\cdot}} = \frac{\text{driver.}}{\text{driven.}}$ Again, $\frac{4}{20} \times 5 = \frac{20}{100}$; or, adding a cypher to $\frac{4}{20}$, $= \frac{40}{200}$, and halving (because there is no 200-toothed wheel in a set), $= \frac{20}{100} = \frac{\text{driver.}}{\text{driven.}}$

A glance at the numbers shows that we have inverse relations between the guide screw and screw to be cut and the driver and driven wheels. Also, in the case of the first two threads of $1\frac{1}{2}$ and 2 per inch respectively, which are *coarser* than the guide screw, the larger wheels drive and the smaller are driven, thus causing a more rapid revolution of the guide screw than of the lathe mandrel, and consequently a rapid longitudinal traverse of the cutting tool relatively to the work in the lathe. In the case of the second set of threads of $6\frac{1}{2}$ and 20 to the inch, which are finer than the guide screw, the smaller wheels drive, and the larger are driven, and the guide screw revolves slowly, and the tool is retarded in relation to the work. But putting the relation of the guide screw and screw to be cut in the fractional form shown, and remembering that the numerator gives driving and the denominator driven wheels, it is hardly possible to go wrong, because the fraction shows at once which wheels should go on mandrel and which on guide screw.

SALT HOLDER AND SPRINKLER.

A SALT sprinkler, designed to obviate the difficulty so frequently experienced in use from the salt becoming damp and caking, is shown in the accompanying illustration. It is the patent of Mr. F. N. Dixon, Philadelphia. As shown in the sectional view, a follower and a spiral spring are contained within the holder. The spring is secured to the bottom and follower respectively, and operates to force the follower upward, to support the mass of salt, whatever its quantity, against and in contact with the cap. The cap is permanently swivelled upon the body so as to freely rotate upon it, having, in the form illustrated, a circumferential



Salt Holder and Sprinkler.

flange engaging a similar flange on the body. The cap may also be provided with small downwardly turned cutting edges. To operate the device, it is inverted and held with one hand, and the cap rotated backward and forward with the thumb and finger of the other hand. In such rotation or working the cap perforations and edges exert a positive grinding or shearing action upon the surface of the mass pressed against them, so that each movement of the cap compels a given quantity of salt to drop through the perforations. The bottom is secured to the body by a screw thread, and may be removed, together with the connected spring and follower, to fill the sprinkler.

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WANTED—A COLOUR STANDARD.—The task of selecting and naming certain colours with a view to their adoption as a permanent standard has never yet been accomplished to the satisfaction of both artist and physicist, and probably it never will be. Heretofore such efforts have been the work of individual skill and enterprise, and have been somewhat wanting in authority and influence. The results of the present endeavour of the Society of Arts will, therefore, be awaited with much hopeful interest. We are informed that the selecting of representative tints, and the naming of these, has been brought to a satisfactory conclusion. To complete the work, each one will now be scientifically tested and examined by electric light, and a formula for the production of each colour determined. To gather some idea of the scientific impossibilities of this task generally, we have but to remember that fully a thousand hues can be counted in the solar spectrum, and that tints and shades of each distinguishable hue may be produced in hundreds. But between the scientific and the every-day, art and commercial, aspects of colour there is a wide difference; and it is doubtless upon the lines of "art and commerce" that the new standard of colours is being prepared. The advent of the electric light has provided a source of illumination of an exact and measurable nature. Light being the source of colour, it can readily be grasped how great are the advantages of the former illuminant compared to the ever-changing daylight. The possession of an authoritative standard will have an important bearing upon the study of harmonious colouring, and, indeed, upon colour in all phases of art. We trust that when the labours of the special committee have been brought to a conclusion, the project of an international standard will be within the bounds of practicability, and that in the process of time "God's greatest gift to the eyesight of man," as Ruskin has described colour, may be appreciated as such by humanity at large. But let no time be lost. It is the wearying and often unnecessary processes of official delay which clog progressive measures that makes progress in all matters in this country so fearfully slow.

"JACK OF ALL TRADES."—The system which holds in many large workshops of keeping a man employed continually on one class of work has some advantages which must be admitted. By daily practice in the same set of operations the workman acquires a dexterity and knowledge of his particular branch of work which enables him to turn out his results with the utmost perfection and speed. The man, for example, who has been brought up from his youth to the making of dolls' eyes of a particular size and colour benefits his fellow-men by the production of very excellent dolls' eyes, and himself by the receipt of the good wages he is enabled to earn. But at what a cost it is to the man's development as a human being! All his thoughts and efforts bestowed on the one narrow object of turning out weekly so many gross of dolls' eyes! It cannot be too strongly impressed on the artisans of to-day, especially the younger ones, that a well-developed and organised brain—what is known as a "level head"—can only be obtained by breadth of culture; that is to say, by knowing something, if only a little, of a great many things. The old millwrights of the beginning of the century, the men who invented nearly all the machine tools and labour-saving appliances that we use to-day, were not accustomed to working in one groove of routine week in and week out. Maudslay, Nasmyth, and Whitworth were not afraid to tackle undertakings of the most diverse character; Richard Roberts invented and improved appliances of every description from cigar-making machinery to locomotive engines; and the inventive and speculative character of the modern American workman is largely due to the fact that every American, from Gilead P. Beck to President Harrison, has generally made a living at half a dozen trades before he is thirty years of age. There is no harm in being called a "jack of all trades." The workman who does nothing year after year but turn pearl buttons may become very expert and turn out first-class buttons, but he becomes little more than a machine that walks about and requires feeding and clothing, while the workman with brains will think the matter over and produce a machine of iron and brass that will do the work of fifty men with absolute accuracy. Machinery does not work by rule of thumb, and does not make mistakes, and so the world is happily supplied with its pearl buttons at a very much lower price, while so much human intelligence and labour are free to be directed to more worthy channels. Every workman, and, for the matter of that, every civilised man, should endeavour to use all his faculties as much as possible by making himself familiar with things and ideas that lie out of the track of his daily life, and by this means save himself from becoming narrowed and bigoted in his views. What a healthy sign it would be if 500,000 British workmen took up WORK and familiarised themselves with some of the subjects which we endeavour to have so plainly treated therein, that with pluck and perseverance any ordinary man might make himself independent of his own trade—if it suited him to do so.

USEFUL FOLDING TABLE.

BY C. S. V.

INTRODUCTION—WOOD—CONSTRUCTION OF PARTS AND PUTTING TOGETHER — CONCLUDING HINTS.

Introduction.—Furniture that can, after use, be folded into a smaller space than which it originally occupied, is found to be very useful in most houses—especially in small ones, where space is limited.

It is with this intention that the following paper is put before the readers of WORK—to enable them to make an article which, I have no doubt, they will find of service to them in their homes. Furniture generally, I am inclined to think, rather influences the members of a household in a certain degree, inasmuch as one becomes attached to an article after years of use, etc., and if smashed or "departed," one is apt to mourn its loss. This is more so the case with chairs—arm-chairs in particular—as one gets well acquainted with their various ways, etc., and habits, and feels "not at home" in any other. I've no doubt most of us remember a piece of poetry commencing—

"I love it—I love it, and who shall dare
To chide me for loving that old arm-chair?"

But I have every right to believe that many become as much attached to other pieces of furniture; and there is no reason why a table such as is put before our readers may not be spoken of in such "loving" terms, especially if made by one's own hands; for, as I myself have proved, it will be found a very useful article for placing books, etc., or for an afternoon cup of tea. With the help of a few simple instructions I think I may say that anyone commencing it will find it an easy task to complete, and that, I trust, satisfactorily.

Wood.—I had first better state what wood it had best be made of. The original is made of American walnut, but I think that mahogany would do as well. A nice clean piece had better be obtained, as it would tend to make the whole a handsomer piece of furniture and more valuable. It can afterwards be French polished, or finished as may be thought desirable.

Construction of Parts and Putting Together.—In Fig. 1 we have a front view of the table complete. Fig. 2 shows a side view of the same, and shows the bars between the two legs. This table will afford a good opportunity for those possessing lathes to turn the legs themselves. Fig. 3 is a view of the top. The lines marked have to be sawn through for the folding, and they had better be sawn through in a sort of half an S form, to enable it to fold better. The edges of the wood may be rounded off, to give it a better appearance. A convenient size for top of the table would be about 25 in. long by 18 in. broad. The height of the table had better be about 20 in. Fig. 4 is a view of the underneath of the table, the construction of which is as follows:—Turn Fig. 3 over, and parallel with the lines of the folding; glue or screw to the wood a piece about 4 in. or 5 in. wide by ½ in. or 1 in. less each way than the length of the top of the table. From one end of the wood screw to it another piece running about half-way; and from the other end of the other side screw another piece as before. These two bits had better be about ½ in. less wide than the piece to which they are screwed. The mode of fastening the wood marked A is shown in the illustration, and a small pin run through the joint at C will enable it to move easily. I think a study of Fig. 4 will show the construction of the underneath, and will make everything clear. The piece of wood running right across must be exactly in the centre, and care must be taken that the pieces on both sides do not pass the lines cut for folding, or else we shall have a rather hard "job" to make it fold nicely. The wood for the top (see Fig. 3) must be rather thick, on account of the pieces that have to be fastened underneath it. The piece of wood, as shown at BB (Fig. 4), can be screwed to the top, and the hole filled in with putty; but I advise the reader to glue it down, and to run a screw sideways at the top and bottom of the length of the wood. This will, if carefully done, hold it firm enough to be able to bear a good strain, and, besides, have a better appearance. Fig. 5 shows a view of the manner in which the table folds; the leg moves on the joint shown at C (Fig. 4), in the position as shown by the dotted lines in Fig. 4; the flap falls down parallel with the legs of the table. Fig. 6 is a plan of the bottom of the two legs, as shown in Fig. 1. At the back of this (Fig. 6) two bars run across, and join a similar piece on the other side. The bar is shown running across in Fig. 2. In Fig. 7 we have a drawing showing the mode of securing the legs in A (Fig. 4); a mortise and tenon joint will do. The end of the wood (A in Fig. 4) must be finished off so as to hold the leg. Fig. 8 shows the joint for the two legs, as shown in Fig. 1, and is fastened on to B in Fig. 4. The end of B must be cut to receive it. A small screw run through the back of it will make it all the firmer.

Concluding Remarks.—In conclusion, I think the fitting together of the parts will be easy enough if the diagrams are well studied. Care must be taken in cutting the top to have a nice joint for folding. The sizes need not be strictly followed, but are given as the measurements of the original. Castors will be wanted for the legs that are moved for the folding, to enable them to run easily and smoothly. Hinges under the table, where it closes, will, of course, be wanted—six in all; and they had better be nailed; and for the position of them the reader will see on one side of the table, in Fig. 4. The whole had better be French polished as desired. Any inquiries I shall be happy to answer in "Shop."

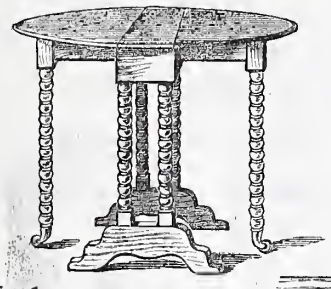


Fig. 1

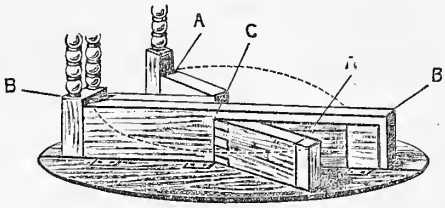


Fig. 4

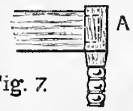


Fig. 7

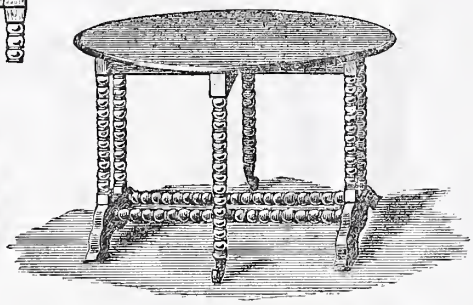


Fig. 2

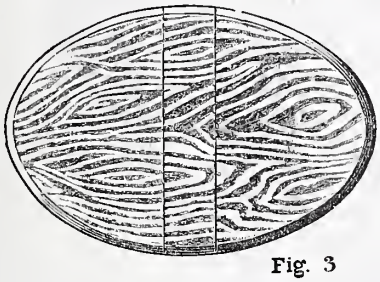


Fig. 3

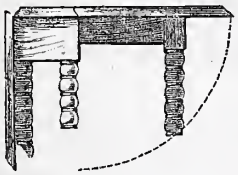


Fig. 5

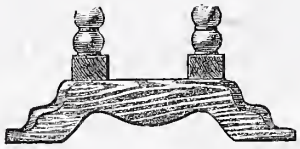


Fig. 6

Fig. 8

Folding Table. Fig. 1.—Front View of Table. Fig. 2.—Side View. Fig. 3.—Top of Table, with Lines for showing Folding. Fig. 4.—Showing Construction underneath the Table. Fig. 5.—Plan of Folding. Fig. 6.—Plan of Foot of Table. Fig. 7.—Method of joining Leg. Fig. 8.—Joint for Front Legs.

WRINKLES.

LUBRICATING OIL.—A good lubricating oil for machinery, that will not clog, can be made as follows:—Place a bottle containing half a pint of fresh neatsfoot oil in the sun, put therein a few scraps or thin pieces of lead, and shake it well, and let it remain a few days; then pour off carefully into another bottle the clear oil *only*. Repeat as before, using fresh scraps of lead. Only use the transparent oil.

BLOWPIPE SPIRIT.—A good spirit for blowpipe lamp can be made by mixing six parts of alcohol, a little oil of turpentine, and a few drops of ether, mixed up in a stoppered bottle.

CARBOLIC ACID will remove paint stains from clothing.

CEMENT.—A useful cement to fix the glasses on paraffin lamps, and also resist the action of the paraffin, can be made by mixing plaster-of-Paris with a solution of alum and water, and it has the advantage of drying hard.

AGE ON WOOD.—To impart to wood carving the appearance of age, boil five ounces of walnut shucks in one quart of water, filter, and apply in a cold state.

BOOT AND SHOE MAKING.

BY WILLIAM GREENFIELD.

THE WAY TO FIT THE SOLE—METHOD OF ROUNDING (OR KNIFING-UP) THE SOLE—THE WAY THE SOLE IS CHANNELLED—THE STITCHING-THREAD.

The Way to Fit the Sole.—The sole has to be wetted, and dried until it is just mellow, then hammered from the centre outwards. In this condition it is pasted well over on the flesh side. The bottom of the boot must have a coat of paste, and French chalk should be sprinkled over the felt, etc., to prevent the boot from creaking. A sole-tack is put in the centre of the toe, as at A (Fig. 1), one at B, and another one at C and C. Here the sole is tapped down all over with the hammer, and the boot held firm on the knees, by letting the strap pass across the centre of the waist, a little below B, and under the left toe. The waist at either side should be manipulated with a round-headed hammer, called a waist- or cramp-hammer.

In very strong work the waist of the sole is left to the full substance; but this depends greatly upon the wear such boots are to be subjected to, and also the special desire of those who will have to wear them.

When the waist is left in this way, and stitched through close to the edge, it is called a square waist, and is only suitable for riding and other strong boots. The thickness is taken down—not the whole way across, but only at either side—and then off the flesh side. This is the general rule. The sole is placed flat upon a board, grain side down, and a skiver taken off, as from D to D, and then another (by turning the sole the reverse way round) from E to E, leaving the skivers a little thicker at F and F. The dotted line in Fig. 1 shows the shape of the soles when bought in pairs, and also how the sole can be fitted to the boot so that, if it be a narrow toe, the piece G is not wasted. Two of these odd pieces will half heel a pair of boots, or, spliced together, will make one top-piece. Therefore, it is well to mark the sole round to the boot, and cut this piece off before putting the sole on. The dark-shaded pieces, F and F, will not, when placed upon the boot, be on top, as here shown, but underneath, next to the welt.

When this is done, and the work has been hammered, so as to make the bottom quite smooth and level, it can be taken off the knees, and a piece of blunt bone or hard wood run right round between the upper and the welt. This will make the welt level, and cause it to set flat against the sole. If rounded up well before the sole is put on, the boot will be a good guide of what the sole should be, which also, in its turn, has now to be rounded up.

Method of Rounding (or Knifing-up) the Sole.—To this part of the work great care and attention must be paid, since it is this "shaping-up" which makes the difference between a well-finished and badly-finished boot.

The boot should be held upon its side on the knees firmly with the left hand. The knife must be very sharp, and held in the right hand. The point should lay on the first finger, with the thumb on the top of the blade, with the rest and the handle held firmly in the hand. The point should only overhang the side of the finger to just the substance of the sole, and not as A in Fig. 2; otherwise, the upper of the boot will be cut as shown. The finger is kept next to the sole, as at point B, and forms a guard to the knife. The piece (C) taken off need not be one cut; it can be pared in very small pieces, so as not to go in too far, and spoil the shape the boot is to be.

This is continued all round, only at C and D the cut must not be close, as the leather here will be wanted to make the seat with and to cover the stitches.

When towards the toe, you will not need to keep the knife cramped up in the hand, as the upper here does not overhang the sole so much, and more liberty may be given to the knife, using the centre more.

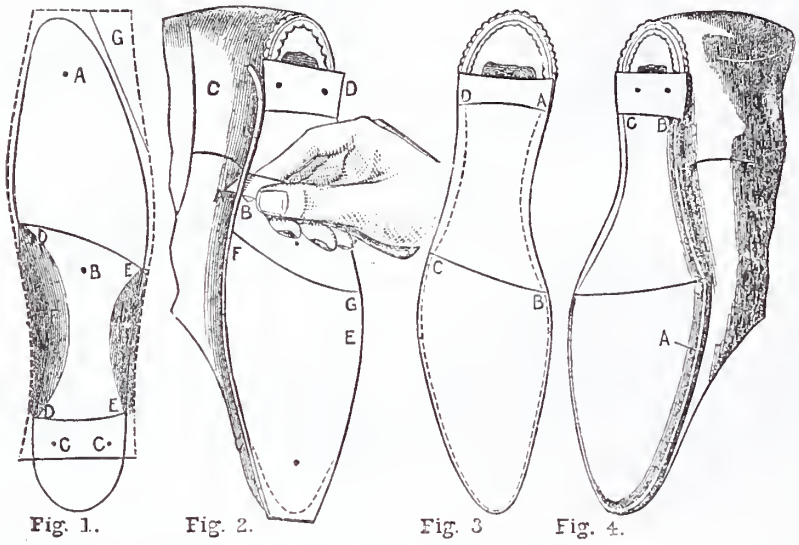


Fig. 1. Fig. 2. Fig. 3 Fig. 4.

Boot and Shoe Making. Fig. 1.—Showing by Line the Shape of a Long Sole, and by the Dark Portions the Skiving for the Waist; also its position on the Boot. Fig. 2.—Showing how the Knife is held in rounding up, and the danger of having the Blade too far out of the Hand; also how the Upper is cut. Fig. 3.—Showing where to cut the Channel. Fig. 4.—Showing how to cut and how to open the Channel.

The welt and sole should be pared closer at E than at F; but starting very close at G, it must become gradually wider until reaching F, and similarly narrower until reaching B. Then the ends of the waist, C and D, should match, but there must be no stint.

In rounding-up, great care is necessary to make and keep the edge quite even and square. This is the only chance now left to give the fore part of the boot shape and form, and this should be done consistently with the shape the heel is to be.

The Way the Sole is Channelled.—This is by holding the boot firm between the knees with the left hand. The knife (which must be very sharp at the point) should not be wide, and should be held in the right hand, as we hold a pen, only a little more upright. The third and little finger should be left loose. The tip of the second finger is placed on top of the sole on the extreme edge. The knife is then dug into the leather at A (Fig. 3), and the third and little fingers that were left loose are now used against the edge of the sole and welt to form a guard, and to steady the movement of the hand while the knife is being passed round the sole.

It will be seen by the dotted line in this figure that the channel has to be cut very near the edge quite round the fore part, as from B to C, whereas it is wider from A to B and C to D in the waist. This line can be marked off first with a pair of compasses, allowing it to be $\frac{1}{16}$ in. from the edge in the fore part and about $\frac{1}{4}$ in. in the waist; or another very good way of doing the fore part is by filing off the sharp edge (where we found the finger should rest), so that the edge of the grain may form a line.

We have seen how to hold the knife, and now its exact position should form an angle of 50° with the flat of the welt. The point of the knife should pass through the grain of the leather and into the fibrous portions sufficiently that the thread may be well embedded into it. This will be nearly half-way through the leather. It is the substance of the sole that decides the thickness of thread which lies in this channel. The thread, lying in the firm part of the leather in this way, leaves the grain free to form a covering for the stitch when the channel is laid down.

Care must be taken with the waist, as the leather has been thinned down; and if the knife should go more than half-way through, it would not hold the stitch, and so the entire sole would be spoiled.

The channel can be opened with any blunt instrument, but the prick-stitch is best. Put the point in at B (Fig. 4), and open it up the whole way round, as shown at A, until reaching C. In doing so, don't disturb the edge, but only the grain on top, throwing it quite back. This will allow the stitching-awl to pass through without cutting. If cut, it would not only make the channel harder to lay down, but also cause an unsightly appearance in the finishing.

The bone can now be rubbed round the welt, and it is ready for stitching.

The stitching-thread is our next consideration. This is made in a similar way to the sewing-thread, only it is not made so stout. From five to nine strands are about what are necessary for ordinary work; but whatever be the work, the thread need not be thick, as the stitches are put very close together, and so tend to make a solid result without substance of thread. The bristles will need to be a very nice pair—thin, with the transparent part long and round. They are not bent at the end, as the sewing-thread bristles are, but kept quite straight. They can be plaited on, as already shown and described. These threads can be wetted and twisted, and when dry, slightly waxed.

In a great many boots and shoes the stitches on the welt side are shown up yellow. If this result is desired, yellow flax is used to make the thread, and white wax or beeswax employed to wax it. If the ordinary brown wax is used, it must be waxed very sparingly indeed.

A very good flax for stitching is slate, if the stitch is required to be black; but whatever material is used, the thread will need to be twisted lighter than the sewing-thread, and should be a firm wiry thread.

The student and worker can thoroughly master this chapter, and if anything is not clear I will answer him in "Shop."

NOTES FOR WORKERS.

The population of New York City is 1,800,000, according to the census just completed.

Near the railway village of Galera, Peru, is a peak which affords the highest inhabited place in the world, it being 15,635 ft. above sea level. A tunnel 3,847 ft. long is being bored through the peak, and this tunnel will be some 600 ft. above the perpetual snow line.

At the New York Eagle Saw Mills, the cutting machine consists not of a saw, but of a blade weighing 450 lb. and moved by a 6-ton fly-wheel. By this, logs are sliced into ½ in. planks at the rate of 1,500 per hour.

Steam should never be led into a brick chimney or sewer, as it causes disintegration and collapse.

Whereas in Germany, Switzerland, Norway, and Sweden from 100 to 400 persons in every 100,000 of the population use the telephone, in Great Britain only 58 do so.

Four wooden "turn-about" torpedo boats, fitted as lifeboats, are being built at Cowes for the Spanish Government. Each will be 60 ft. long by 9 ft. 4 in. broad, and provided with compound surface-condensing engines and locomotive boilers. With a load of 2 tons on board, each will have an extreme speed of 17¾ knots, and when going ahead will be able to describe a circle of 40 yds. in 35 secs.

A new building material, called "fossil coral," is being worked on an island in the Bay of Suva, Fiji. It is so soft that it can be easily cut into any form, but soon hardens on exposure to the air, becoming similar to fire-brick.

Gommeline, used by dyers and finishers for finishing their goods, is made by boiling starch with water, and then adding diastase, which converts part of it into dextrin. The solution is boiled down to 30° Baumé, run into casks, and sold as liquid gommeline, or boiled further until it solidifies, and sold as solid gommeline.

SCIENCE TO DATE.

Anhydrous Crystallised Fluorides.—Anhydrous crystallised metallic fluorides have been lately prepared by the following process: A double fluoride of ammonium and the metal in question is first obtained by the action of ammonium fluoride on the metallic chloride. This, on being heated in a current of carbonic acid gas, leaves the anhydrous metallic fluoride, but in an amorphous state. If this is now heated in a current of hydrofluoric acid gas, it becomes crystalline.

Ohm's Law.—An American electrician suggests the following mnemonic for remembering Ohm's law: Writing E for electro-motive force, C for current, and R for resistance, as usual, arrange the letters as follows—

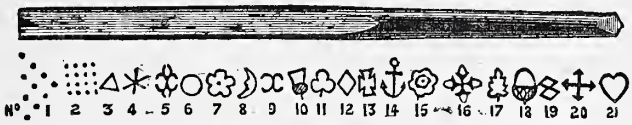
E
C R

Now covering C with the finger, we get $\frac{E}{R}$ $\left(C = \frac{E}{R}\right)$, and, similarly, $R = \frac{E}{C}$ and $E = CR$.

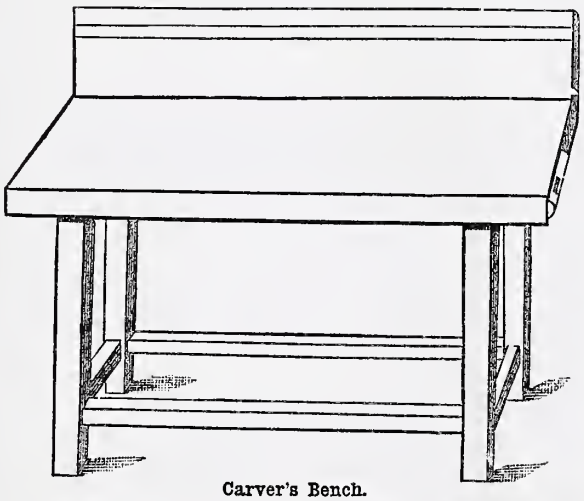
Electric Resistance of the Human Body.—Von Frey finds that the electrical resistance of the human body varies from 300 to 400 ohms.

SOME GOOD THINGS.

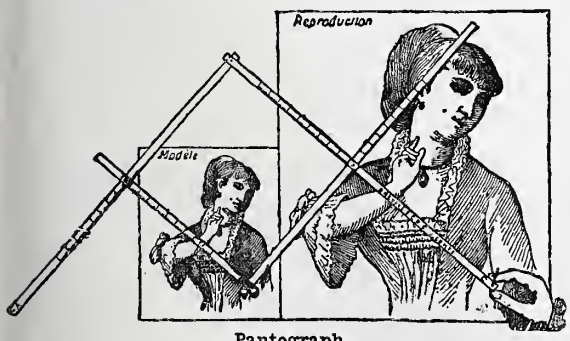
Tools.—With the long winter evenings rapidly approaching, the industrious craftsman and apprentice, hobbyists—professional and amateur—and all who take the sensible view of employing the spare time in some profitable pursuit—these will be looking round and spacing out their winter work. It is safe to predict that no hobby will find a larger number of adherents than carpentry. Little wonder, then, that tool-makers, both in London and the country, are to the fore with lists of tools at prices which should make this hobby a favourite one in any home where there are boys and youths. We have already commenced series of papers on "Carpentry for Boys," to be followed by "School Carpentry," and with the plain and easy instructions therein given, every lad who can purchase a few tools from one or other of the advertisers in Work ought, with practice, to be in a fair way towards attaining not a little proficiency in, perhaps, the best of all hobbies—that of wood-working. A sign of the coming busy times is the list after list of tools which pour in upon us. One of the latest is that of Mr. Henry Osborn, whose advertisement appears in this issue. The copy before us is the 17th edition of a really useful and well got-up price-list of tools and cutlery of some one hundred odd pages for the cost of 6d., which amount is returned to all purchasers of first orders for 10s. or upwards. Illustrations to the number of about 500 embellish the catalogue, which is divided into six sections, thereby materially simplifying the process of finding tools for particular crafts and processes. Mr. Osborn's system of enclosing order lists upon which selections from his catalogue may be written is a good idea. With the price-list a box of goods, taken haphazard from stock, has been sent for our inspection, and, after making this, we have no hesitation in pronouncing Mr. Osborn's tools entirely satisfactory on the score of quality, finish, and price—points which amateurs and professionals alike will admit to be the chief desiderata. The punches for grooved-work, lamps, bench, and pantograph, illustrating this page, and all articles often inquired after by Work readers, are from Mr. Osborn's list. We shall hope to bring under notice selections from other manufacturers' lists as they commend themselves for remark.



Punches for Ground Work.



Carver's Bench.



Pantograph.

TRADE: PRESENT AND FUTURE.

*** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

Plasterers' Trade.—The plasterers' labourers in Aberdeen are out on strike for an increase of wages from 4½d. to 5d. per hour.

Plumbing Trade.—In Aberdeen this is brisk.

Edge Tool and Skate Trades.—The edge tool and skate makers of Sheffield are having a busy time.

Cutlery Trade.—There is a little more work, chiefly of the better classes of table and pocket cutlery and fine scissors.

Flannel Trade.—The contract to supply the War Office with no less than 1,737,000 yards of flannel has again come to Rochdale.

Wool Trade.—Prices are nominal, and buyers very careful: East Indian, white, 5d. to 9¾d., yellow, 3½d. to 8½d.; washed Peruvian, 7d. to 11½d.; washed River Plate, 11d. to 13d.; unwashed River Plate, 5d. to 8d.; washed Morocco, 8d. to 9½d.; unwashed Morocco, 4½d. to 6¼d.; Egyptian, white, 7½d. to 10½d.; Oporto fleece, 7½d. to 8d.; mohair, 11½d. to 12½d.; alpaca, 10d. to 12½d.

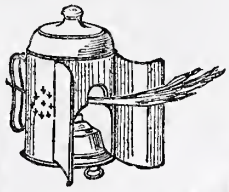
Silver Trade.—Sheffield silver trade is looking up. Firms that have been running short time for the last six months are now giving full employment to their men.

Engineering Trade.—In the Lancashire district the stationary engine trade is very depressed, as is also the machine tool making branch. Boiler makers are exceedingly slack, and in the locomotive business there is practically no work coming forward. At Barrow the strike continues, and 1,250 men are unemployed in consequence.

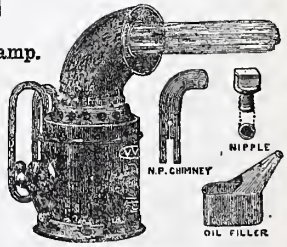
Steel Trade.—The Lancashire steel trade continues very unsatisfactory, and prices continue to fall. Exceedingly low rates are being quoted for both raw and manufactured material.

Iron Trade.—Rolling mills are slack. Heavy iron shows an improved tone. Hematites are quoted at from 58s. to 60s. Some forges are well employed on sheets, bars, and angles. In the Lancashire district prices are somewhat firmer. In the Midland district a better tone prevails, and, in Staffordshire especially, increased activity exists. Several of the Midland furnace owners are behind in their deliveries, while in one or two cases extra furnaces have been blown in. New iron works are to be commenced at Middlesborough. A new wire works is about to be opened out also.

Cotton Trade.—The operatives having unanimously decided to oppose the proposed reduction of 5 per cent., submitted a scheme for curtailing production, which they aver is all that is required to improve the industry. The employers have declined to accept the alternative suggestion, and although only 77½ per cent. of the members of the Federation are in favour of enforcing the reduction, instructions have been issued to the members to give the necessary month's notice for the reduction. There is thus every prospect of a severe struggle taking place in the industry shortly. As against all this our Rochdale correspondent writes:—One local limited company took stock last week, and again declared a dividend of 12½ per cent., which does not look like bad times!



Paint-removing Lamp.



"Paquelin" Plumber's Lamp.

Tinplate Trade.—The proprietors of the Alyn Tinplate Works have given notice of a ten per cent. reduction in wages or the closing of the works.

SHOP:

A Corner for Those who Want to Talk It.

**** *In consequence of the great pressure upon the "Shop" columns of* Work, *contributors are requested to be brief and concise in all future questions and replies.*

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of Work *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given.*

I.—Letters from Correspondents.

Technical Education in the Army and Navy.—C. B. (*Battersea Park*) writes:—"I have read your leader 'Handicraft Education for the Army and Navy,' in Work, No. 178. I have tried very hard to get this subject taken up by the military authorities, and in March, 1888, prepared a paper on the subject; but I was a humble *private* soldier, and what I tried hard for ended in nothing save one thing—viz., the Royal Military Exhibition. Very few people know that this was proposed, also the site, etc., by Musician C. Brock, Scots Guards Band. I cannot enter into all the details in a letter, but I can say that I hoped we might clear a good amount of money by which we would have been enabled to start workshops, etc., in every barracks on the Polytechnic lines. The surplus was, I believe, devoted to soldiers' homes, and nothing whatever was done towards what I proposed. I can give every proof of what I say, and, more, I served on the committee for a short time, but was very quietly ousted, owing, so I was informed, to an objection to anyone serving on the committee under the rank of a commissioned officer. Anyone, therefore, who feels inclined to take up your subject with the hope of seeing it carried out must be prepared to meet with the strongest opposition from the high military authorities that be, unless he himself is one of that very highly distinguished assembly. P. S.—I left the army in disgust after serving no less than eighteen years." [The following extract is from the paper referred to.—Ed.]:—"After long experience, and much questioning with my comrades, I find the great thing needful is education, especially in technical subjects. Therefore, I advocate evening classes on such lines as are laid down in the Polytechnic and similar institutions. This will seem next to impossible, but I have great confidence in the proposition, and if tried on well-founded plans they will take far better than we imagine. The expenses need not be heavy, for I think we would get much help from our civilian professors without having to pay for it. There would have to be a small company subscription, or individual payments, and I suppose the Government would give the army a grant of money on the same lines as they do the civil institutions. Of course, prizes would be offered, and the day when they are to be awarded should be kept as a general holiday for the regiment, and a good entertainment given in the evening. Do not engage any renowned music-hall star, at a good salary, to attend simply for sake of howling 'Two Lovely Black Eyes,' or some such foolish stuff. Give our soldiers an entertainment that will not only open their eyes, but their ears and also their mind. A series of lectures on chemistry, geology, etc., should be given throughout the year. Recollect, to counteract the many temptations by which we know the soldier is surrounded, we want something very powerful indeed to win him from them. Nay, more; we want something that will make him appear a foolish man when he is in bad company, and a wise and elevated man when he is in good company. Another thing I will advocate is regimental exhibitions. Indeed, the opening of one about the time when the prizes spoken of above are awarded would be a great thing accomplished at one and the same time."

People's Homes.—J. C. K. (*London, N.W.*) writes:—"The able leaders in Work, though so brief, yet so succinctly ask How, why, and when the people are to be housed in a way their worth as workers demands, and the progressive civilisation of this age warrants, in one of the richest nations in the world? For 800,000 able-bodied men and women to be workless in these islands means that they are homeless, or on the verge of that sad state; while those who are in work, your able articles show, have to pay exorbitantly out of their uncertain wages for a home which, in nine cases out of ten, is unfit for health, comfort, or misplaced for their work arrangements. The purpose of Work, I assume, is to obtain cogent and logical answers to such questions as are submitted to its readers. As in physics, a definition should be clearer than the thing defined, or a definition would not be needed; so in ethics, the answer should be more demonstrative than the question, or it fails to be an adequate answer. The space at the disposal of those who attempt replies is very limited, and well it is so. It enforces condensation of ideas, which are of more value if focussed to brevity, being at once comprehensive and conclusive. To epitomise the matter, our modern existence may be summed up in two words—'peck' and 'perch.' The 'peck' for food has been settled by Free Trade. The 'perch' for a home must be settled by free land—that is, enough of it for making a home on State-owned domains. Luckily, notwithstanding the vast enclosures of common and open land within the past fifty years, there are many millions of acres still available for people's homes. Of 20,000,000 acres of waste land, 8,000,000 are well suited for productive cultivation, which, under State ownership, would provide as many millions of pounds revenue at once, and produce food for which we now pay £130,000,000 yearly for these imported food products. Average this acreage at ten for each State-renter; it would absorb thousands of able-bodied men and women at healthy productive work without doing injury to a single person in the community. Practically, but a moiety of the army of waiting workers would be fit for land cultivation, and only those proved fit should be allowed to have just as much as their labour could make productive; the remainder would fulfil their duties in other equally useful and productive works, according to their capacities. So much for the *bare land* now waiting for the spade, pick, or plough, where every worker produces twenty-five times more than he consumes. Now for the home for everyone who worked and wanted one. The monster iniquity of home-mongering should be gradually suppressed by a graduated penal tax on this class of property, so that it would cease to be profitable to hold many homes, and at the death of every householder of more than one, a tenth should revert to the State as a home death duty, and by the State be handed to County or Borough Councils to let at the lowest possible rate to all who wanted homes, and never to be made a source of profit taxation. In a roundabout, costly way County Councils are becoming dealers and homemongers, resolving into a source of official gain which will soon rival City proceedings in the same line, and make municipal home-mongering an almost irresponsible tax-levy and a curse to the people who have to endure the extortion. This would be avoided if cost were to be the limit of rent-charge."

Jewellers' Trade Annuities.—One of the Trade writes:—"Will more members of the trade make it convenient to attend the next half-yearly meeting of the Annuity and Asylum Institution? A proposition to make the annuity bear some proportion to the amount subscribed was worth discussing at the last meeting, but was withdrawn, partly on account of a rather noisy faction then present. It will probably be brought forward again, when some of the more thoughtful members of the trade should attend and give their opinions and votes."

II.—Questions Answered by Editor and Staff.

Boiler.—R. A. (*Leeds*).—You do not say what type of boiler, nor the nature of the draught, so that it is impossible to frame a reply that would be of any service.—J.

Mill.—G. V. (*Stepney*).—It is impossible to give any useful advice without seeing the mill in question. There are a number of mechanical movements capable of imparting a backward and forward movement from which choice might be made.—J.

Screw Cutting.—P. B. H. (*Southport*).—Of course, anyone "with a moderate intellect would soon find out" that J. H. was not talking at all about the "handing" of screws in the paper referred to, but simply illustrating the elementary relations between the *pitch* of the leading screw and that of the screw to be cut. I think all readers of Work, even though "not blessed with the same brain power," would understand this, and allow the author to finish his work before offering premature and childish criticism.—J.

Locomotive.—G. S. (*Windsor*).—The best book on the subject, though deficient in recent practice, is "Locomotive Engineering and the Mechanism of Railways," by Zerah Colburn, published by William Collins at £2 2s. The only other good book relates to American practice. It is the "Catechism of the Locomotive," by M. N. Forney, published at 10s. 6d. You can get it of Spon, in the Strand. A useful little book is "Locomotive Engine Driving," by Michael Reynolds, published by Crosby Lockwood at 4s. 6d.—J.

Casting.—H. G. (*Coventry*).—The only work which I can recommend is "Casting and Founding," by Spretson, published by Spon at 18s. Chapter XXIV. is devoted to the brass foundry, but is very brief. There is quite a dearth of really good works on this subject. I think the matter will be treated in Work eventually, and, if so, the articles will be exhaustive and reliable.—J.

Etching Ink for Zinc.—Zinc.—To 1 gallon of dissolved gum arabic (genuine and of best quality) add 1 pint gallic acid and ½ pint phosphoric acid; thoroughly mix. To obtain gallic acid, boil 1 oz. gall nuts in 3 pints water. This is the recipe, but it pays no one to make his own zincographic materials. Get them from Stroeger & Co., 68, Barton Street Arcade, Manchester. It is probable that Zinc fails in his lines from want of practice; but if he gets his materials as above, and still thinks that the fault lies in them and not in himself, he should write to Messrs. Stroeger for explanation.—S. W.

Making a Print Imitate an Oil Painting.—Oil Painting.—I am not acquainted with the print in question, and you do not say what kind of print it is. Possibly the same system by which mezzotintos are made to look like paintings will serve your turn. Render the picture fairly transparent by coats of mastic varnish (in which just a trifle of oil is mixed) on back and front; then paint on the back, either with oil or varnish colours, laying them on flat merely, as the shading of the print will give the modelling. But should the paper be too thick to be rendered transparent, I know no other plan than that of retouching on the surface with oil or varnish colour for oleographs, and with body colour for chromos. When this plan is adopted, the strokes of the brush are not "sweetened" out, as they aid in furthering the deception.—S. W.

Thread.—Reader of "Work."—The "pitch of the thread" means the distance from centre to centre, or, what is the same thing, the distance from edge to edge, of a continuous thread. But that is not the same as saying "a ½ in. Whitworth thread;" the latter term relating to diameter at the points. There is no other way of finding change wheels for square threads. Whether the threads are square or V'd is quite irrespective of the pitch; the same change wheels are used for threads of the same pitch, and different thread sections are imparted by different tools.—J.

Wringer Rollers.—Warsaw.—These rollers are made from sycamore or American maple, and can be bought in any large town. The cheapest firm we know of is Messrs. Baker, New Cut, Westminster, London, S.E. The prices range from about 6s. up, according to size.—A. J. H.

Monograms.—F. K. (*Bradford*).—Much obliged, but your designs are not quite good enough for Work. Study more.—Ed.

Making Model Gas Engine.—C. W. L. (*No Address*).—I made one, vertical, about the size you name—1½ in. diameter—but 4 in. stroke. You will find an account of my difficulties with it in two articles, entitled, "Why my Gas Engine won't go," Vol. I., pp. 742 and 759. This was of the simplest description, and I think you will find the information you require in those articles as to how the engine works, etc., and how the valve gear is managed. Several books are named on p. 364, Vol. IV., middle column.—F. A. M.

Medical Coil Battery.—R. P. W. (*Worcester*).—Battery solutions get hot in working when a large volume of current is being taken from them in a short time, and when the carbon plates are of inferior quality. In your case, I suspect the primary of the coil to be of large wire, and the contact spots on the break also large, thus allowing a full volume of current to be taken from the battery. Under such conditions, the solution will soon be exhausted. Respecting the dry battery described by my colleague, Mr. J. Brox, in p. 100, No. 163, Vol. IV., I think you may safely follow his directions, which are most explicit. Dissolve scrap zinc in a teacupful of hydrochloric acid until the acid ceases to act on the zinc, then warm the killed spirits thus prepared, and add sal-ammoniac, a few grains at a time, until the liquid ceases to dissolve any more. As the capacity of cells varies with the size of the carbon block used as the negative element, I advise you to first fill the cell with dry plaster, then turn it out and make the paste. As the holes at the sides of the carbon are for ventilators, you may leave short lengths of glass tube in the holes.—G. E. B.

Steam Economiser.—Interested, D.B., J.W.S., and others, who have asked for the address of the inventor of the engine fitting for economising steam at Glasgow.—Inquiries have been made from engineers in Glasgow and other places, but, so far, none of them have been able to give any information on the subject. As soon as the address is obtained it will be published.—M.

Lens.—Amateur Photographer does not say which kind of distortion is produced. Almost any wide angle lens, if used without a small top, will distort, or the lens may be faulty of itself. Any rectilinear lens of good quality will produce pictures without distortion, but very much depends on the manner a lens is used whether it distorts or not. The best lenses made will do so if used improperly. If your camera will not extend more than 6 in., a lens of about 4 in. or 4½ in. focus would be suitable. Lancaster, of Colmore Row, Birmingham, could supply you with a suitable instrument at a low price, but any photographic apparatus dealers could do the same. We can scarcely recommend one before another. If very low prices are paid for instruments of this kind, the buyer must take the risk as to the quality. High-class optical work is always expensive.—D.

Tuning-Forks.—Bottom.—Our correspondent can obtain the set of chromatic tuning-forks—thirteen in number, from C to C, price about 18s. 6d.—from S. Walmsley, St. Thomas Road, Finsbury Park, London.—G.

Polishing Organ Case.—Amateur.—The plan you suggest of putting a fair body of polish on the organ case, and finishing by giving a coat of oil varnish, would give a good result: it would look and wear well if you are careful to be sparing in the use of oil with the polish rubber. The oil varnish should be of good quality; for the pews the price must be a good one to allow you to adopt such a method. It is usual to size and give two coats of oil varnish. You need not feel afraid of the varnish cracking; I have some before me that was done four years ago on the lines you suggest that still looks well.—Lifeboat.

Hanging Sashes.—J. G. (*South Africa*).—The hanging sash referred to in No. 167, p. 168, is Hough's Patent Reversible Sash Frame with Sliding Sashes—135, Great Suffolk Street, Southwark, London, S.E. Kindly mention Work, wherein they should advertise.—E. D.

Engravers' Copper Plates.—H. Y. W. (*Bromley-by-Bow*). — Your second letter contains no details, but I must endeavour to guess your requirements. You can buy of Messrs. Sellers, Arundel Street, Sheffield, engravers' copper plates of any size and thickness at from 2s. 2d. to 9s. per lb. Their steel and copper plates—indeed, all their manufactures — are of first-class quality, which makes their prices a trifle higher than others in the same line of business. I cannot advise you to attempt the making and polishing of copper plates unless you have a full plant of tools and skilled workmen, as a copper plate is of no use unless it be flat and free from scratches. You may, however, get a fairly flat surface on a small plate by proceeding as follows:—Procure a sheet of best copper, and with a boxwood mallet on a plane surface take out the inequalities of the surface; this may easily be done with a few smart taps in the proper places. Ordinarily, the sheet copper is very smooth as from the rolls, and the scratches are mostly superficial, which therefore will not take up much time to remove them. You may now take a "Tam O'Shanter" stone and water, and go over both surfaces till scratches are removed. Next tack down the plate on a board, to keep it flat and also from bending. Now rig up in your lathe a buffing wheel of any convenient diameter—say 3 in. or 4 in. by about 1 in. in width. You will require to get up a speed of about 1,500 revolutions, using lime, previously pulverised, as a dressing for the buff wheel. If you have got an old lathe which you can utilise for the buffing process, you might place it in a room where dust is of no account, as if the lime gets into a good lathe it will certainly spoil it by clogging the oil, although beyond that it will do no further damage.—N. M.

Cabinet Varnish and Reviver.—One that wants to Learn.—(1) A varnish good enough for all practical purposes can be made as follows:—1 gal. rectified naphtha, 2 lb. shellac, 1 lb. gum sandarach, ½ lb. benzoin, ½ lb. gum thus, ¼ lb. pale resin. Crush the gums, and dissolve by gentle heat and frequent stirring; carefully strain before using. This brings the cost to about 8s. per gallon, or the price of the commercial brown hard spirit varnish, which, by the way, makes a capital varnish either used alone or by mixing with French polish in the proportion of 3 parts polish to 1 part varnish. There are scores of recipes for varnish-making; the one frequently recommended in "Shop" by F. P. of 3 lb. shellac, 1½ lb. benzoin to the gallon, makes a really first-class varnish, though for common work, such as Windsor chairs, resin only is often added to the polish. But the one I give is what I use daily, only that I dissolve the gums apart from the polish; I then mix the polish—white or brown, as advised—with the brown hard, varying the proportions according to the job I have in hand. For the carved work it should be slightly warmed. (2) There must have been some mistake in the reviver you mention, as *boiled* oil is never used in polishing, though there is a reviver made of equal parts of turpentine, vinegar, methylated spirits, and linseed oil, the secret of making which appears to lie in mixing in the order given to prevent curdling. A reviver in general use in the trade is (*a*) Vinegar 1 quart, naphtha 1 quart, linseed oil 1 quart, butter of antimony ¼ lb.; shake well before using; apply with flannel; wipe off with clean rag; (*b*) linseed oil 1 quart, 4 oz. spirits of camphor, ½ pint vinegar, 1 oz. butter of antimony, 1 oz. spirits of hartshorn. These revivers containing vinegar soon become to some persons disagreeable by reason of the vinegar turning sour; for this reason I have long discarded their use, using instead one made of lime water 1 quart, linseed oil 1 quart, sweet oil 1 pint, turpentine 1 quart; mix carefully in the order given, apply with wadding, wipe off with soft rag, and finish with a clean piece damp (not wet) with methylated spirits. Many thanks for your good wishes and appreciation of services rendered. —Lifeboat.

Metal Repairs.—Mendall should experience no special difficulty in turning down the edge upon the stake. Perhaps he tries too great a length at once. It needs to be done little by little, going round again and again, till all puckers are obliterated. One-sixteenth of an inch will be wide enough for the turn down. For the other job open the chaps of your leg vice, lay the strip upon it, and with the pane of a hammer strike it down into the interval between the jaws. This will start it. Then lay in it a round bar of wood, and repeat the hammering.—J. L.

Electric Regulator.—W. W. C. (*New Kent Road*).—The value of any invention is governed by the usefulness of its application. To what purpose do you intend applying your special arrangement for regulating the strength of the current by a movable resistance controlled by a solenoid? As an automatic regulator it might serve some useful purpose. The idea of regulating current by means of a solenoid and an adjustable resistance is not new, but your application of it presents a few novel features. Your next course should be to find a use for it, then make a model, and practically test its usefulness.—G. E. B.

Demagnetising Watches.—J. A. (*Thirsk*).—To take the magnetism out of a watch, either revolve it rapidly for a few minutes in a strong magnetic field—such as that of a dynamo—or revolve a powerful magnet or set of magnets over the watch close to its face. Hanging it for some time close to a mass of iron will sometimes cause it to give up its magnetism. Watches kept in iron cases are shielded from magnetic influences. An ordinary block-tin case will serve the purpose.—G. E. B.

Ceilings.—J. H. C. (*East Ham*).—The advice given by your friend is the best you can adopt under the circumstances, but you need not go to the expense of painting or whitewashing at once. I should advise you to wash off the ceiling, fill up the cracks with plaster-of-Paris, rub down smooth and level, and then paper, which should wear two or three years, after which you may paint or whitewash. In the living rooms you might lay on a border round the ceiling, which would improve the appearance. After filling in the cracks and rubbing down, if any of the ceilings are fairly hard, you might try whitewashing alone, and save the expense of papering; but if soft and loose, they should be papered.—M.

Child's Swing Cot.—T. J. H. (*Nuneaton*).—You can make the cot to swing either from the ceiling, hung by two hooks in the joist over, or else make a frame for it, as in Fig. 2. As the latter has many disadvantages—such as a tendency to tip over—and

Fig. 2.

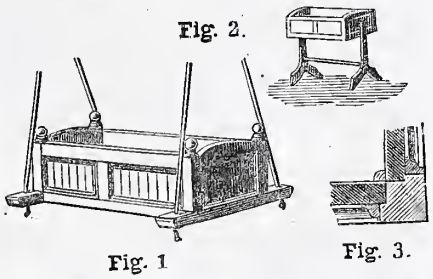


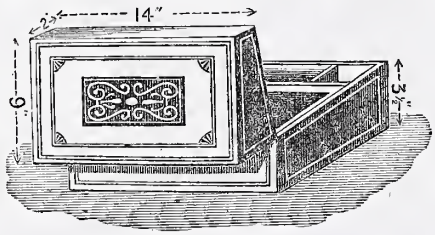
Fig. 1 Fig. 3.

Child's Swing Cot. Figs. 1 and 2.—Different Methods of hanging. Fig. 3.—Section of Corner-pieces.

takes up a good deal of room with its strutted legs, I shall briefly describe the construction of the one shown in Fig. 1. All the wood is framed together in the usual way, of 1½ in. rebated stuff, the corner-posts having turned knobs. The two bottom end rails project a little, and a hole is bored in the projection for the cord to go through and a knot tied on its under side. The cord also passes through an iron eye screwed in the corner-pieces just below the knobs. The end rails had better be 2 in. square, as all the strain is thrown upon them. The panels are filled in with ¾ in. or ⅝ in. boards, moulds run outside, and beads in all corners inside. I will not give any general sizes, as you may please yourself in that matter.—F. J.

Induction Coils.—G. F. D. (*York*).—Articles appeared in Work, Nos. 157, 159, 164, 166, 170, and 178.

Writing Desk.—Joiner.—Convenient sizes for a writing desk are marked on the sketch. Brass for inlay can be purchased in various thicknesses from any of the fretwork material dealers (see Work advertisement pages); from $\frac{1}{64}$ in. to $\frac{1}{32}$ in. thicknesses are the most useful. From the same source you can get the saws necessary; Nos. 1, 0, and 00 are generally used for this work. To saw the sheets of thin brass, they should be placed on a piece of wood, and then saw through both, the wood giving the support necessary to the thin metal. Supposing you to proceed with the panel shown in this design, the ground would be taken out to a uniform thickness to receive the panel. The brass inlay and the veneer filling up the interstices (of ornamental wood, and same thickness as



Writing Desk.

the brass) are glued on a newspaper face downwards, and when quite dry, the back of the panel must be roughed with a "rasp," and coated with thin glue. Then lay in the design, press out all superfluous glue, screw up in a "caul" or press, and leave to dry for a few hours. When firm, it is cleaned off with a cabinet-maker's "scraper;" this will bring off the newspaper and any glue that may have been squeezed up. Then carefully go over the surface with fine glass-paper. All the other brass lines and the escutcheons may be treated in the same manner.—F. J.

Dentistry Appliances.—Amateur Dentist. —Sample of spring sent is brass (plated), and very dangerous to wear in the mouth, and would only be used by cheap advertising dentists. Occasionally silver gilt springs are used, but very seldom; by good dentists none other than gold is used, which lasts for years. If Amateur Dentist would send a list of his requirements to Editor, Denta will obtain them, and forward upon receipt of name and address.—Denta.

Dental Plates. — Amateur Dentist. — The metals principally used for dental plates are 18 and 16 carat gold, platinum, and dental alloy; silver is seldom, if ever, used, owing to its becoming dark, due to the action of the acids in the mouth. When used it must be alloyed with copper, same as coin; but dental alloy can be obtained at from 15s. to 25s. per oz.—Denta.

Boring Holes in Wood.—S. S. (*Grantham*).—I understand the pieces are 4 in. square, and the holes are to go through lengthways of the grain, and that your difficulty is to hold the pieces so that they will not turn round by the action of the auger. I never had such a job to do, so I can only suggest what I think would do. First, are you using the full size, 1½ in. auger at first? If so, I think you would do better to begin with a small size and then enlarge it, so that each size would do part of the work—the number of sizes to depend on the hardness of the wood. Second, I think I would fix up on the lathe-bed a kind of wooden trough, in which the pieces could lie while being bored. This would enable you to hold them firmly and present each piece at the right height. Thus you could put in one piece after another, and bore from both ends. Patterns for table legs have been advertised in Work, and articles on tinwork, giving recipes for making solder.—F. A. M.

About Work and Power.—Velo.—Articles appeared in Work, Nos. 158, 164, 169, and 173.

Watch and Clock Cleaning, etc.—E. W. C. (*Leicester*).—Glad to hear you appreciate the articles now running on this subject. The writer will treat the trade in as full a manner as possible, at the same time making everything plain to beginners. Repairing will be fully gone into, and it is hoped the articles will be of service to all, whether amateurs or practical watchmakers.—F. J. G.

Brass Lacquer.—W. H. B. (*Barrow*).—You will be able to get what you require from the Frederick Crane Chemical Co., Newhall Hill, Birmingham.—R. A.

Hand-working of Specula.—W. H. (*Nantwich*). —No; the passage which you quote does not refer to a Trunnion vision telescope. "Trunnion vision" describes a method of mounting at one time much in vogue in this country and in America. The oval reflector (which would have to be used) would not, of course, screen off any more light in that than in any other form of mounting. What was written on p. 132 was based on the simple fact that it is much more difficult to perfectly parabolise a mirror of short than one of long focus. Thus, a speculum of 6 in. diameter and 6 ft. focal length is easier to work than one of the same diameter but 3 ft. only in focal length. On the other hand, a mirror of short focus can be more conveniently mounted. There was at one time a rage for metal mirrors of short focus, and the great makers rivalled each other in producing such instruments, which were aptly named "dumpies." "Powder emery like that made up in tins for knife cleaning," is not "good enough for the fine grinding of the speculum." It would be quite useless for the purpose. The mere process of washing would speedily show the stuff to be more slate and mud than emery. Good grain or washed flour emery should be obtainable from any stone polisher or dealer in jewellers' sundries; or a polite note to a wholesale firm of reputation (with a stamped envelope enclosed) will probably procure for you the address of a reliable dealer in your neighbourhood. Years ago Messrs. Oakey & Son informed me that washed flour emery, manufactured by them, could be obtained in any town in the United Kingdom at about 1s. per lb.—E. A. F.

Refracting Telescope.—Amateur.—If you will refer to Work, No. 145, you will find instructions for the making of a simple refracting telescope, and you had better see this before you proceed further in the matter. For prices, write to some established firm (say Lancaster & Son, of Birmingham) and to some dealer in second-hand optical materials (say Caplatzi, of Chenies Street, Tottenham Court Road), and compare their charges for achromatic object lenses. You will then, most probably, find that a 5 in. lens is beyond your means, apart from the cost of mounting. There is, of course, some element of risk in the purchase of a second-hand lens, unless you protect yourself by making an arrangement with the dealer. Make your experiment with a 2½ in. or 3 in. glass, and try to mount it so that it can be used with success. You will do better work with a small lens carefully mounted (by carefully I do not mean expensively) than with a larger one badly mounted. If properly mounted, the telescope should be quite rigid when fixed for observation, and there should be no shake when the instrument is moved on its bearings. When you have further considered the matter, if difficulty occurs, you must ask for advice again. But in that case, detail your difficulty. For eyepiece making, see No. 148, p. 701, and read the recent account of the making of telescope eyepieces in Mr. Parker's paper on the Spectroscope (see No. 177, p. 323).—E. A. F.

How to Make a Galvanic Battery.—H. J. (*Burnley*).—Given: Two carbon rods 1 ft. by 2 in. by 1 in., and two zinc cylinders 10 in. long by 4 in. in diameter—how shall these be made into a galvanic battery? This is the purport of your letter. The task is not a difficult one. You may get glass, stoneware, or porcelain pots, 9½ in. in height and 4½ in. inside diameter, for the outer cells, and porous pots 10½ in. in height and 3 in. in diameter for the

inner cells. The zinc cylinders must be well washed in soda-water, rinsed in clean water, then rolled in a flat dish containing mercury and dilute sulphuric acid until well coated inside and out with mercury. When thus amalgamated, fit to each a binding-screw of brass. The carbon blocks must have brass connecting clamps fitted to one end. They will go in the porous cells in a mixture of 3 oz. chromic acid and 1 oz. sulphuric acid in one pint of water. The porous cells go inside the zinc cylinders, and these in the outer cells, which are then filled with a mixture of one part sulphuric acid in twelve parts of water. By cutting the zinc cylinders and carbon blocks in equal parts, you can form a battery of four cells, each 4½ in. by 4½ in., with porous cells 5½ in. by 3 in. This will make a strong galvanic battery.—G. E. B.

Testing Electric Belt.—Mrs. M. (*London, W.*).—The most simple method of testing an electric belt for an evidence of electric current is as follows:—Attach a thin copper wire, 1½ yds. in length, to a copper disc at one end of the belt, and a similar wire to a zinc disc at the opposite end. Put on the belt, take the two free ends of the wires, and bring the two ends to touch on tip of your tongue. If the belt generates any electric current at all, a sharp acid taste should be experienced at the moment when the wires touch.—G. E. B.

Improver.—Jack Plane, in rather a vague letter, wants to know if he can go as an improver after he is twenty-one. An apprentice's indentures are not *legally* binding when he comes of age, and he can then become an improver, if he wishes, for a year or two. If Jack Plane has made the most of his opportunities and time during his apprenticeship, he could go as a journeyman at once, instead of an improver. Whatever he does, he shouldn't devote his evenings and spare time to loafing. After he has "knocked off" work, he should take up some profitable study and home work, and thus really "improve" himself.—F. J.

Fret-Cutting Machine.—S. P. (*Whitechapel*).—Articles appeared in Work, Nos. 58, 60, 114, and 139.

Boiler.—Anxious Engineer.—Do not attempt to rivet so small a boiler, nor bother with return tubes. Unless very skilful, you will never make it water-tight nor safe. Get solid tube and, preferably, make the simpler vertical boiler. You cannot do better than copy the boiler illustrated in Vol. III. of Work, p. 812.—J.

Recommending Work.—C. H. C. (*Grosvenor Road, S.W.*).—Thanks for acquainting "many young fellows of Work." If every subscriber did the same, or induced one new subscriber for the fifty-two weekly numbers, there would be no need to advertise Work above ground or below it. Readers all, see what you can do.—Ed.

Blades for Thread Bobbins.—Steel Wire.—After exhaustive inquiries, I am sorry to have to inform you that no Sheffield firm will take up the manufacture of these blades, on account of their small size, which is, approximately, as follows: Thickness on back, $\frac{1}{32}$ in.; width, $\frac{3}{64}$ in.; and length, ¾ in. The manufacture of such small blades clearly belongs to women. Such being the facts, I can only direct your attention to what I consider the cheapest method of making them. A small plant will be required, but which need not be very expensive. In the first place, send an exact sample of the wire, which, practically, will be a length of flat wire of the width and thickness as above, bevelled on one side to nothing. This wire should be supplied in convenient lengths, which, I think, you had better decide—perhaps 3½ in. would be best, as a longer length would generate a most inconvenient spring while being worked. The work should be divided into four processes—namely, grinding, pointing, cutting-off, and driving into the bobbin. For each of these processes an intelligent girl of fourteen years could, in a very short time, be trained to do the work better than any boy. Of course, you would want a foreman to look after them and to adjust and keep their tools in order. The "grinder" and the "pointer" would both work on wet grind-stones—known as "blue stones"—such as are used by the razor grinders; and, indeed, their stones which have worn down too small in diameter for razor grinding would be the very thing for your job, and could, no doubt, be bought cheaply. The size of these discarded stones is about 3 in. to 4 in. in diameter and 1 in. across the face. Two of these stones could be rigged up on a long shaft between the centres of an old lathe, and each fitted with a trough and backboard, taking particular care that the stones are fitted at such a height from the floor of the workshop as will ensure the comfortable sitting of the girls while at work. Thus, one girl would grind the long length of side to form a sharp cutting edge, which, by reason of the bevel formed in the drawing of the wire, would be easily done, afterwards taking off the "burr" at the other side. The length of wire, being sharpened, would be passed on to the second girl, who would point both ends of the wire. This being done, another pair of hands, at a self-acting cutting press furnished with a gauge for cutting off the exact length, would cut off the ends of the sharpened and pointed wire and pass back the wire to be re-pointed, repeating the process until the whole length of wire is used up. In all wet-grinding processes it is necessary to have a box of dry lime in which to drop the wet articles, to prevent their rusting. The process of driving the blades needs no instructions, but, probably, a magnetic hammer might be used with good effect.—N. M.

Model Electro Motor.—Youthful Gunman.—Your question shall be sent to J. Brox to answer for you. As you have made the model electro motor and the battery so successfully from Work, it is to be hoped you will make the fact known among all your friends. The success of a journal like Work depends largely upon the exertions of those who already know it. You and every reader should induce one new subscriber for the year. The recommendation of readers is better than much bold advertisement.—Ed.

Luminous Bell-push.—Tavy.—If I understand your letter aright, you think there should be some means for rendering a front-door bell-push luminous at night, because you have found some difficulty in locating those on the fronts of strange houses. Some town dwellers who are pestered with runaway rings and knocks will think otherwise. A friend of mine was so pestered that he invented a secret bell-push, known only to his intimate friends. Another friend had his bell-push wrenched off from the door-post at night on several occasions. Luminous paint around the push would not be very desirable. But Tavistock youth may be less mischievous than London gamins; nevertheless, I think you would have some difficulty in getting a patent for your invention, and the money spent on it would be thrown away. Your good opinion of Work is gratifying, and you are quite right in spending your pennies in scientific papers instead of trashy literature.—G. E. B.

III.—Questions Submitted to Readers.

**** The attention and co-operation of readers of* Work *are invited for this section of "Shop."*

Model House.—T. B. (*Kirkbythore*) writes:—"Will some kind reader give me an address, or inform me where to get model fittings, such as chimney-pots, door-handles, and small spouting?"

Easel with Tray.—J. O. S. (*Glasgow*) will thank any reader for directions for making a light folding sketching easel with tray.

Meerschaum Pipe.—G. E. (*Falcon Square*) writes:—"Will some kind reader tell me how to treat and to preserve a meerschaum pipe, and the best method for re-waxing?"

Charcoal.—R. A. (*Leeds*) writes:—"Will anyone inform me how to make charcoal, etc., from English ash, elm, and oak? Is it profitable or otherwise? Also, could anyone tell me how to dispose of about 3 tons per week?"

Bottle-filling Machine.—T. S. C. (*No Address*) writes:—"Will any reader kindly explain the working of the bottle-filling machine used by beer bottlers, filling three or more bottles at once, and stopping automatically when bottles are full? I want to try and make one."

Corn Bushels.—Ironwork writes:—"Can any reader of Work kindly tell me where I can obtain the ironwork necessary for making bushels—such as handles, etc.?"

IV.—Questions Answered by Correspondents.

Refuse Destroyer.—Manlove, Alliott & Co., Ld. (*Nottingham*) write:—"In reply to Colonist (see No. 178, page 350), our destructor for dealing with town and city refuse is used in most of the principal towns in this country, and we have already supplied destructors capable of dealing with upwards of one million tons of refuse per annum. The destructor is working in Australia and New Zealand. In England the refuse is reduced to about one-seventh in bulk and about one-fourth in weight; in the colonies we should expect that the amount of residue would be somewhat less. This residue, being perfectly innocuous, may be tipped anywhere without fear of nuisance or contagion; or may be used for road-making, for grinding with lime into mortar, for making artificial stone, and for other purposes. The waste heat from the furnaces may also be utilised for raising steam, for electric lighting, pumping, sawing, grinding, or other purposes for which steam power is required.

Piano Panels.—M. (*Bishop Auckland*) writes to J. D. (*Ipswich*) (see No. 178, page 350):—"You might use Lincrusta Walton, which could be painted or gilded."

Bamboo.—M. (*Bishop Auckland*) writes to Rufus (see No. 178, page 350):—"Heat them over a spirit lamp or Bunsen burner, moving them about continually, to prevent burning them. Then have a piece of U-shaped iron rod turned down at the ends fixed in the bench, and projecting over one side. Insert in this, and bend when sufficiently hot."

V.—Letters Received.

Questions have been received from the following correspondents, and answers only await space in Shop, upon which there is great pressure:—J. H. H. (*Catford Bridge*); J. G. (*Kilmarnock*); P. R. (*Alloa*); W. N. (*Shrewsbury*); R. S. (*West Croydon*); S. S. (*Blackburn*); F. P. (*Campden Hill*); W. H. (*Leicester*); C. R. (*West Kensington*); Novice; H. H. (*Stony Stratford*); W. P. C. (*No Address*); J. B. (*Dalton-in-Furness*); W. S. (*Bedford*); Constant Reader; A. N. (*London, N.E.*); T. L. F. (*Portsmouth*); J. H. (*Gateshead*); Opifex; W. T. B. (*Kenton*); H. C. (*Clapham Junction*); C. G. W. (*Knutsford*); T. W. (*Wigan*); J. H. (*Newton*); Boxer; A Young Clockmaker; Pat; J. O. (*Aston*); X. (*Rotherham*); G. L. (*Salop*); J. B. (*London, E.*); F. J. (*No Address*); Little Jim; T. S. (*Kokstad, Griqualand, Cape Colony*); Gulielmus; W. J. G. H. (*Errington, W. Nanaima, British Columbia*); J. H. (*Birmingham*); Whitesmith; W. H. (*Arbroath*); H. K. K. (*Chiswick*); E. P. (*Islington*); E. J. C. (*Charlton, S.E.*); Newel; F. C. (*Stockton-on-Tees*); Joiner; J. O. H. (*Balham*); F. H. R. (*Queen's Park*); R. E. M. (*Sunderland*); W. P. B. (*Birmingham*); W. E. (*Haverhill*); F. T. R. (*Lybster*); Pipes; E. C. (*Ixbridge*); P. J. M. (*Bristol*); A Worker in Iron; W. J. W. (*Wolverhampton*); E. W. B. (*Herne Hill*); H. R. (*Openshaw*); W. M. (*London*); Mackintosh; W. J. C. (*Islington*); E. B. (*Darlaston*); F. D. (*Dunstable*); Ribs; Felt; E. C. N. (*Islington*).

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will be found in No. 181 and subsequent issues.

All manuscripts intended for the "Tourists' Travelling Requisite" Competition must be addressed to the Editor of Work, c/o Cassell and Company, Ltd., Ludgate Hill, London, E.C. They must reach him on or before Saturday, October 29, endorsed, "Tourists' Travelling Requisite" Competition.

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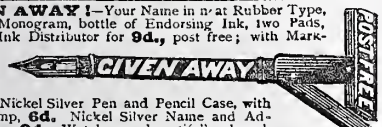

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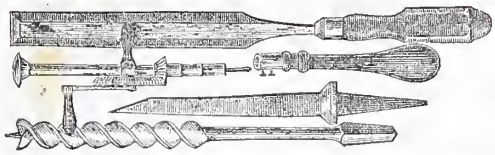

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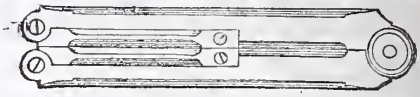

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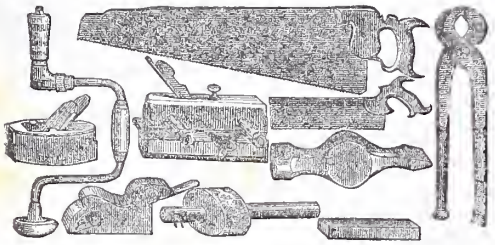

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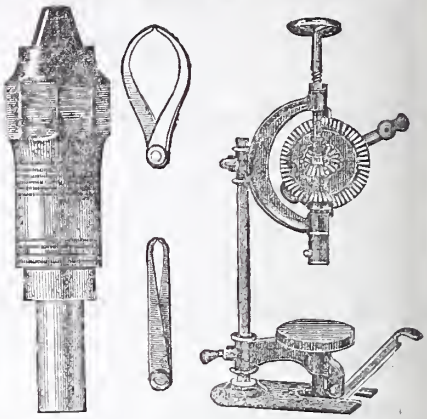

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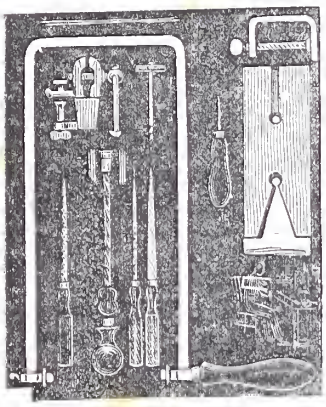

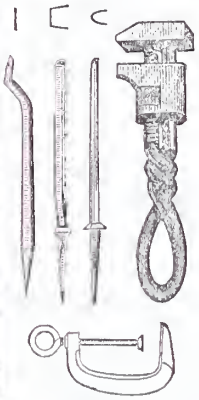

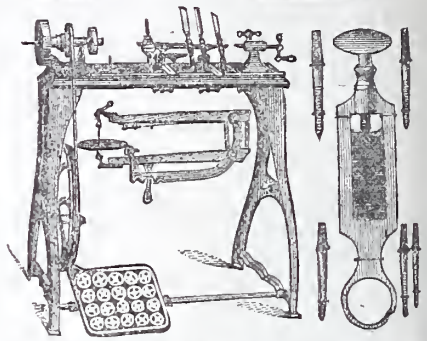

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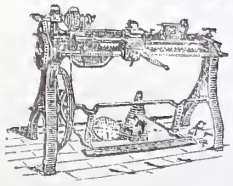

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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VOL. IV.—No. 188.] SATURDAY, OCTOBER 22, 1892. [PRICE ONE PENNY.

WORK WORLD.

EMPLOYÉS of the Montrose Foundry Works are to be put on an eight-hours day without any reduction of wages.

* *

Before the strike at the Homestead Works, Pittsburg, Mr. Carnegie, it is stated, made a daily profit of nearly £1,000.

* *

A new process of warping and beaming takes the yarn direct from the cop or bobbin and winds it upon the ⅜ in. skewer, entirely dispensing with the spools used in creels for warping.

* *

Pneumonia has been cured by the administration of oxygen gas. The relief was immediate, and the cure rapid. WORK subscribers will note in view of the coming winter.

* *

A new application of diamonds consists in fixing them on gun-barrels to aid sighting, even in dim light. We can understand that some advantages are to be secured, but the materials are costly.

* *

Rumours of a strike among 20,000 cotton spinners in Lancashire against a five per cent. reduction in wages are being circulated. It is also said that some of the coal-miners intend coming out on strike this winter.

* *

A prize of 3,000 francs has been offered by Baron Léon de Lenval, of Nice, to the inventor of the best adaptation of the microphone in an instrument to improve the hearing of deaf persons.

* *

An army of 9,000 milkers are engaged in milking 84,000 cows, from which they extract 42,000,000 gallons of milk per annum to supply the wants of London. Still, we import large quantities of Swiss milk.

* *

Railway companies in India have adopted the "Pintsch" oil gas for lighting. Its production takes place at Howrah and Allahabad, and also on some of the Bombay lines. This is another blow to the castor-oil industry.

* *

In a new process for colouring photographs no paints are used. All the colours are produced by chemicals. Silver prints, enamels, opals, opalines, etc., can be treated at a small cost, and be made to show as though the colours were photographed direct.

* *

Yarn-spinning promises to become a profitable industry in China, where one factory, on the borders of the Yangtse-Kiang, turns out about 130,000 yards of cloth weekly. The machinery is English, but the operatives Chinese.

* *

Brewers are now on the look-out for hop substitutes to put into beer. The wholesome effect of the hop on health has been proved, but we cannot say the same of its substitutes. Beer drinkers should be watchful, too, and see that those substitutes are as wholesome as hops.

* *

A substitute for indiarubber has been discovered by Dr. N. A. Tilden, in a product obtained from turpentine. The material can be vulcanised, and resembles pure Para rubber in every way. M. Bouchardet has found that the product may be obtained by heating the turpentine.

* *

Hot springs are to be utilised in Boise city for heating the buildings. These springs are situated about a mile from the city, and the water in the wells is always at boiling heat. A 6-in. pipe is being laid to convey the water to the city, and it is estimated that this mode of heating will be much more economical than using coal for that purpose.

* *

What becomes of all the ships? Last year sixty-eight vessels, comprising 49,100 tons, sailed from some port or other, and were not heard from again. Of the total thus passing out of record 28,500 tons were British. Of the total tonnage lost only 12 per cent. were constructed of steel, while 41 per cent. were of iron, and 47 per cent. were wood and composite vessels.

* *

A new invention for assisting a locomotive in climbing steep gradients consists of a grooved wheel keyed on the driving axle, and surrounded by a coil of a fixed cable. The groove is of the same diameter as the driving wheels, and the cable lies in the centre of the track, being kept in position round curves by means of guides. The hold on this cable prevents the driving wheels from slipping.

A recent test, with the object of obtaining the velocity of a 250 lb. shot fired from an 8-in. gun with a charge of 81 lb. of hexagonal prismatic powder, is said to be one of the most satisfactory tests made in the history of modern ordnance. The standard set down for these conditions is 1,700 ft. per second, or at the rate of about 1,200 miles per hour. The electrical measuring instruments used showed a velocity of 1,702 ft. for the first shot fired; this came so close to the standard that further tests were considered unnecessary.

* *

For conveying coal through pipes—a method for which has been patented—the coal is pulverised and mixed with an equal weight of water; it is then pumped through pipe lines like petroleum. It is then allowed to settle in vats, the bulk of the water drained away, and the residuum pressed into bricks and used as fuel. Mr. Andrews says that he has pumped coal "mush" 300 miles at five miles an hour, and that a 12-in. pipe will deliver 5,000 tons of coal a day.

* *

In a new method of hardening copper castings, small quantities of metallic sodium are introduced into the molten copper, and thus the dissolved gases are eliminated, and the copper rendered more compact and hard. A marked improvement is shown by the introduction of 0·1 per cent. of sodium. Potassium and lithium have this property also, but sodium is cheaper and is more easily handled. In melting the copper a covering flux is used, consisting of about one part sodium carbonate, two parts powdered anthracite coal, and a small quantity of common salt.

* *

Magnesium light for lighthouse purposes has shown results more brilliant than any obtained from the electric light. The apparatus employed is about 7 ft. high and 3 ft. in diameter. Inside is a blast evaporator which blows air over pumice-stone strongly charged with benzol. This benzinated air is sent through fine magnesium dust and becomes charged with it. It then issues through a tube, and is burned in a small flame, which gives a brilliancy estimated at 40,000 candles. The apparatus is controlled by clockwork. The consumption of magnesium dust varies from ½ oz. to 1¼ oz., according to the lighting power, and costs from 6s. to 10s. for ten hours.

INEXPENSIVE CEILING DECORATIONS.

BY A LONDON DECORATOR.

PAINTED ceiling decoration has a province to fulfil, in connection with decorative art and progress, of no small importance. No portion of the modern-built residence or public building offers more scope for the legitimate display of ornament and colour than does the ceiling; and no other position displays its structural or applied embellishment at all times to an equal advantage therewith. So far as one's personal observation goes, however, this most important factor of a decorated apartment is the one least studied and cultivated by the average painter-decorator. Some reasons for this apparent neglect come readily to the mind. The difficult and fatiguing circumstances attending its execution, for instance, are always present. Again, at the present time the custom of covering the ceilings of reception rooms in new buildings with ornamental sections of metal and plaster relief-work is very prevalent, and, indeed, is spreading rapidly.

I am not here disposed to run a tilt with all ceilings of this description. They have some advantages; but, generally speaking, these advantages are not of a kind conducive to an artistically decorated room. An elaborate mass of relief ornament spread upon a ceiling does not constitute house decoration, and when, as we may see advertised, some of these productions consist of a jumbled mass of ornamental chaos, arranged irrespective of style, no minor art prophet is needed to cry "Shame!" on their claim of being *artistic decorations*. Between a ceiling of the aforesaid description, introduced by the builder for cheap show and quickness, and a ceiling decorated with one of the modern applied relief materials by the decorator, there is a wide difference. In the first case the ceiling is a veritable decorative "white elephant;" in the latter instance it is simply part and parcel of a decorative interior, arranged in harmonious keeping with the wall decorations, the furnishing, and drapings.

What, then, may be considered the salient points of successful ceiling decoration? To answer this query with regard to any particular instance necessitates a definite acquaintance with the apartment of which the ceiling treatment must be a section of the harmonious whole; nevertheless, there are a few features common to all satisfactory examples. For instance, although but a *division*, its treatment in form should be *complete in itself;* there must be an expression of balance throughout, of unity and flatness—a decorative picture, of which the cornice must be the distinctive boundary and frame. However ornate the design in its completeness, there should also be portions of comparatively plain surface—not only to serve as a foil for the ornament, but to relieve the eye from physical weariness. Without repose, there is no art. Turning from line and form to the domain of colour, we may have a ceiling decoration with its colour as the outcome of the wall treatment, or as a direct harmonious contrast to the prevailing tone of the room.

The flat, plastered ceiling—to which description this paper is closely related—presents great possibilities for painted ceiling decoration where time and cost are not the chief consideration. But the highest productions of the artist, a phase of decorative art popularly described as "painting angels on the ceilings," is usually far removed from the sphere of our general environment. Nevertheless, between the extremes of, on the one hand, a "fine art ceiling painted in oils," and, on the other hand, of a glaring display of whitewash, there is a wide range for the introduction of ornamental line and colour. *Flat ornament—i.e.*, without shade or shadow—is the class of embellishment that lies most within the powers and opportunities of the average operative or amateur decorator; and in executing such work, the humble and much-abused stencil must, perforce, play an important part.

It is generally recognised in the trade that estimating for decorations pure and simple is not an easy task; and in dealing with an ornamental *ceiling* the governing authority must, indeed, be "wide awake" to obtain results financially as well as artistically successful. So much depends upon the actual experience and ability of the craftsmen employed, since, however able the employer, the practical execution of his own designs would be a commercial impossibility. But given, on the part of an employer, the designing and directing powers, in conjunction with a trained faculty for colour, and, on the part of his workmen, the aforesaid zeal and ability: then the stencil process may be productive of charming but inexpensive ceilings.

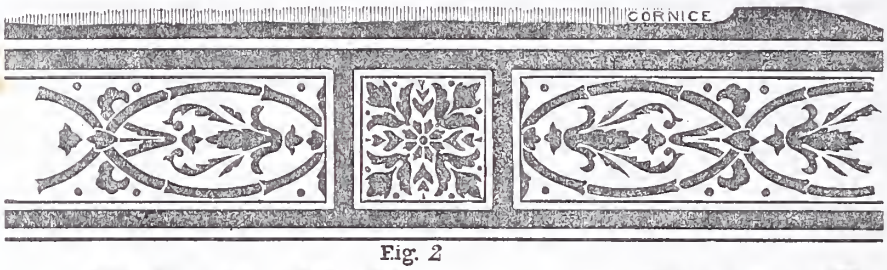


Fig. 2

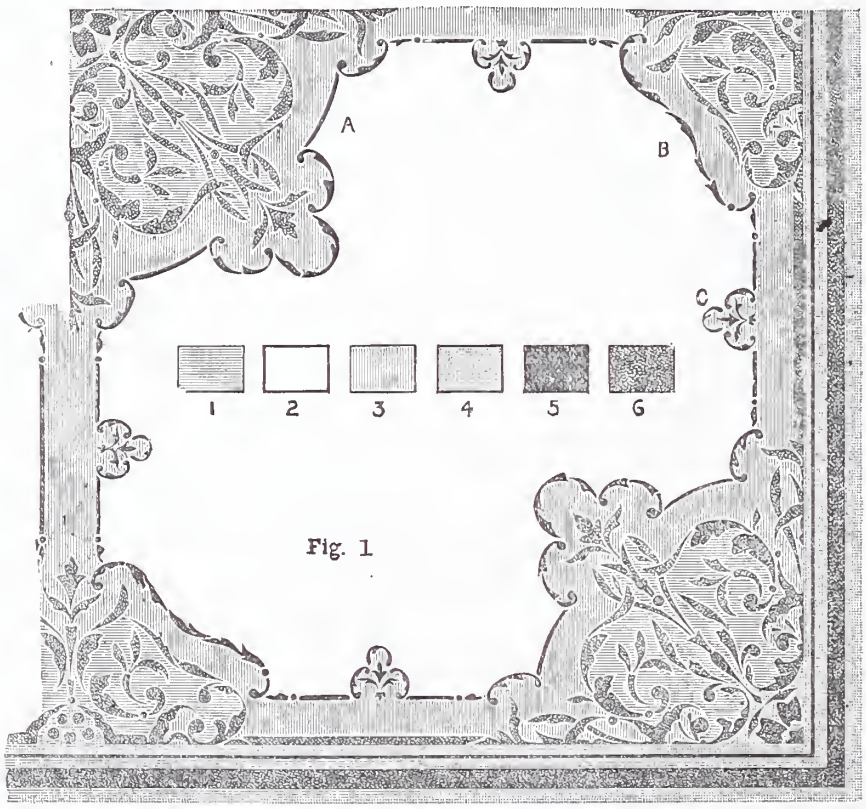


Fig. 1

Ceiling Decoration. Fig. 1.—A, Corner and Central Ornament; B, Large Break; C, Small Inner Break. Fig. 2.—Outside Stile with Stencil Border and Patera; for use on large Ceilings, in conjunction with the same Ceiling Design. Colours represented:—1, Light Electric Blue; 2, Ivory White or Cream; 3, Pinky Buff; 4, Deep Cream; 5, Bright Red; 6, Old Gold Colour.

The accompanying design will give point to my dissertation, since any smart and careful craftsman could be trusted to execute it, in *tempera*, upon the flat of a good-sized room in a couple of days. The advantages of this simple treatment are numerous. The adaptability to a ceiling of any reasonable shape or size, the scope for a little effective colour display without "lowering" the apparent height of the room, and the inexpensive means of covering or connecting the whole surface, are all practical points worth studying; whilst a dozen different variations of the one theme could well be executed in colour harmony with their respective apartments, and yet without any two of them being noticeably alike. Whatever the purely artistic shortcomings of this class of design, or of the ornament herewith submitted, its practical advantages have been fully established in connection with the work for which it was recently designed, and where it was satisfactorily executed by a careful and experienced journeyman.

Now a few notes to assist any ambitious amateur reader of WORK in the execution of my design. Upon the accompanying page we have disconnected corner ornament in simple stencil effect of black and white. It will be found, on reference to the *connected* design, that the corner has been so drawn that four sections of it will join

up into a pleasing centre ornament—thus answering the double purpose of corner and centre. To draw this ornament, which I have shown at about 1½ in. to the foot, take a piece of drawing-paper large enough for the *whole* corner. Take point A, at the extremity of line A B, as a centre, and mark off the curves at every 6 in.; now divide the corner or angle, C D, into four equal parts, and connect each with point A. By this means any worker with a very limited talent for drawing can enlarge these small designs to working size, since, with so many points fixed for us, each bit of ornament is easily placed in its particular and corresponding division. Having drawn in correctly the half of the corner, mark over the outline with charcoal, fold it over at the central line, and rub an impression of the charcoal on the opposite half. Now pencil over the charcoal duplicate, and the corner is complete. To transfer it to the cartridge paper for stencil cutting, rub the back of design with dry powdered blue or red, pin the drawing - face upwards, with the cartridge-paper beneath it, to a smooth table-top, and mark over the design with a hard wooden point. I have explained this well-known process for the benefit of the learners and younger readers, and, inasmuch as the directions for drawing the corner apply to the other ornaments, it is well worth the space it occupies.

Ceiling Decoration. Fig. 3.—Plan for making Stencil.

Let us now assume the worker has a set of the stencils marked A, B, and C, and wishes to operate on a ceiling in the quickest and most economical way. In such an instance, the ceiling can be finished with a decided cream tint all over. The four corners may be stencilled on in "old gold" colour of ornament (No. 6), and light blue (No. 1) outer fine line and break. The large side-breaks being put in also, and the centre chalk lines snapped across the middle of the ceiling, we can now stencil in the centre and join up the margin lines with the old gold and blue. By referring to the connected sketch, it will readily be seen that the ornament, if used in this simple way, will not appear so large as when used with the coloured stile. An ordinary room ceiling worked on these simple lines is but a summer day's work for a good workman. Let us now take the more elaborate treatment I have given for a little explanation. To make my estimate of "one man, two days"—a correct one for this—other stencils and aids are necessary. We require a thick paper or card template cut to the outer edge of the small outer ornament, and a stencil for putting in the blue and pink (see colour key). To make the latter, stencil the ornament on to a second piece of cartridge, and then cut out the background, but *leave a ½ in. space between the two colours of pattern and background.* The horizontal lining shows where the blue stencil is cut to, and the down lines the space requiring to be pink.

The methods of execution are almost identical in all variations, but where the pink stile is used we cannot ground the ceiling all over with cream, as in the previous instance. First take the template of the extremes of corner and break, tack each to the ceiling, and mark around the curves with a blacklead; treat the centre in the same way, and then connect all these with the straight lines. We have now divided the ceiling into panels and stiles. Now tint in the cream panels, and put in the straight bands of the pink stile. Next stencil in the ornament with No. 6, and No. 5 for fine scrolls. When all is complete of this portion, take the background stencil, and put in the blue and pink. The joining together of the margin and fine stile lines completes the work, as shown. Tint No. 4, a full cream, I have put outside the ornamental work as a simple stile, with 1½ in. line of stencil colour. This latter feature will be very useful where there is no plaster cornice; otherwise it would not be called for. Figure No. 4 (in black and white) is a suggestion for an ornamental stile. For a large public or semi-public room the coloured treatment suggested by connected design would alone scarcely be sufficiently ornate, since it must be remembered that the plain space between every corner and break ornament would be *much more in proportion than appears with the design.* I should, in such a case, carry a stile of old gold all around the ceiling, next the cornice, making it much fuller in colour and slightly greener than No. 4 tint and 1 ft. in width. At the corners and centres the square pateras would be introduced; the stile stencil border (running *outwards* from the middle of either side), as well as the wide marginal lines, would be best stencilled in a medium terra-cotta shade, and the fine inner line a soft blue tint.

As before stated, any ceiling colour scheme must depend, first, upon the nature and use of the apartment, and then upon the decorative treatment of the room in its entirety. The colours here given require somewhat careful balancing, and would not suit for a room having but little colour on the walls. But whether worked out in self-colours, different shades of creams, soft terra-cottas, or even grey upon a cream ground, the display will be well worth the labour. Let the doubters remember that in such a case it is better to err upon the side of simple and quiet colourings than to get doubtful colour combinations. The tints suggested with the connected drawing will correspond to those on the present "Alabastine" sample card in the subjoined order: No. 1 = tint 9; No. 2 = 17; No. 3 = 4; No. 4 = tint 7, darkened with a little dry umber; No. 6, for stencilling, I recommend to be made from white lead, turpentine, and Japan gold-size in equal parts to working consistency, then stained with a little yellow

ochre in oil and blue to a soft but decided old gold colour. It will be found that this "flatting" paint works much better for stencilling with than would water-colour. No. 5, a soft full red, used only for lines and ornament separating the cream panels and pinky stile, should also be made of white flatting stained with a little vermilion or Venetian red. I hope that any of WORK's readers finding a difficulty crop up will duly seek advice through "Shop" corner.

BOTANY AMUSEMENT.

STUDENTS of botany who desire to preserve permanent impressions of leaves of trees and plants can do so in the following simple manner:—At any druggist's get a pennyworth of bichromate of potash, and put it in a 2 oz. bottle of soft—that is, rain—water. When the water has dissolved as much as it will of the potash, pour off the clear liquid into a shallow dish. On this float a piece of ordinary writing-paper till it is thoroughly saturated. Let the paper be hung on a piece of string in the dark until it gets nearly dry, when it should be in colour a bright yellow. On this put the leaf, and under it a piece of black cloth and several sheets of newspaper. Put these between two pieces of clean window-glass of the same size, and hold them together with spring clips, similar to those used for holding letters or bills, which can be purchased at about 1d. each. Expose to a bright sun, placing the leaf so that the sun's rays will fall upon it as nearly perpendicular as possible. In a few minutes it will begin to turn brown, but it requires from half an hour to several hours to produce a perfect print. When it has become dark enough, take the paper and immerse it in a dish of clean water, which must be changed every few minutes, until the yellow part becomes perfectly white. The print can then be mounted into a scrap-book.

ELASTIC MOULDS.

THE best material to use for elastic moulds, very frequently required in the arts, is glue or gelatine. Good fish glue will answer the purpose in many instances as well as gelatine, and has the important advantage of being cheaper. The material is dissolved, like glue, in a vessel placed over the fire in a pot of water, being stirred during the process. To each pint of the material it is necessary to add $\frac{3}{4}$ pint of water and $\frac{1}{2}$ oz. of beeswax. The material is ready for use when about the thickness of syrup. The pattern or model from which the mould is to be taken must be carefully oiled with sweet oil, and then the composition is poured upon it while warm, but not boiling. After having time to set, it is taken off the model. In using the moulds thus made, when the model is small, it is well to keep it in the hands, which gives facility for shaking the mould while the plaster is poured, so as to drive it well into the crevices. The plaster used should be fine; and in order that it may harden and set quickly, about $\frac{1}{2}$ oz. of alum should be added to each pint of water used in mixing it. Before using an elastic mould, it should be carefully oiled. Great care is also required in mixing the plaster and watching it when in the mould, for if it be allowed to remain long enough to heat the mould, the latter will be destroyed.

EASILY MADE FOLDING TABLE.

BY J. THOMPSON.

THIS little table will form a very ornamental addition to the furniture of a drawing-room. It is not difficult to make, and when folded, only occupies a space of 8 in. in width. It is intended to be painted with enamel paint, the tint being chosen to harmonise with the furniture in the room. The best material for making it will be a piece of dry well-seasoned birch.

Fig. 1 is a side elevation of the table, showing half of one flap folded. Fig. 2 is an end elevation, showing the table folded. The height is 2 ft. 1 in., and the diameter of the top is 20 in. The top is formed of three boards, the centre one being 6 in. broad, and the two sides, or flaps, 7 in. broad and $\frac{3}{4}$ in. thick. They should be planed level and gauged to thickness. The edges must be planed straight, and the three boards fixed together by two temporary backs. Then mark out the circle, cut the edges to the mark, fix it on the face-plate of a lathe, and turn the edge, forming a small quarter-round moulding on the top side. If a lathe is not available, the edge can be finished square, cutting it with chisel and rasp, and finishing with glass-paper.

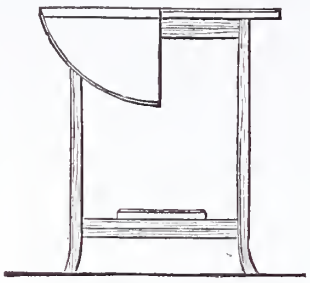


Fig. 1

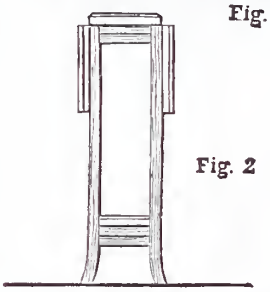


Fig. 2

Fig. 3

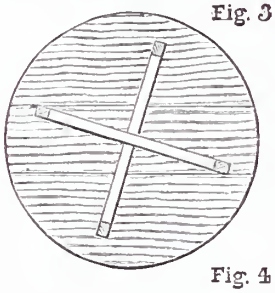


Fig. 4

Fig. 1. — Side Elevation of Table. Fig. 2.—End Elevation of Table. Fig. 3.—Plan of Under Side of Table-top open. Fig. 4. — Plan of Under Side of Table-top folded.

The legs and frames are 1 in. square, the lower end of the legs being curved outwards. These can all be cut from one plank by a bow or keyhole saw. Then dress them up, gauging them to one size, and take off the sharp arris at the corners. The four pieces for frames must be made the same size. The legs are framed together 16 in. wide outside, the joints being mortised and glued. The mortises are $\frac{3}{4}$ in. deep, and the tenons should be accurately fitted and the joints glued. Pins may be put through; but if the tenons are well fitted they are not necessary. The rails in one frame are made to fit just under those of the other frame, the bottom rail being $3\frac{1}{2}$ in. from the end of the legs, and the top one close under the table-top. It will be better to make the legs of this frame a little longer at the top and cut them off when the joint is dry.

The two sets of frames are fixed together in the centre by a screw passing from the top frame into the bottom one, a thin iron washer being inserted between them. The screw-heads must be countersunk, so as to be clear of the table-top, and the small stand fixed on the lower frame. This stand is 8 in. diameter, turned and moulded on the edge similar to the top, and is fixed to the frame by glue and screws passing upwards through the frame. One set of legs is then glued and screwed to the under side of the table-top (as shown in Fig. 4) in an angular position, the screws passing upwards and about $\frac{1}{2}$ in. into the top, so that they are not seen. The heads must be countersunk, so as to clear the lower frame. The lower frame is arranged to open at right angles to the upper one (as shown in Fig. 3), and must have a stop to prevent it opening any further. It will be noted, by referring to Fig. 3, that when in this position the flaps will be held up by the frame. I omitted to state that the legs of the lower frame must project upwards to the same height as the others, to hold the flaps level when open. The flaps are fixed to the centre part of top by brass hinges. These must be let into the edges flush; they are fixed on the under side, and are not seen when the table is open. A stop will also be required to prevent the frame closing further than shown in Fig. 4. Before fixing the frames to the top, the frames must be carefully smoothed at the joints with a plane set very fine, and the top and the whole must be finished as smooth and level as possible, as the smoother it is finished the better will be the appearance when painted. It should have three coats of enamel paint of approved colour; a painted or stencilled ornament may be applied to the top, if desired.

WATCH AND CLOCK CLEANING AND REPAIRING.

BY A PRACTICAL WATCHMAKER.

REPAIRS.

To Tighten the Hand Work. — It sometimes happens that when a watch is cleaned and put together again, the hands are *too easy*. Thus, the watch itself may go all right, but the hands occasionally lag behind and make it appear to a casual observer as if it had stopped and gone on again without anyone touching it. To remedy this the set-hand-arbor, which passes through the hollow arbor of the centre wheel, must be tightened. The safest way to do this is to hold it by the square in the pin-vice, and resting the arbor upon the boxwood in the vice, trace several burred rings around it with a hard steel edge, such as a graver or square burnisher edge, upon the part which fits into the centre-wheel. If the cannon pinion only is loose upon the centre arbor it may be tightened by taking a hair from the watch brush, and passing through the pinion before pushing it on. Afterward the projecting ends of the hair must be broken off short with the tweezers.

To Repair the Winding Work. — In Geneva watches, which have seen much wear, and especially those which were never carefully made in the first instance, the ratchet teeth are found very often to be partly worn off, and the point of the click which engages with them in the same

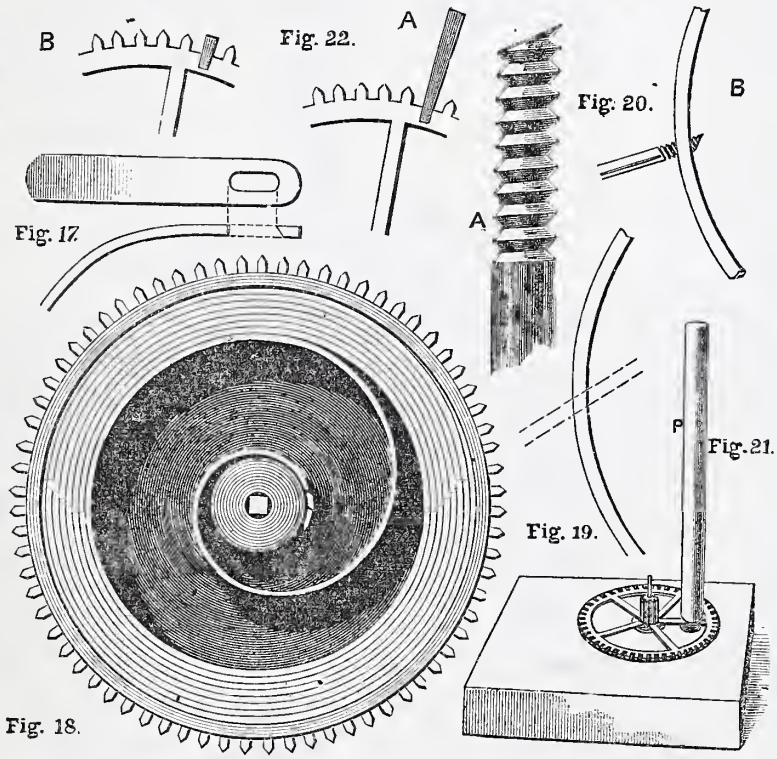
condition. In these circumstances it is liable to fail, and run back in the hand during the act of winding, and endanger the mainspring and other parts of the watch. In a ¾-plate watch, the remedy is easy. Holding the ratchet in the sliding tongs (brass-nosed if you have them), a triangular file must be applied carefully to file up the teeth to their right shape again, after the manner of a saw sharpener. The click is then to be filed up with a suitably shaped file, and both replaced, when the evil will be cured. In a bar watch, the ratchet and click must be served in the same manner; but on putting it together, it will probably be found that the click will no longer reach the ratchet teeth. To make this right, the brass of the bar must be carefully reduced on the edge with a flat file, till the click spring lays in close. In filing, the bar is held in the fingers, and rested upon a piece of cork in the vice. When this is done, the brass cap which covers the ratchet will probably require filing up also. In filing up clicks, be careful to leave the parts which engage with the ratchet teeth as smooth as possible.

To Fit a Mainspring.—After taking the watch apart, take out the old spring, and break a small piece off (about ¼ in. long). Stand this piece up in the barrel against the side, to see if the old spring was of the right width. The top of the spring should be *nearly* level with the bottom of the groove into which the barrel cover snaps. If correct, obtain another spring the same width and thickness (they will gauge this for you where you buy the spring), and proceed to wind it in the barrel to see if it is of the right length. This can be ascertained by the fulness of the barrel when the spring is in. When the spring is in the barrel, and unwound, it should occupy rather more than one-third of the space between the rim of the barrel and the edge of the arbor when in position. The outside end of the new spring must be shortened till it fulfils this requirement. This done, hold the extreme end of the spring (about ⅛ in.) in a flame till it assumes a dull red, and let it cool again. This has the effect of softening the steel. Place the spring over a hole of the steel stake, and, taking a punch rather smaller than this hole, punch it through the spring. Enlarge this hole with a broach, and elongate it in the direction of the length of the spring with a small round or square file. Then bevel off the edge which catches on the barrel hook to a knife edge, so as to hold better, and finally round up the end nice and smooth. It can then be wound in and oiled properly.

Fig. 17 shows the shape of the hole in the spring to hold properly on to the barrel hook. Fig. 18 shows a mainspring in a barrel, from which the correct length may be judged.

If, on taking off the barrel cover, the outside end only of the spring is found to be broken, and the break is not more than one inch from the end, the same spring can be used again, especially if it is in good condition. A mainspring is said to be in good condition when it opens out nicely when taken out of the barrel, and lies flat. If cramped, it indicates a soft spring. But it seldom happens that a spring breaks so near to the outside end. If the inside "eye" of the spring breaks, no attempt should be made to use it again, and nine springs out of ten break near the "eye" when they go.

To Put in a New Barrel Hook.—This is a repair frequently required, especially in those watches not provided with stop-work. In some common watches various "dodges" are seen in place of the hook and hole in spring. If any such is present, discard it, and proceed to punch a proper hole in the spring, and put in an ordinary barrel-hook. It is a great mistake to put in a steel hook, under the impression that it gives extra strength. A well-made brass hook will outlast many steel ones.



Watch and Clock Cleaning and Repairing. Fig. 17.—Shape of Hole in Spring. Fig. 18.—Mainspring and Barrel. Fig. 19.—Direction of Hole for Hook. Fig. 20.—Shape of Hook. Fig. 21.—Trueing a Wheel—P, Punch. Fig. 22.—Putting in a Tooth.

If the old hook is not already cut off or pushed through, proceed to cut it off quite level with a sharp knife or graver. Having done this, with a pointed chamfering tool carefully dot a centre for the hole, and selecting a drill rather smaller than an ordinary pin, drill the barrel through in a slanting direction, as in Fig. 19. Then with a tap carefully cut a thread in this hole, being most careful to work easily, and not break the tap in. To work a tap easily, after each half-turn in, turn it a quarter back, to free it and allow the oil to flow; also keep it well supplied with oil. When tapped, take an ordinary brass pin (these are good hard wire), cut off its head with the nippers, put it in the pin-vice as before described, and taper *slightly* and smoothly till the end just enters the hole in screw-plate corresponding to the tap used. Then keeping it well oiled, cut a good full thread upon it. Try this in the hole in barrel, and if correct, and a tight fit, cut off the superfluous brass and shape it as shown at A (Fig. 20), and make it such a length that when screwed up home and quite tight into the barrel, it is like B in the same Fig. Then with a peg clean out the oil from the hole, wipe the brass pin, and finally screw it in. Up to this point it is still held in the pin-vice. Now release it, and with a slitting file cut it off flush outside, and finish with a smooth file, taking care not to injure the barrel teeth. The hook should project inside the barrel little more than the thickness of one coil of the spring.

To Tighten a Barrel Cover.—Sometimes, when a spring breaks, the shock expands the barrel, especially if the latter is thin, and the cover will no longer snap on tight. In such a case take the stake figured on p. 357 (Fig. 9), screw it in the vice, and with the hammer gently tap the edge of the cover on the under side, hitting it flat. Hold the cover in the left hand flat upon the stake and slowly revolve it, giving perfectly even blows all round. This will spread it, and leave no marks if carefully done.

To Repair the Stop-work.—In ordinary Geneva watches, if the stop-work goes wrong, take off the star-wheel and screw, and discard it altogether. But be careful, in the case of the bottom barrel pivot running in a hole in the plate, to keep on the stop finger, or the square on the arbor will surely cut the bottom pivot-hole large, and cause the barrel to run out of truth and foul the plate or the centre-wheel. In watches where this precaution has been neglected, and the hole has cut badly, the centre of an old English minute-hand, or anything else having a square hole which can be made to fit the arbor, can be placed upon it as a protection, and prevent further cutting.

To Straighten a Pivot.—Hold the wheel in the fingers of the left hand up to the light, and revolve it. This shows the extent and direction of the bend. Then in the right hand take the brass-nosed pliers, and grip the pivot firmly, using the eye-glass, and bend it straight. This is the safest method I know, and seldom breaks the pivot. Avoid all hammering or pressing with steel tools.

To Straighten an Untrue Wheel.—Run it in a pair of callipers or in its pivot holes, and make a slight mark on the arm next to the bend, say where the rim wants bending up. Take a piece of boxwood, and make a hole in it to accommodate the pinion or arbor so that the wheel may lay flat on the wood. Also make a slight hollow under where the centre of the arms comes. Place the wheel in such a position that the arm next the place where the rim requires to be bent up is over this hollow, and take a round-faced punch and give the arm a gentle tap. This has the effect of raising the rim. Repeat till correct. Fig. 21 shows the arrangement. This method can be safely applied to all wheels, including steel 'scape wheels and

balances, though in the latter cases a brass punch must be used, and very gentle taps.

To Replace a Broken Tooth.—Take a square file and reduce the stump of the old tooth level with the wheel; then, with the slitting file, cut a notch exactly in the centre, and a trifle wider than the tooth. Where possible, cut this notch of a depth equal to the height of the tooth. This done, file up a brass pin flat on both sides till it pushes tight down to the bottom of the notch. Then with a little killed acid (the merest touch) moisten inside the notch and on the pin, place a minute dot scraped from a stick of solder on the place, and gently heat over a spirit lamp flame or with a blowpipe; it will run in solid. It is then like Fig. 22, A. Cut off the brass pin and file level with rest of teeth on edge, as at B; flat it down nicely top and bottom, and burnish with the burnisher gently, and then carefully shape up the curves with a fine "side" file. The tooth can then hardly be detected from the rest.

If a barrel tooth is broken, the safest way is to drill a hole, and screw in a steel pin, afterwards shaping up as before. In this case, soldering in a brass tooth is hardly safe, though the steel pin does not look so nice. If a 'scape-wheel tooth is broken, do not tinker it up—get a new wheel.

To Bush a Pivot Hole.—In the course of wear, especially in common watches, the pivot holes wear large, and cause the wheels to rock, and possibly foul the plates or the other wheels. To remedy this, procure some "bouchons" from the material shop. Select one which fits on the pivot tightly, and screw it in the pin-vice. Take a broach and carefully open out the old pivot hole, keeping it quite upright, till the small part of the "bouchon" fits tightly; then tap it in gently till the end just comes flush with the plate, or cock, on the other side, and with a sharp bend break it off close. It is cut round, nearly through, for that purpose. A slight tap with the face of the hammer or a punch, to bruise it a little on each side, prevents it coming out. This done, gently turn a small pivot broach round in the new hole till the pivot goes in easily and drops out with its own weight. Give it as little side shake as possible to be free. This applies to a brass hole of a third, fourth, or 'scape wheel. If it is a centre wheel or barrel hole that wants bushing, a different method is resorted to. In a very common watch that is not a particular job, the hole may sometimes be closed by going round it with a "botching" punch—a punch with a round face—and afterwards broaching the hole out smooth to fit the pivot. This, however, is truly a "botch," and is not recommended. Better proceed as follows:—Broach the hole out as large as convenient, and slightly bevel off the edge on both sides with a round chamfering tool. Get a piece of large brass wire and file down to fit the hole. Cut it off on both sides and file it flat, then with the round-faced hammer or a punch, rivet it in well, and finally smooth off level. The old hole will then be filled up with solid brass. It must now be re-drilled. The possessor of an uprighting tool or a mandrel can do this easily, quickly, and correctly, by centring from the other hole, with the plate or bar screwed in position, and bringing down the top or back centre, as the case may be, upon it. The repairer who has neither of these useful appliances can take a pointed chamfering tool, and centre it as nearly as possible by the circumference of the piece of brass he riveted in. This, as a rule, can be done very nearly correct. It must then be carefully drilled and opened out to fit the pivot.

The above reads like a formidable task, but in reality is very soon done, and makes a good sound job.

NEAT CASE FOR PLAYING CARDS.

BY W. D.

I FANCY that a great many readers of WORK will be fond of a game at cards. We cannot be always at work; we must play sometimes, and no doubt a game of whist, nap, twenty-fives, etc., adds to the enjoyment of the home fireside when the evenings are dull and dreary.

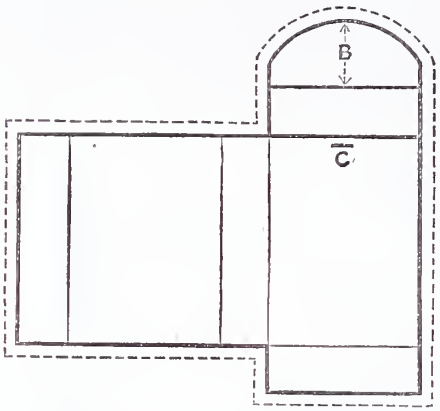


Fig. 1.—Leather-covered Card-case. Heavy Lines indicate Cardboard; Light Lines, Scoring for Folds; Dotted Line indicates the Leather.

I have many a time been asked to make one of a party for whist, and not unfrequently, when the cards were produced from a drawer or a corner of a shelf, have I heard, after the host had counted them over, the remark, in a rather injured tone, "I say, my dear, there are some of these cards lost. Look if you can find the rest; they must be there!"

It is a pity when such a thing happens; the evening is sure to be spoiled; someone loses his or her temper, and the visitors have an uncomfortable evening, which, with a little care and trouble, might have been otherwise. I do not want to blow my own horn, but when I produce my pack it is always complete, for the simple reason that I keep them in a case—a case covered with leather, with my name in gold letters on the front.

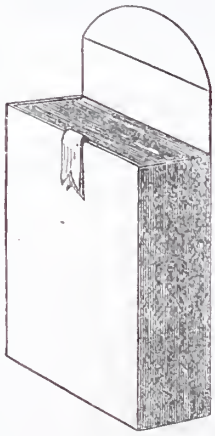


Fig. 2. — Perspective View of Case with Flap open.

As this case was made at home, without the aid of any special tools, I will now proceed to give instructions for making a similar one.

The first thing which is required is a piece of Bristol board or cardboard, about two-sheet thickness. The cardboard could be had a fancy colour, or it might be lined with a fancy paper, but I think that a plain white surface is quite fancy enough; indeed, I think that it is to be preferred, as it will harmonise with any colour of leather which may be used for the outside of the case.

The size of the cardboard will depend upon the size and thickness of the pack of cards. My pack measures exactly $3\frac{1}{2}$ in. × $2\frac{1}{2}$ in. × $\frac{3}{4}$ in.

The easiest manner to arrive at the exact size is to take a piece of paper, such as a sheet of note-paper, and lap it round the cards, which should be held tightly and evenly in the hands in the meantime. It should be folded over at top and bottom and rubbed with the fingers, and afterwards cut out with the scissors to the shape given in Fig. 1. The plain line shows the paper, and is half the size of my own pack.

Now cut the cardboard to the heavy lines in the figure; this will give the case with the bottom. The flap shown at B, with the double arrow running through it, must be cut separately. When this is done, turn the card over and mark off with pencil and straight-edge the light lines in the figure; these should be carefully drawn from the paper shape, with the aid of compasses or dividers. When marked out satisfactorily, take a sharp penknife and place the straight-edge close to the line and draw the knife gently from top to bottom, allowing it merely to cut the skin of the board; or, in other words, to "score" it, as we say in the trade. When scored it should fold up easily, the sides and bottom just meeting nicely. The flap piece must be cut to shape with the scissors.

A piece of silk ribbon or tape, about half an inch broad and about three times the length of the case, should now be procured. The colour should be chosen to harmonise with the leather. Make a cut at C with the knife, taking care that it is in the centre and about half an inch from the top; pass the end of the ribbon through the cut and glue it down to the cardboard—half an inch will be enough to hold it in place. Before cutting out the leather see that the glue-pot is boiling and that the glue is in good condition.

The best leather for the purpose is what is known in the trade as paste-grain roan. Of course, any thin leather will do, but this is to be recommended, as it is easy to work, has the appearance of morocco, and if a little care is taken it will be almost impossible to detect the joints.

The colour of the leather will be according to taste, but I would suggest dark purple. Cut out the leather from the paper shape, one-eighth of an inch larger every way (see dotted line in the figure).

When the leather is cut out it must be pared thinly and very carefully round the entire edge. This may be done with a penknife, but it will be much easier if the operator has a shoemaker's knife. A piece of glass or a smooth flat stone will also be required. Lay the leather upon this and work the knife from the body outwards. The aim should be to have the leather pared for one-eighth of an inch all round. The leather should now be glued all over on one side with good warm glue; it need not be very thick—rather, I should say, it must be thin.

When glued lay it flat upon the table, glued side uppermost; upon this lay the cardboard with the scored side down, being careful to have the one-eighth of an inch margin even all round. Now turn it over and rub the leather down with the hand. This done, turn over again, pack the ribbon out of the way, and bring the two sides together neatly, and turn down the one-eighth of an inch margin, rubbing it well with the fingers to make it stick. Turn up the bottom in the same manner. Next turn in the margin at the top of box, making a

little cut at the corners to make it lie neatly. Now drop the pack of cards into the box, lay the small piece of cardboard flush with the top of the box, and bring over the flap, rubbing it down; throw it back again and turn in the margin. This must be all done quickly, as the glue will soon dry.

Cut another piece of leather to cover the flap and joint, and to extend one-eighth of an inch into the box. This must fit nicely inside the flap, and, of course, must be pared round the edge. Make a small cut at the top edge of the flap through the leather, and pass a small piece of ribbon (doubled) through, and glue down the ends inside. Now glue the piece of leather and lay it neatly inside the flap, and make sure that it sticks well all over. The box or case is now finished, as far as making is concerned, and should be set aside to dry.

When it is dry, a line should be marked round the edges about one-sixteenth of an inch in. This could be done with the back of a table knife slightly heated, and a straight-edge to work against. While doing this the cards should be inside to make it solid, otherwise the sides of the case would be apt to fall in when a little pressure would be applied. It should now be varnished with shellac varnish.

In use the ribbon is drawn out and laid over the top, the cards are dropped in all at once, and the ribbon is taken by them to the bottom, leaving one end hanging out. This is laid over the top of the cards, then the flap is brought over and tucked in between the cards and the side of the case, the little bit of ribbon standing upright. The cards are now perfectly tucked into the case, free from dust and dirt. To take them out, the little piece of ribbon is first drawn outwards; this opens the flap. The large piece of ribbon is now drawn out. As it comes out the cards rise, and can be drawn out or allowed to drop upon the table.

I hope I have made the whole thing clear enough, and that those who try to make the card-case will succeed. It is much neater than a pull-off case, and is more easily made.

WRINKLES.

Ink for Marking Bales.—Take gum arabic, 10 lb.; logwood liquor (specific gravity 1·37), 20 fluid ounces; bichromate of potash, 2½ oz.; water sufficient to dissolve the bichromate of potash. Dissolve the gum in 1 gallon of water; strain, add the logwood liquor, mix, and let the mixture stand for twenty-four hours; then stir in rapidly the bichromate solution, and add a little nitrate of iron and fustic extract. If too thick, thin down with hot (not boiling) water.

Magnesia Cement is made by digesting fluorspar for some time in sulphuric acid, adding magnesium sulphate, and stirring calcined magnesia into the mixture. The cement thus made sets very hard, and is not affected by water. Articles made of it are pressed and dried by exposure to air or heat.

A new Tin Alloy for connecting metals to glass is formed of 95 parts tin and 5 parts copper. The copper is poured into the molten tin and stirred in with a wooden mixer, and the alloy afterwards re-melted. It adheres strongly to clean glass, and has nearly the same rate of expansion. It may also be used for coating other metals, and, if required, rendered more fusible by adding 1 per cent. of lead.

IMPROVED BOLT-HEADING MACHINE.

This has been patented by Mr. William H. Betts in America. A box at the upper end of the hollow column, as seen in the sectional view, contains the bolt-holding dies, preferably of steel, and having on opposite sides grooves, terminating at one end in a square shoulder and at the opposite end in recesses, so that they are adapted to form either a flat head or a head to fit a countersunk hole. These dies serve as an anvil, and

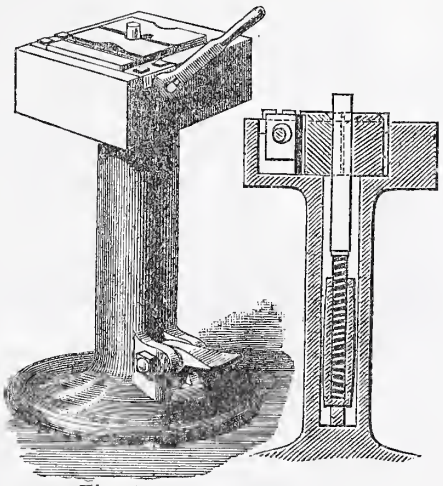
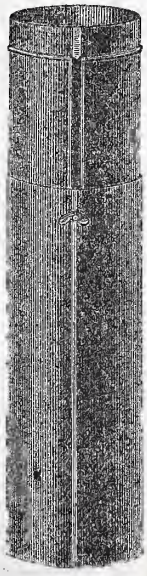


Fig. 1 Fig. 2

Fig. 1.—Bolt-heading Machine. Fig. 2.—Sectional View.

when the bolt projecting through them has its head formed, the end of the bolt is hammered down upon the upper faces of the dies. The bolt extends down and rests upon the head of an ejecting plunger, adjustable to fit bolts of different lengths, the lower end of the plunger resting upon the inner end of a treadle lever. Within the box, at one side of the dies, is a binding block mounted on a cam shaft, having a hand lever by which the shaft may be turned to force the block against the dies to hold them firmly in place. The treadle mechanism is necessary, as the bolt when inserted hot between the dies is inclined to stick.

TELESCOPIC STOVE-PIPE.



Telescopic Stove-pipe.

We illustrate herewith a novel form of stove-pipe. It is called a telescopic stove-pipe, and consists of two joints of pipe, one fitting in the other, the inner one having a slot so constructed that a bolt, compressed or loosened by a thumb-screw on the outer pipe, holds the inner pipe at any height. When the inner pipe is fully pulled out, two joints of pipe are formed, one only being formed when the inner pipe is pushed to the bottom. Any intermediate length may be added at will, and the pipe is especially so adjusted that no smoke can leak out.

SCIENCE TO DATE.

Nitric Acid from Air.—When an electric spark is made to pass in a closed vessel containing air, the amount of nitric acid formed quickly reaches a limit which is small, but if the air is caused to move by drawing a current of air through the vessel, the amount of combination may be made to reach 10 per cent. It has been suggested that, by the use of high voltage discharges in air, nitric acid may be produced even on a manufacturing scale.

Trisulphide of Boron.—Moissan has devised several methods for the preparation of trisulphide of boron. It can be prepared by the direct action of sulphur vapour on pure boron at 1,200° C.; also sulphuretted hydrogen gas acts on boron at a high temperature, forming this substance. Boron trisulphide burns in chlorine gas with a green flame, producing perchloride of sulphur and boron trichloride, and reacts energetically with most metals. Sulphur in fusion dissolves it. Nitrogen has no action on it, and it may be distilled in an atmosphere of this gas.

Phosphide of Mercury.—At the ordinary temperature phosphorus has no action on mercury, nor do they combine even when heated together in open or closed tubes. But Granger has found that if a halogen compound of phosphorus is used—such as the iodide, for example—then a reaction takes place, with the formation of iodide of mercury and phosphide of mercury. By washing the product of the reaction with potassium iodide, iodide of mercury is removed, and the phosphide is left in the form of fine crystals, metallic in aspect, having the composition Hg_3P_2.

"Nitro Metals."—The "nitro metals" are a new class of compounds recently discovered by Sabatier and Senderens. They have found that reduced copper absorbs in the cold the vapours of nitrogen peroxide, heat being disengaged during the process. The product is a maroon-coloured compound, the composition of which is represented by the formula Cu_2NO_2. This is nitro-copper. A similar compound has been obtained with cobalt. Nitro-copper reacts violently with water, giving off nitric oxide and yielding a green liquid containing copper nitrate mixed with a little nitrite. A residue of almost pure copper is deposited at the same time.

NOTES FOR WORKERS.

The fusing point of an alloy is generally lower than that of either of its constituents. Gold alloyed with 10 per cent. of aluminium follows this general rule, but when the aluminium is increased to 20 per cent., the resulting brilliant ruby alloy has a fusing point above that of gold.

The first overhead telegraph wire in France was erected in 1793 by M. Claude Chappe, to whose honour a statue is to be erected.

Soap and water, to which is added permanganate of potash or oxalic acid, is harmless to the hands and the best disinfectant there is.

Major Moore has had built a flying machine, on the model of the flying fox, and driven by a 3 horse-power electric motor.

A very handy grooved wheel for many purposes may be made by soldering two penny tin plates back to back.

A handy mallet may be made with the boy's discarded wooden horse by fixing one of the legs in the centre for a handle.

Girls' steel knitting needles (four a penny at the draper's) make small drills for a twisted brace. The handles of the girls' skipping rope, being bored right through, are handy also.

By placing the ends, in turn, of disused condensed milk cans on a hot plate to melt the joint, you may remove the remaining portion with an old knife; then melt the body seam the same way, and you have a handy piece of tinned plate, 9 in. by 3 in. It is best to clean the cans by soaking inside and out first.

Some 140 families emigrated from Manchester and Bradford about thirteen months ago to Brazil. The unhealthy climate, swamp fever, and other hardships caused the death of many heads of families, and the destitution and penury of the others. Some have been assisted back again, and the first detachment arrived here in a pitiable condition.

The largest known roof on a permanent structure is that of St. Pancras Station (M.R.), which was opened for traffic in 1868. Its total length is 690 ft., and its breadth is 245 ft. 6 in.

NOTICE TO READERS.

Next week's contents of Work (No. 189) will include :—

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How to Make a Rain Gauge.
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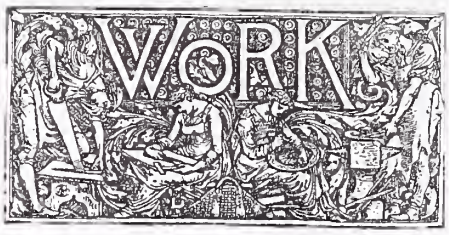

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Prominent Positions, or a series of insertions, by special arrangement.

*** Advertisements should reach the Office fourteen days in advance of the date of issue.

*** All letters suggesting Articles, Designs, and MS. communications for insertion in this Journal will be welcomed, and should be addressed to the Editor of Work, Cassell and Company, Limited, London, E.C.

Indian Metal-work.—In the centre of a dark and deserted district will be found the Imperial Institute. This noble, but at present unfinished, building has been partly thrown open to the public, at a charge originally of 1s., now 6d., per head. The attraction is a small exhibition of Indian metal-work, and to those interested in that class of art productions it is well worth the price paid for admission. Many of the articles are unique. Specimens of Jeypore enamel can be seen in perfection, and the one matchless vase of Jade, encrusted with rubies and emeralds, is—along with the spoon (whose bowl is made from an emerald)—worth all the trouble of a visit. We note with pleasure and approval that most of the articles have clear and bold labels attached—a detail of great importance this to those who have few sixpences to spare for the purchase of a catalogue.

Utilisation of Natural Forces.—We are surrounded by evidences of natural forces. Our earth maintains a well-balanced and well-regulated motion around the sun and on its own axis by the force of attraction. Whether magnetic or not has not yet been proved. In its passage it receives light and heat from the sun, and electric force is developed in its atmosphere. The force of gravitation holds terrestrial objects in position against contrary centrifugal force. Gravitation gives weight to the mobile element named water, and the movement of this element from a higher to a lower level in rivers furnishes us with a source of natural force. Yielding to the force of attraction exerted by the sun and moon, the waters in oceans and seas rise and fall in the form of tides, which also provides another natural force. The atmosphere of the earth is also always in motion, as the air expands under the influence of solar heat or contracts in cooling. This gives us the force of wind. During the progress of his civilisation, man has learned to utilise some of these forces and bend them to his will. The movements of the winds and of the waters have been specially useful to him in the past, and there is great promise of their extended use in the future. In the past, the movement of water from a higher to a lower level in rivers and streams has been utilised by means of overshot, undershot, and breast water-wheels to turn and work machinery in mills and factories built on the river banks. The introduction of turbines has extended the use of this natural force, but it has been circumscribed by locality, as there has been no means of conveying this source of power to a distance from rivers, except by conducting the steam itself in conduits across country. With the invention of dynamo-electric machines for the generation of electricity, the possibility of conveying the electric current at almost any distance from the generator, and transforming it through an electro-motor into mechanical movements, the field of usefulness for natural water-power has been widely extended. Already we read of towns being electrically lighted with current obtainable from dynamos driven by turbines actuated by the falling waters of distant rivers, and there is no reason against the extension of this practice. As the current may be used for this purpose, it may also be extended to other purposes in which electro-motors can be utilised. Our enterprising cousins on the other side of the Atlantic even talk of laying the waters of Niagara under tribute for power to be conveyed to the Chicago Exhibition! By the use of high-speed dynamos generating high tension alternating currents at the source of power, and transformers at the other end to transform the high-tension current to one of lower tension and larger volume, it is possible to transmit electric force through light conductors over a wide space. Very little has hitherto been effected in the utilisation of tidal forces, but we think a future may be in store for these when broad platforms, furnished with suitable rockwork machinery, may be made to communicate motion to dynamo-electric machines, or undershot water-wheels be made to turn by the incoming and outgoing tides. The power thus obtained could be stored in accumulators and used as required for lighting and for driving electro-motors. The force obtained from the movements of the atmosphere must always be variable and uncertain, but it is as possible to get electric power from this source as from any other natural force. If windmills can be used to grind corn they may also be used for pumping water into reservoirs to be alternately used in driving turbines, or in driving dynamos to charge accumulators. Perhaps the former method of utilising this natural force would be preferable, since the variable current obtained from a wind-driven dynamo would not be the best for charging accumulators. Whether it will ever be possible to utilise the enormous quantities of high-tension electricity annually exchanged between celestial and terrestrial regions is a problem at present unsolvable, and entirely outside the range of practical science. The collection is so variable, and the period of discharge so uncertain, and also the pressure of the accumulated electricity so fitful, as to make its utilisation appear unmanageable. Perhaps some future electrician may yet discover a means for quietly drawing the charge from earth and cloud, and storing it in manageable apparatus.

BENT IRON WORK, AND HOW TO DO IT.

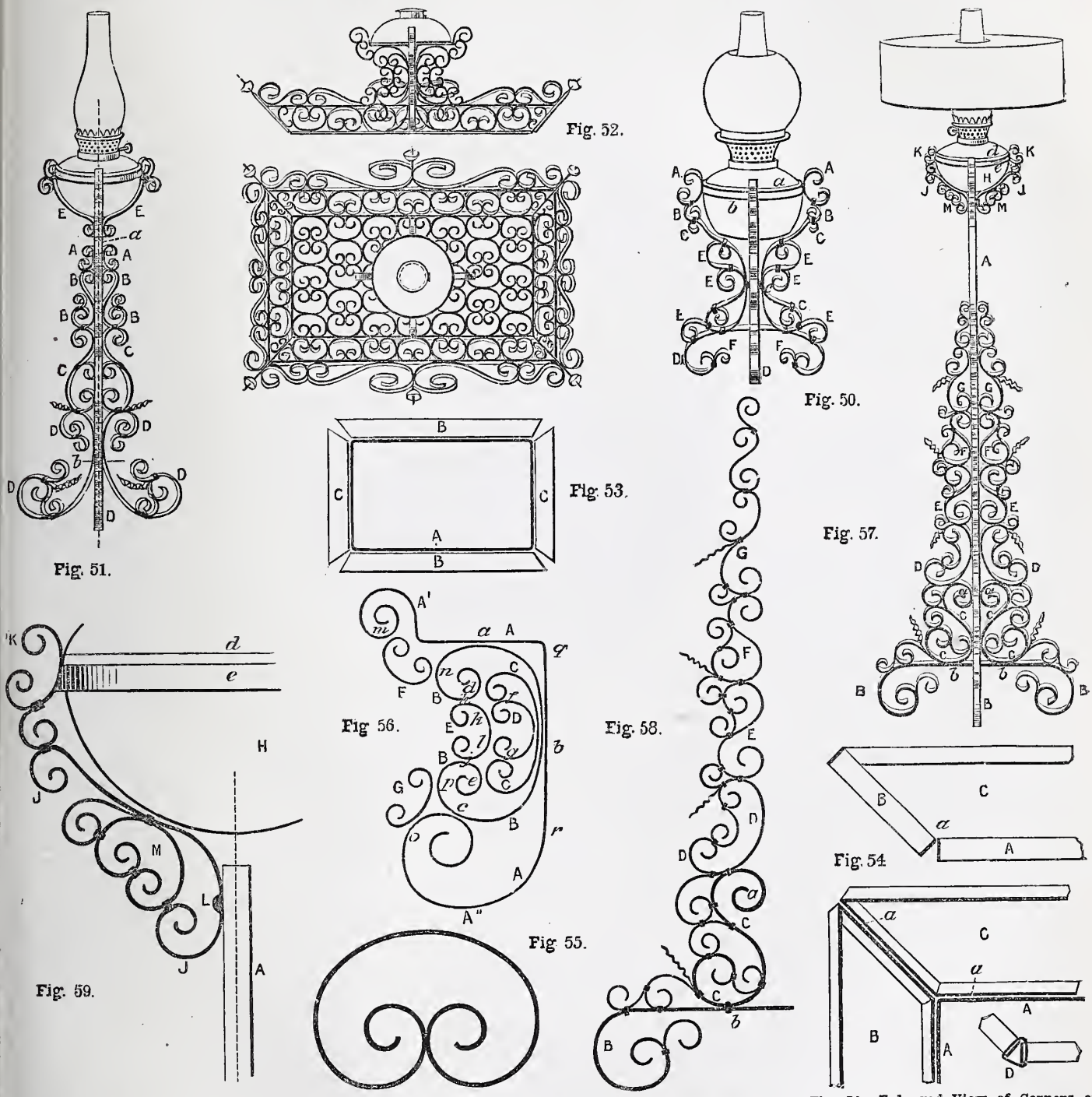
BY J. H.

LAMPS.

LAMPS—A TABLE LAMP—ANOTHER TABLE LAMP—INKSTAND—THE FRAMES—THE CURVED WORK—THE SUPPORTING CURVES FOR THE INKPOT—A FLOOR LAMP—ITS DETAILS—THE BOWL AND ITS SUPPORTS.

A Table Lamp.—Fig. 50 illustrates a simple mounting for a table lamp. There is a rim, *a*, round the bowl, and underneath this, and embracing the bowl closely, there is a ring of thin iron, *b*, of ⅜ in. in width. This ring should be bent, and soldered or brazed, with ends lapping, say, to the extent of ⅜ in. or ½ in., and the joint neatly filed. To this ring the first scrolls, A, are fastened, each other, and riveted or soldered at the centre, where they cross. Small curves, F, F, may be added or omitted. The main series of curves being secured to the ring B above, and to the curves D, D below, it is only necessary besides to stiffen the central part by introducing a ring at *c*, binding the curves to it with wire.

Another Table Lamp.—A stand differently



Bent Iron Work. Figs. 50 and 51.—Table Lamps. Fig. 52.—Inkstand. Fig. 53.—Main Frames separated. Fig. 54.—Enlarged View of Corners of Frames. Fig. 55.—Enlarged View of Scroll. Fig. 56.—Enlarged View of One Series of Supporting Curve. Fig. 57.—Floor Lamp. Fig. 58.—Enlarged View of Scroll-work. Fig. 59.—Enlarged View of Iron-work round Bowl.

Lamps.—There is scarcely a limit to the tasteful ways in which common lamps can be mounted. Glass lamps sometimes come out of their seatings, the cement giving way. Or they can be taken out and mounted in bent iron. But it is better to make use of copper bowls, because there is always some risk of cracking the glass in the work of mounting.

with wire crossing at the joint. There may be three or four sets of scroll-work. I have shown four in the figure. The continuation of the scroll-work is in detail as follows:—A short curve, B, fastened with a clip to A; a long curve, C, reaching from B to the foot D, and fastened to B and D; short curves, E, E, E, fastened with clips to C and to D. There are two double curves, D, crossing constructed is shown in Fig. 51. The lamp is taller, and the thin iron is supported with a central rod, *a*, of $\frac{5}{16}$ in. or ⅜ in. square. To this there are attached four series of scroll-work; the main scrolls are A, B, C, D. There are also minor scrolls and tendrils. The rod *a* terminates at *b*, below; at the top it ends close beneath the bowl of the lamp. The bowl is enclosed with

four scrolls, E, fastened with wire to the encircling ring, and riveted or soldered to the top end of the rod *a*.

Inkstand.—A combined inkstand and tray is shown in Fig. 52. There is a good deal of work in it, but it forms a fitting companion to one of the table lamps, mounted in bent iron.

The Frames.—First there are the main frames, five in number. These are made in thin strips. They are all bound together so effectually with each other and with the curves, and there is practically no weight upon them, that there is no need at all to make use of stout iron for them. The frames are made by bending the thin strips to the proper angle, which is not important, so long as the angles of all are alike. Fig. 53 shows the bottom frame, A, the side frames, B, B, and the end frames, C, C, separated, and laid down flat. The union of each frame can be made either at one corner or about the centre, by riveting, brazing, or soldering. In Fig. 54 one corner of the frames is shown enlarged and slightly separated, in order to render the method of their union clear. It is seen that the frames do not come into contact throughout the whole width of the iron strips, but only at the keen corners, *a*, *a*. To make them meet, the strips would have to be set to a bevel, which would be a troublesome job; and more than that, the curves that are fitted within the side and end frames, B and C, would have to be set to a corresponding bevel. The binding together of the frames and curves will make a perfectly rigid job, even though there is contact only along the edges. The frames are fastened together with clips, as shown in section at D (Fig. 54).

The Curved Work.—Now all the interspaces of the frames are filled up with curves of the form shown enlarged in Fig. 55. At every point of contact with each other and with the frames a clip is placed. There is no need, however, to show these in the figure. Also all round the top edges of the outer frames scroll-work is fastened, the scrolls being attached to each other and to the top edges of the outer frames. At the four corners, flowers of iron or copper are inserted.

The Supporting Curves for the Inkpot.—The inkpot is supported upon four series of scroll-work, each series being set at a right angle with the series adjacent. A single series is shown enlarged in Fig. 56, with the component curves slightly separated. There is the main curve, A, upon the top horizontal portion of which the inkpot is supported, while the curving upward at its termination, A′, confines the inkpot, and prevents it from sliding off sideways. This main curve is too weak in itself to carry the weight of a large pot of ink without yielding. Both for support and ornament, therefore, a number of minor curves are fastened to it and to each other, and arranged in such fashion that they afford mutual support. The large curve, B, is clipped to A in three places, *a*, *b*, *c*, but the clip *b* is not put on yet. The next curve, C, is fastened to B at *b*, *e*. The next curve, D, is fastened to C at *f*, *b*, *g*. At this stage a clip is fastened round A B C D at *b*. Then curve E is fastened to B at *h*, *j*, and to D at *k*, *l*. Finally, the curves F, G, are fastened respectively to A and B at *m*, *n*, and at *o*, *p*. The four series of curves are now fastened together at right angles with two stout clips at *q*, *r*, around a central square rod. Then the portion A″ of the curve A is fastened to the bottom curves of the tray, with which it comes into contact, with crossing wire or with solder.

A Floor Lamp.—A floor lamp is shown in Fig. 57. These lamps have hitherto been mostly made in forged iron or in brass; but bent iron opens up a new sphere of decorative mounting for them. The ornamentation may either be wholly in bent iron, or partly in iron of stout section and partly in thin strips; the latter being preferable by reason of its superior strength.

Its Details.—In Fig. 57 the central pillar, A, must be stout, not less than $\frac{1}{2}$ in. square. It is riveted at the bottom to the two crossing curves, B, B, made of iron $\frac{1}{2}$ in. × $\frac{1}{8}$ in. The curves C, C, made of stout iron of similar section, are riveted to A at *a*, *a*, and to B at *b*. Thus a good foundation is laid for a firm and steady stand. The upper work may be of thin iron wholly. The main scrolls are D, E, F, G. These are firmly bound to the central pillar, A, with clips, made to embrace at once the four corresponding scrolls that lay against the four faces of the bar. I need not figure the minor scrolls nor the tendrils, but Fig. 58, which illustrates a single series, shows the way in which each series is built up. Clips, of course, will be employed at all points of contact.

The Bowl and its Supports.—The lamp bowl, H, is of copper, provided with the usual beading, *d*. A ring of iron, *e*, fitted underneath and around this, supports the bowl; and the scrolls J, K, carry the ring, and are fastened at L to the pillar, A. This particular work may be of thin iron, but it is better to use that of stouter section, as $\frac{1}{2}$ in. × $\frac{1}{16}$ in., or $\frac{3}{8}$ in. × $\frac{1}{16}$ in. The lamp bowl will be steadier than if carried by thin strips. A single series of these curves is shown enlarged in Fig. 59. The two curves J and K are riveted together, or else secured with clips. If difficulty is experienced in making a firm job of this union, then substitute a single curve for the two. The principal point to be noted here is the union of the four curves, J, to the pillar, A. These curves are brought down a considerable distance below the end of A, say a couple of inches, so that two rivets can be got in to unite them firmly. Two rivets will pass through from side to side at, say, 1 in. or $1\frac{1}{4}$ in. centres, to hold the curves which come upon opposite faces, and two will pass through from the other sides at right angles with these at the same centres; but, say, $\frac{1}{4}$ in. above or below the others, to hold the remaining two curves. The long open space is then filled in with a small scroll, M.

LABOUR AND CAPITAL MEN.

MR. GEORGE LIVESEY.

Mr. Livesey acquired more than a mere local reputation towards the end of 1889. It was then that the gas-stokers of the South Metropolitan Gas Company, of which Mr. Livesey is the chairman, struck work and entered upon the bitterest struggle known in the conflict between labour and capital. The position that Mr. Livesey was compelled to take up through the struggle must have been extremely distasteful to him. On the one hand, he was represented as the most uncompromising foe of the worker; while, on the other, he appeared to capital as the best fighting man that had yet arisen on its side. He was denounced in unmeasured terms by the labour party, and he was lauded to the skies by the opposing party. In his own heart, however, he would have preferred, had circumstances permitted, to appear in quite another *rôle*—viz., as the friend of the worker.

This is Mr. Livesey's true position in the labour world, and only the blinding spirit of partisanship can represent him in any other light. He recognises the severe lot of the worker, and is willing to promote whatever scheme may seem to his judgment sound and likely to meliorate that lot. It is in profit-sharing that, in his opinion, the solution of our industrial difficulties lies, and for the wider acceptance of this view he has used the influence of his strong character and high position. Nay, more, he would go the length of allowing workmen, when possible, to sit on the boards of directors, and so have a voice in the management of undertakings that they are now interested in as mere wage-earners. Thus much has Mr. Livesey stated as a witness before the Royal Commission on Labour, of which he is also a member; and when a man in his position, representing a company that sometimes employs over 3,500 men, says even this in public, he must be prepared to make concessions to labour that capital is not habitually given to make.

It was these expressed views, revealing, as they do, a rather interesting attitude, that induced us to make further inquiry into Mr. Livesey's treatment of his company's *employés* and into his opinions upon aspects of the labour question generally. In passing, we may state that he was born in London and practically brought up in the gas works, where his father was secretary and manager. In 1848 he himself entered the service of the company, became its engineer in 1862, secretary as well as engineer in 1871, director in 1882, and chairman in 1885. In 1888 he offered a site and building to the Camberwell parish for a public library, and in October, 1890, the Livesey Library was opened. In Greenwood's "Public Libraries" we read that, "at the opening of the library, the donor stated that Camberwell had been more or less his parish for half a century, that he had received much kindness at the hands of working men, and that, having enjoyed some prosperity, he held it to be his duty to do something to brighten their lives. He had accordingly given them a public library." Mr. Livesey is also a prominent temperance reformer, and is sometimes afraid that higher wages and increased leisure will mean to too many men more drink. However, the present position he is assured cannot last, and a way must be found for making the interests of labour and capital identical.

There must be a real partnership between capital and labour, and a fair division of profits between the two—that is his belief; and to make that partnership as real and the division of profits as fair as possible, he is prepared, as we have already said, to have labour represented on boards of directors as well as capital. Just now it is capital only that is represented, and it is in this respect that profit-sharing schemes, so far as they have been adopted, are so one-sided. No capitalist before has made so generous a claim as this for labour, and curiously, it comes from the man who, more than any other, has been held up by certain organs of the Press as an inhuman suppressor of the rights of labour.

There are difficulties in the way, however—"practical difficulties," to use Mr. Livesey's own words. First of all, Mr. Livesey is afraid that, though he individually is in favour of labour representation on boards of directors, capitalists generally are very far from being so minded. Many an employer may, from prudential motives, be quite willing to grant his men a percentage of the year's profits. It is not a difficult thing to do that; it is often a very wise thing, inasmuch as it offers an inducement to the men to so work as to make the profits as large as possible. It is a very different thing, however, for an employer to take his men into his confidence and his counsel, and, in the absence of perfect trust between employer and employed, an impossible thing. In the condition under which businesses are now conducted, it would be in the power of the men to wreck a business when their knowledge of it was as minute and entire as their master's. Another difficulty lies on the side of the men.

With their present methods, Mr. Livesey is of opinion that the representatives they would appoint would most likely be the best talkers. So far there seems to be ground for this apprehension. In the labour movement the men that

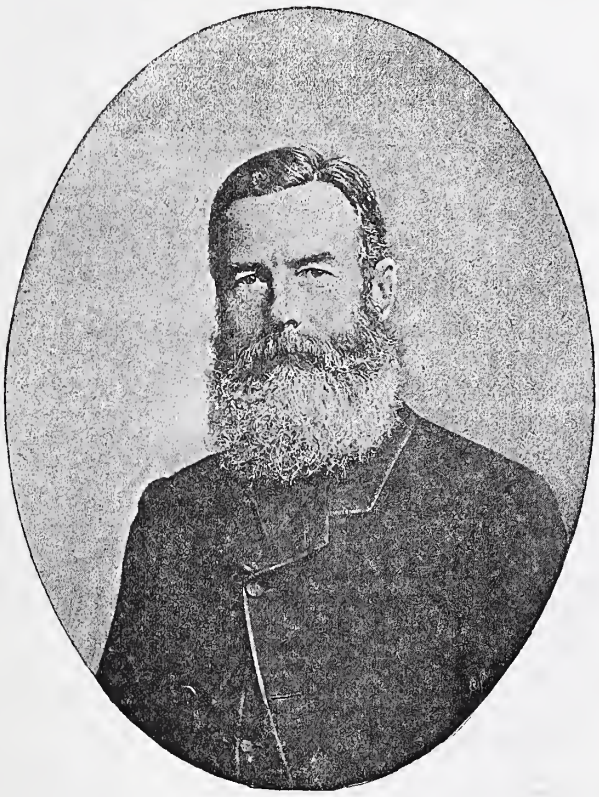
have been placed in the lead seem to be those that are gifted with the power of expression. This process of selection is, however, not confined to the labour movement. We find it in politics. To rise to distinction in that sphere, a man must be able to make a good speech. Perhaps too much importance is laid upon this point, and perhaps we might be better served if there were less necessity for so much talking. The best business men are not necessarily the best speakers, and the best men to represent any interest on a board of directors are the men of business capacity. Another difficulty emphasised by Mr. Livesey lies in the fact that employers by having their capital invested in the business are absolutely bound to stick to it. Workmen, on the other hand, may be under one employer to-day and another to-morrow. They are thus chiefly interested in present prosperity and in present large profits, which may be distributed to the future detriment of the concern.

The employer, again, in consequence of his capital being locked up in the business, is in a position different from the workman, who is far more free to leave at any time that suits his purpose. "The workman's interest, in fact," to use Mr. Livesey's own words, "is to get as much out of the business in the shape of present profit as possible, whereas to do so in some cases might prove detrimental. For instance, the plant might suffer, and its future earning power be diminished, if too much profit were taken out. It is, therefore, the interest of the proprietor to spend a sufficient portion of the profit of the business in keeping the plant and everything connected with it up to the mark, so that its future earning power may not be impaired. One way of getting over this difficulty is to require, in the case of, say, a gas company, that the men's representative be also a shareholder. The qualification of an ordinary director is the holding of a considerable amount of shares, and the same rule might well apply to the workmen; though, of course, the qualification must be much lower, but sufficient to prove their practical interest in the concern."

These are the "practical difficulties," in Mr. Livesey's opinion—what may be called the fear of the capitalist that the men might betray him, strengthened by prejudice and a want of a proper method of selecting representatives—that stand in the way of placing the keystone on any profit-sharing scheme—viz., labour representation on the board of management.

The foregoing is the length that Mr. Livesey would like to be able to go; we shall now point out how far he, or rather, his board, has gone. In the South Metropolitan Gas Company's Act of 1876 there is a curious clause, whereby the dividend payable to the shareholders increases as the price of gas decreases. Being of the nature of monopolies, gas companies, like railways, have by the Acts incorporating them been restricted to the payment of dividends at the rate of not more than 10 per cent. This hard-and-fast rule with the development of these huge concerns is apt to become embarrassing and to impede their financial working. Accordingly, Mr. Livesey hit upon a device which is embodied in the Company's Act of 1876, and which is the basis of the profit-sharing scheme in operation amongst the company's *employés*. By this the standard price of gas is fixed at 3s. 6d. per 1,000 cubic feet, and when gas is at this price the company may pay 10 per cent., the standard rate of dividend. For every penny above 3s. 6d. that is charged for gas a reduction of $\frac{1}{4}$ per cent. must be made from the dividend. Thus, if gas be 3s. 7d., the company may pay no higher dividend than $9\frac{3}{4}$ per cent.; if 3s. 8d., then only $9\frac{1}{2}$ per cent.; if 3s. 9d., then only $9\frac{1}{4}$ per cent.; if 4s., then only $8\frac{1}{2}$ per cent.; and so on, the highest dividend payable decreasing $\frac{1}{4}$ per cent. with every increase of a penny to the price of gas. With every penny taken off the price of gas, then $\frac{1}{4}$ per cent. may be added to the dividend. If gas be 3s. 5d., the dividend may be $10\frac{1}{4}$ per cent.; if 3s., $11\frac{1}{2}$ per cent.; if 2s. 6d., 13 per cent.

Thus it is to the interest of the shareholders to lower the price of gas as far as possible. It is also, of course, to the interest of the consumer, who benefits under this scheme to the extent of £5 for every £1 paid in the shape of extra dividend to the shareholders. Under this sliding scale, thus established by Act of Parliament, no recognition is taken of the *employés*, who have thus no special concern in the price of gas. To remedy this defect, the directors, in October, 1889, offered the workmen a share in the profits in the form of a percentage on their wages, and to be calculated on the principle of the sliding scale, the percentage to rise when the price of gas falls and to fall when the price of gas rises.



Mr. George Livesey.
(*From a Photograph by Elliott and Fry.*)

The starting-point in the profit-sharing scheme is 2s. 8d., and for every penny taken off the price of gas from this point 1 per cent. is added to the wages of the *employés* for distribution amongst them. During the last two years the price of gas has been 2s. 3d., therefore the percentage payable to the men has been 5 each year. It thus becomes to the men's interest to produce the gas as economically as possible, and this is in accordance with the interests of the general public and the shareholders. By care the men's interest might become very great, for they can leave their bonuses in the hands of the company to accumulate at the rate of 4 per cent. compound interest. There are other aspects of this scheme that we should like to treat upon, but must defer doing so for a later number.

Up to the end of June, 1891, the amount divided amongst the men under the scheme was £22,909 14s. 1d.; and the highest amount received by an individual is £33; many have received between £20 and £30, and an average amount is £14. About half of the total credited to the men at the end of each June is withdrawn during July, the remaining half being left in the business.

The next sketch in this series will be Mr. Thomas Burt, M.P.

TRADE: PRESENT AND FUTURE.

Ivory Trade.—The Sheffield ivory cutlers are working short time, but there is activity in the pearl trade.

File Trade.—In Sheffield the file trade is improving.

Tool Trade.—There is little doing in saws and shipbuilding tools.

Metal Trade.—The price of copper has been irregular, prices varying between £43 11s. 3d. and £44 16s. 3d. Refined and manufactured sorts are steady, tough cake at £47 15s. to £48 5s.; best select, £49 to £49 10s.; Indian sheets, £52 to £53; strong sheets, £56; and yellow metal sheets, $4\frac{15}{16}$d. per lb.

Steel Trade.—The crucible steel trade in Sheffield has slackened. Common spring steel and octagons for India are in good demand, and there is a better inquiry for wire rods. The rolling mills are better employed. There is no alteration in the price of Bessemer material and hematite, and common forge irons remain unchanged. No business of any weight is being done in the Lancashire steel trade. Steel boiler plates continue to fluctuate in price, but rule at about £7 for best qualities, common at £6 15s., and tank plates at £6 5s.

Shipbuilding Trade.—Mersey shipbuilding yards remain inactive. At Barrow briskness has apparently come to an end.

Cotton Trade.—Operatives will resist the proposed 5 per cent. reduction of wages. Notices have been sent out by all the leading employers in the various centres, with the exception of Bolton. Our Rochdale and district correspondent writes:—The results of the last quarter's working have been declared by forty-four companies in the district during the past few days. Of these, seventeen announce a profit and twenty-seven a loss; only nine of the whole number have made sufficient profit to pay a dividend.

Gun and Rifle Trade.—The decision of the War Office, that all pistols of the Adams or Enfield pattern now in possession of the army shall be exchanged for those of the Webley pattern, which have interchangeable parts, has found Messrs. Webley & Sons, of Birmingham, employment for three years past. Already 24,000 weapons have been supplied. The contract is not expected to be completed for another year, although two hundred hands are daily employed in the manufacture of the revolvers.

Silver Trade.—Some of the leading Sheffield houses are fairly busy.

Cutlery Trade.—A German firm at Solingen has placed an order in Sheffield last week for 200,000 dozen pairs of fine pearl scales.

Watch Trade.—The watch industry has hardly known worse times. The Lancashire Watch Company have reduced their working hours to eighteen per week, with notice of a reduction of 25 per cent. on the wages earned. This the keyless hands resist. The English Watch Company (Birmingham) talk of entirely closing one or more of their departments.

Engineering Trade.—The Lancashire engineering trade is worse. Only about one-third the usual staff is employed, while several firms of machinists are working short time. Boiler-makers are not in quite so serious a position. Well-informed individuals do not expect a revival for two years.

Iron Trade.—Prices are firmer in the pig-iron branch, but only a small amount of business is being done. The manufactured iron trade shows no signs of improvement, while both iron and steel founders are necessarily feeling the lessened activity in the engineering trade. In the Midlands a much better tone prevails, and three extra furnaces have been set to work recently to meet the increased requirements.

SHOP:

A Corner for Those who Want to Talk It.

**** *In consequence of the great pressure upon the "Shop" columns of* Work, *contributors are requested to be brief and concise in all future questions and replies.*

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of Work *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given.*

I.—Letters from Correspondents.

£700 from a Work Notice.—Quid Pro Quo writes:—"Of course, Work is a trade paper. Its purpose is to pay its owners and to serve its supporters. I think no craftsman's paper ever published, either in England or America, so well fulfils its aims. I say aims; I mean, to give the highest forms of elementary and advanced instruction to its readers, as well as regain the initial outlay of its capital. I have left out Continental trade papers, where there are any published—few and far between—pretentious and fribbling writing, mostly, to be attributed to defects of language. All have passed under my purview in the course of forty years' professional and practical experience. I candidly put Work above all. Now, to come to my point. There is no doubt Work has done good by stealth, and deserves a stealthy return (I am dignifying an outcast term in our language). A gentleman recently remarked to me, '*I have got orders for £700 for my patent that was in* Work, and I never knew it had been noticed by one of its writers till shown it. Of course, I do not suppose all this came of the notice, but it must, undoubtedly, have done me good, and I will try and make some return for the unexpected favour. I should like a copy of the very accurate illustration of my invention, which took me by surprise when I first saw it.' As I was the writer and sketcher, unknown to the inventor, I told him that the electros of all the engravings in Work were for sale at Messrs. Cassell & Co.'s, and that he might buy them or even have his circulars printed by the firm, in a way to ensure satisfaction, at a reasonable price. He had not thought of it, so said he would adopt the idea, and it would be a *quid pro quo* that would still leave him under obligation to Work."—[We print this letter, and are glad to find that any sum approaching £700 has been made out of a notice in Work. From inquiries made, we find that the article referred to was the "Dividing and Revolving Flower-pot and Tub for Heavy Plants and Trees," on page 391, No. 181, of Work. This testimony should be gratifying to our readers and advertisers alike, as affording some indication of the influence of Work.—Ed.]

Book-keeping.—One in Doubt writes:—"A friend has told me that a knowledge of book-keeping is of more use to an educated girl than typewriting in working along in life, and the pay better. I constantly hear about book-keeping as one of the mysteries of figuring in account-books. Why should there be any mystery in these days of enlightenment? Is book-keeping to be made as obfuscating to a learner as chemistry or geometry, algebra or botany, are all made by the professors of those sciences, especially those who write books pretending to explain them to beginners? I know that every trade requires its own system of Dr. and Cr. account keeping, some very simple; for others, a single-entry system serves, while others, again, need a double-entry system. Now, there are numberless guides and A B C's to book-keeping that fail to help a beginner, but often disgust him at starting, by the writers trying to prove how clever they are—but they are not clever enough to write clearly and explain palpably what is so necessary to a starter in life, who wants to know how the balance-sheet proves the books to be correct, or the books prove the balance-sheet to be correct, and to readily test and find out any error in one or the other, if it appear. My experience has been with a large manufacturing firm with diversified products, and at times Government contracts; at others with a large estate, farms, pedigree stock, timber mills, and brick grounds, buildings, etc. In both cases large numbers of men had to be supervised, drawings made, stock inspected, machinery altered or newly designed, and the books balanced weekly, with comparative statements shown half-yearly. Now, this had to be done by one man, but it certainly was simpler than double entry, yet as correct as is that system. I have often wondered if the simple system adopted was better than the mysteries of book-keeping professed to be taught by books on the subject."

British Museum Gold Collection.—H. S. G. (*London, W.*) writes:—"It is to be regretted that the keeper of the gold ornament room in the British Museum does not prepare a popular handbook to the collection of gold ornaments he has in his charge. 'Early Christian Art in Ireland,' by Margaret Stokes, and 'Indian Arts,' by Sir George C. N. Birdwood, are the sort of books we mean. At present, the amount of information that a visitor can obtain is very slight indeed—in fact, it is restricted to what he can gather from some very small labels on the articles and from two-thirds of a page in the 'Guide.' This extravagantly generous treatment of the valuable collection works out, as far as space is concerned, to this: that for some fifteen show-cases, each one containing over fifty articles, space for description is given equal to half of one of Work columns. Such a state of affairs nearly, if not quite, spoils the good the collection might do from an educational point of view. While the handbook is in preparation, and as a small item on account, will it not be possible to give a little more space in the 'Guide,' if only four or five pages, such as is devoted to the engraved gems? From those few pages some information may be derived, if they are carefully written. One last word, and that is: This book will be for the use of young students as well as of the public. It ought not to be forgotten that technical education is increasing, and for that good purpose many of these books are required, in order to let the young workmen know what has been done in the old times."

II.—Questions Answered by Editor and Staff.

Drilling Machine.—Drill.—The Kinographic apparatus will, I think, suit your purpose. It is made by E. Hines, Norwich, and is arranged to work from a lathe. If you write him, he will, I think, supply you with what you require. If he cannot supply you, try Thos. Robinson & Son, woodworking machinists, Rochdale.—M.

Mixing Clay.—Workite.—I should think the machine will answer your purpose, but it may require the material to pass two or three times through to thoroughly mix the colour. If you write to Messrs. Smith, Powers & Co., Priory Works, Coventry, they will send you an illustrated price list, and tell you if it will be suitable for your purpose. If not, try Hartley, Arnous, & Fanning, California Works, Stoke.—M.

Bicycle.—No Name.—The shape of the frame is to a great extent a matter of individual taste; but, personally, I should prefer the Diamond frame. The same applies to the steering; but here, again, I would prefer the socket arrangement. I have a Diamond frame with socket arrangement, which has been in use three years, and is, practically, no worse. I should recommend you to have cushion tires. The pentagon frame is also recommended by some riders as the best.—M.

Sign Writing.—J. F. (*Leyton*).—Articles on Sign Writing appeared in Work, Nos. 1, 2, 4, 11, 13, 17, 19, 23, 30, 34, 39, 43, 44, 45, 47, 49, and 51.

Work.—J. S. E. (*Armagh*).—The price of Work in which the articles on the Quarter Horse-power Engine appeared (Nos. 106, 110, 121, 125, 131, 136, 141, 145, and 149), posted to Armagh, would be 1s.

Aquarium.—G. W. E. (*Armley*).—An article on an Aquarium and Fountain combined appeared in Work, No. 31.

Sewage Problem.—Idea.—Your views, if very concisely put, might find room in the limited space of "Shop." Thanks for warm approval and recommendation of Work.—Ed.

Cast Steel Forks.—Tom Doctor.—You do not say where your forks need repairing.

Incubator.—A. J. (*Leytonstone*).—I cannot tell you how to make a Mann's Simplex Atmospheric Incubator, having never seen one; but if you purchase Nos. 143, 150, and 151 of Work (post free, 4½d., from publishers), you will probably find something to your liking. If not, write again, and I will endeavour to help you.—Leghorn.

Incubator.—T. J. B. (*Heywood*).—Your plan for water supply is an improvement on my original method as given in my article in No. 143; but in No. 150, p. 731, Vol. III., you will see I have already published an arrangement on the same lines as yours for keeping a constant level in the evaporating tray, but much simpler. If you adopt this, your troubles will vanish. Am glad to hear you have been successful, and hope you will now have still better results.—Leghorn.

Harmonium Fittings.—R. B. (*Glasgow*).—Messrs. Dawkins, Charterhouse Street, Holborn Viaduct, London, supply the internal fittings you require for harmonium, and will give you particulars as to cost.—G.

Artificial Fly Making as an Employment for Women.—Fly.—Looking at the ordinary scale of payment for women's work, this may be considered as fairly lucrative, but the amount earned must, of course, depend on the skill and facility of the worker. In the chief centre of the fishing-tackle trade—Redditch—there are several places in which the art might be learned for a premium. But, as the young ladies mentioned by Fly seem to be in London, they may prefer to learn the art nearer home. In the suburbs of London there is a lady—one of the best fly dressers in this country—who, if I am rightly informed, takes pupils. Fly might, in the first place, communicate with Mr. Chas. Laigh, fishing tackle manufacturer, Redditch (mentioning this periodical), who would, if all matters seemed satisfactory, smooth the way for the intending pupils with this lady or elsewhere. It should be remembered that some natural aptitude is required for this art, and, before taking more expensive steps, it might be well for the young ladies to make sure that they possess it. They might get "Ronald's Fly-fisher's Entomology" (published at the *Fishing Gazette* office, Fleet Street, London), which gives thorough information in the *modus operandi* of fly-making, what feathers to get, etc., and by its instructions test their powers. Or they might do more than this. In the opinion of a practical tackle maker, a girl with a real turn for the thing might, from such a work as this, alone, and without lessons, gain sufficient proficiency to obtain profitable employment—which is to be found in London, Manchester, Redditch, and some few other places.—S. W.

Telescope.—Jupiter has a telescope with a 2 in. object-glass and, approximately, 34 in. focus, with an eye-piece 9 in. long, and wishes to know what is the highest magnifying power eye-piece, and what should be the power of eye-piece for general astronomical work. A local "Shoptician" (excuse the ancient joke) informs him that a power of 60 diameters would cost 15s., and that it is immaterial what length the telescope is as regards power. In reply, I will say, first of all, that the value, as a rule, of the local optician's opinion on matters optical is *nil*. They are watchmakers, who sell spectacles and absolutely know nothing of optics, and, even when they do understand the subject, one has to keep his wits working when doing business. Some time ago I was asked 20s. for a simple lens, which, afterwards, I got from Birmingham for 9d. As Jupiter concluded, the optician was altogether in the wrong with reference to the magnifying power of object-glass. The diameter of the object-glass has nothing to do with its magnifying power, but its length of focus everything; but the diameter is of equal importance, as that determines its light-grasping power. An object-glass of 48 in. focus will magnify with a given eye-piece twice as much as a 24 in. with the same eye-piece. Judging from the length of the supposed eye-piece—9 in.—I conclude that the telescope is not an astronomical one, and that the 9 in. draw-tube, with "an eye-piece at each end," is simply a tube carrying the eye-piece and also an erector. To determine this without taking the instrument to pieces, does the instrument show a terrestrial object in its proper position, or inverted? If the former, then it is intended for terrestrial work. For celestial work we want as much light as possible and to have as few lenses as we can work with, seeing that a measure of light is absorbed in passing through the glass. Jupiter asks, "What is the highest magnifying power eye-piece?" Well, there is no "highest power" limit; or, at least, the only limit is the power of the skilled worker. In a general way, 100 to the inch is as much as an object-glass will bear, seeing that whatever defect the object-glass may have, it, too, will be magnified. To determine the magnifying power of the eye-piece, its focal length must be multiplied into the focal length of the object-glass—for example, suppose the object-glass is 34 in. and the focal length of the eye-piece is ½ in., then, with such an eye-piece, the object is magnified sixty-eight times. "What is the power of eye-piece for general astronomical views?" This question can only be answered in a general way, seeing it is not definite in itself. For a general survey of the moon or the nearer planets, use the highest power your object-glass will admit; but for the distant planets or nebulæ, then a low power must be used, as we want all the light the object-glass can grasp. As to the price of an eye-piece, the optician spoke from a catalogue. I know a firm who advertise all powers at 15s. If Jupiter intends buying his eye-piece, I advise him to send the draw-tube, with the focal length and diameter of object-glass, to Lancaster, Colmore Row, Birmingham (I have no interest whatever in mentioning this firm beyond that I have repeatedly had work done by him, most satisfactory in execution and price), stating the power you need, and I think you will get what you require at a most reasonable price. Should Jupiter prefer making his eye-piece, he may find the information how to proceed on p. 598, Vol. III., of Work. It may be said, in passing, that often the eye-pieces sold are greatly exaggerated as to their magnifying powers. I think I have answered all the points in Jupiter's letter, but should any other difficulty arise, I shall be glad, if possible, to answer it in "Shop."—O. B.

Wood Letter Work.—A. S. (*Burnley*).—This subject awaits treatment in Work. If a capable worker who could write on the subject would communicate with me, I should be obliged.—Ed.

Dry Collodion Plates.—Jan and Shilling.—Any dealer ought to be able to procure the Hill-Norris collodion dry plate for you on your informing him of your requirements as to rapidity. Should you meet with any difficulty, write to the manufacturers—the Birmingham Dry Collodion Plate and Film Co., Ltd., Yardley. By the way, should you reside in Birmingham, Mr. W. Tylar would be able to supply you.—G. P.

Preserving and Mounting Birds and Fish.—J. H. (*Battersea*).—Ward & Co. publish a book on Bird Stuffing, price 1s. For Fish Stuffing, see Work, Vol. III., No. 117, p. 206.—F. H.

Oxygen Generators.—Oxy.—In reply to Oxy, I wish to say that I am preparing a short article on the subject, which will, I trust, meet his case. It will be in the hands of the Editor at an early date.—O. B.

Re-tinning Copper Pans.—J. E. J. (*West Witton*).—To re-tin copper pans, first of all you must get the grease off. To do this, light a fire of coke or charcoal—preferably the latter—and place each piece separately on it till all the grease is burnt off. If you use a forge, be careful not to blow too hard, and not to allow the goods to get red-hot. Some wash the coppers with a strong lye of soda and potash water to get the grease off, but it is not

such a good plan as the fire. The articles must next be well washed inside with strong spirits of salts, and afterwards rinsed with water; then scoured well with some "scale" from round the blacksmith's anvil, using a piece of carpet as a rubber. The articles must be well cleaned, or the tin will not adhere to them, but it is not necessary to get off all the old tin. It will be as well to finish scouring with a little sharp silver sand, using a handful of tow to rub with. After scouring, wash each piece well, and rub a mixture of salt and whiting over the outside; this protects the copper from the fire, and makes them easier to clean afterwards. The articles are then ready for the actual tinning, but before commencing several things must be got ready. Some pure tin must be run out in strips for convenience in using, some sal-ammoniac must be pounded in a mortar to a coarse powder, a piece of sheet iron should be bent round to the shape of the handle of a stew-pan, and made slightly tapering, so that it will slip on tight and leave a little at the end of the handle to catch hold of, as the handles get very hot whilst on the fire. A "tinning-rod" will also be required. A good form for this is a $\frac{3}{16}$ in. or $\frac{1}{4}$ in. rod, bent round at one end into a series of concentric rings till of a diameter of about $1\frac{1}{2}$ in., and at the other end a simple ring to hold it by. All may now be considered in readiness to commence. Slip one of the sheaths on to a handle, and place the article on the fire, blowing gently. Sprinkle a little of the powdered sal-ammoniac into it; take a stick of pure tin, and rub on the article enough to melt an inch or so of it; warm the tinning-rod in the fire, dip it in the powdered sal-ammoniac, and rub the tin well all round the article, turning it about on the fire to get all parts of it equally hot, and every now and then sprinkle sal-ammoniac in it. When tinned all over, warm it up, and then wipe the surplus tin out with a piece of tow. Wipe quickly all over before the tin "sets;" if it should "set" in any part before you have finished, it must be warmed up again. After tinning, scour up inside and out with silver sand, and polish inside with flour and outside with orocus powder.—R. A.

Phonograph.—W. H. (*Hartlepool*).—Articles on the Phonograph appeared in WORK, Nos. 167, 169, and 174.

Restoring Leather Couch Covering.—E. E. (*Northampton*).—An upholsterer would probably advise you to have the couch re-covered, for I believe the usual opinion is that any attempt to re-dye leather thus used will end in making matters worse. A correspondent of WORK, however, told us some time since that he had used Jackson's varnish stains for this purpose with good results. If you should not make his plan succeed, you might at least freshen up your faded leather with white of egg or a very little thin French polish brushed lightly over; or with one of the "kid revivers" sold at boot-shops.—M. M.

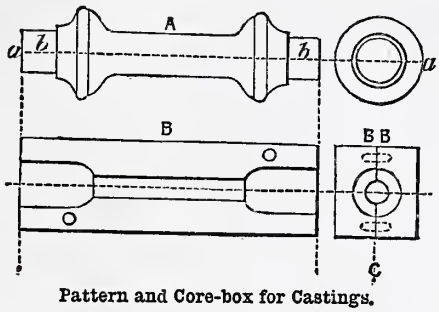
Rubber Brake.—FROST.—Rubber to rubber does not make a satisfactory connection when applied as a brake. There is too much adhesiveness, and the action of the brake would be a sort of jumping, not a sliding, motion. Suppose such fault did not exist? Your design would have to be altered as regards the rubber plugs, as the pull on them would be so great that they would be wrenched out of the case. Your Fig. 4 should be made to grip in the turned-in lips, with a hole through them for the rod, same as the plates in your Fig. 3. A brake such as shown would collect all the mud behind it between, and seriously impede the action of it. The reason the present spoon brakes cut the tire is not the fault of the spoon, but the hole left unplugged in the tube which forms the rod passing through the spoon. When the brake is applied the rubber bulges up into this hole, and the forward motion of the tire cuts little round pieces out of it, the edge of the hole acting as a knife. If riders would plug this hole neatly with hard wood or iron, and file smooth with the spoon, they would save their tires from this cutting. The latest brake, and one which does not cut the tire, is a piece of 1 in. tube, filled solid, or nearly so. It is about $2\frac{1}{2}$ in. long, and has the rod screwed into the middle of its length. When in position, it lies *across* the tire. While it "brakes" the wheel effectively, it, from its shape, allows small stones or other hard substances to pass under it, or diverts them to one side, without hurting the tire. Some makers cover the spoon with a thick piece of leather, which is better than the bare spoon.—A. S. P.

Triplet Safety Cycle.—J. W. N. (*Glasgow*).—The triplet safety is made by Rudge, Coventry. The machine is very fast on the road, but difficult to steer on a racing path. J. W. N. can see one of these machines in Smith's Cycle Warehouse, Wellington Street, Glasgow.—A. S. P.

Air-compressing Pump.—A. W. (*Aberdeen*).—An air compressor may be made as a piston pump with light indiarubber valves over "grid" seatings, but much depends upon the speed at which you wish to run the pump, and the pressure to which the air is to be forced. In compressing air you raise its temperature, and in some cases it is necessary to water-jacket the pump-barrel. I do not know what particular class of pump is used for the Wells light. If you write to any makers of air-compressing machinery they will give you prices and advise you. Messrs. Richard Schram & Co., 17A, Great George Street, Westminster, S.W., have a large trade in air compressors. Messrs. Tannett Walker & Co., of Leeds, also make such machinery, and there are many others, whose names you can find in a trade directory. The pressure gauge used with air compressors shows pounds pressure per square inch as a rule, but this is marked on the gauge, for some are made to show pressure in inches of mercury, and others in inches of water.—F. C.

Electric Tricycle.—W. S. (*No Address*).—Sorry I am unable to give any further information regarding the electric tricycle; neither am I aware of the motor being on the market.—A. S. P.

Gun-metal Castings.—A. F. (*Leicester*).—The figure shows the pattern, A, and core-box, B, for the hub. A may be jointed and dowelled along the line *a a*, or left solid; it does not much matter which. *b, b* are points for carrying the core made from box,

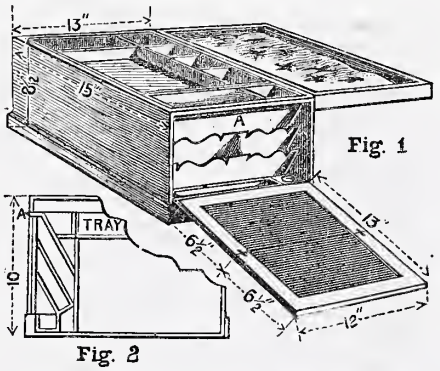


Pattern and Core-box for Castings.

B. The end view of the box is seen to the right hand, B B, jointed and dowelled at C; B shows one half the box open in the joint face, C. In the bracket shown in your letter there appears to be a boss standing out of perpendicular; if so, this must be left loose from the pattern, with a dowel.—J.

Incubator.—A. J. F. (*Bow*).—Your theory as regards working of regulator may be all right to your mind, but theory without practice is not much good. If you had tried the regulator I described you would have found it quite satisfactory. However, if you have made a regulator which is satisfactory to yourself, use it by all means, and if it is any improvement on mine I shall be pleased to have a description for the benefit of other readers of WORK who may be making incubators. Any good thing is always welcome.—LEGHORN.

Workbox.—W. E. (*Notting Hill*).—In the combined arrangement accompanying this, the desk, etc., occupies about 3 in. out of the length of the box, which is, in all, 15 in. The plinth is $1\frac{1}{2}$ in. high, and the writing-flap hinged to the top of it is of $\frac{1}{4}$ in. stuff; this $1\frac{1}{2}$ in. gives a good slope for writing. The flap is in two $6\frac{1}{2}$ in. lengths hinged to each other, and, when required for use, are made firm by two flush bolts. When folded up, they fit into the front of the receptacle for stationery, and the outside flap is fitted with a lock and key, locking into the piece marked A, so that the desk may be used independently of the workbox. Behind the plinth room is left for an inkstand and pen-groove, and above are two sloping spaces—for envelopes and postcards in the lower one, and note-paper above. These places



Lady's Workbox and Writing-desk combined. Fig. 1.—Sketch showing it opened. Fig. 2.—Section with Desk closed.

should be made to fit the articles they are intended for, blocked up, if necessary, from below. Above this, in the workbox, is a fixed tray for pins, and in the remainder of the top is fitted a movable tray, 1 in. deep, divided into compartments. All the outside stuff of the workbox, etc., is $\frac{3}{4}$ in. thick, except below the tray on three sides, where it is $\frac{5}{8}$ in., on account of $\frac{1}{4}$ in. being glued on; and the tray rests on this. The plinth also is $\frac{1}{4}$ in. thick, glued on with a mould on the upper edge: the cover is $1\frac{1}{2}$ in. deep, making the total height 10 in. It can be fitted up as choice directs. Another lock is required to fasten the workbox, and it is best to have one key to open it and the desk.—F. J.

Emigration — Bamboo Furniture Trade.—J. H. (*Birmingham*).—I do not quite relish the idea of undertaking the responsibility of advising which part of America you had better go to in order to gain a livelihood at your trade of bamboo furniture making. Even were I in a position to accept the responsibility, it would be a difficult matter indeed to properly suggest any particular part of the United States, for the reason that you omit to say whether you are a young man, or whether you are married and have a family. I incline towards believing, however, that you are a young man, and under this belief would strongly urge you not to emigrate on chances. I advise you to have a look at the penny weekly publication entitled *American Settler*, published at 24 and 25, Basinghall Street, London; from which magazine, by writing to its Editor, you may be enlightened regarding your inquiry. So far as concerns the American firms who undertake this branch of work, the best way in which I think you can discover the reliable ones is to obtain a copy of each of the four or five American furniture journals, and scan their advertisements. If the Editor will permit me, I shall be glad to transmit to you through the post (as publication will be of little use to others) the names of these magazines and their publishing addresses.—J. S.

Electric Locomotive.—H. B. (*Worcester*).—The subject of a model electric locomotive will, no doubt, appear in time, but it is far too large a question to be treated in "Shop" columns. It must also be remembered that the real machine is, at present, only in its infancy, and that a great deal has to be invented before it will drive steam off the railroad, as the present locomotive did the old stage-coach. The mixture for the dry cell in Vol. IV., No. 163, is as follows: After having killed 1 lb. of hydrochloric acid with as much zinc as it will take up, you dissolve in it, when nearly cool, $1\frac{1}{2}$ oz. of pulverised sal-ammoniac, and with this liquid make a cream with plaster-of-Paris. If you then charge the cells with this, you will find it act rightly. If you look up the back indices of WORK, you will find other mixtures that may suit you better; this one was given on account of its simplicity.—J. B.

Examinations.—A. F. B. (*Selly Park*) asks a question which it is impossible to answer satisfactorily. He wants to know what examinations ought to be passed and what books read in order to become an efficient architect and surveyor. I think I am safe in saying that there are hundreds of efficient architects in England who never passed an examination in their lives, and I know that there is nothing to prevent A. F. B. or anyone else putting out their brass door-plates to-morrow and setting up as architects and surveyors. The chief examinations in architectural knowledge are those held by the Royal Institution of British Architects for the diplomas of A.R.I.B.A. and F.R.I.B.A., and the possession of these is a guarantee that the holder is a man of ability. But the passing of an examination does not make an architect; he has to have a very wide range of knowledge, including, amongst other things, architectural drawing and colouring, geometry, applied mechanics, land surveying, levelling, and mensuration. Then he has to know all about the materials and processes and "tricks of the trade" in bricklaying, concrete work, joinery, constructive ironwork, slating, painting, paper-hanging, heating and ventilation, drainage and sanitary science, plumbing, electric lighting and bell fitting, and a few other things, as well as the writing of specifications and preparation of bills of quantities. If, also, he is not a business man with a certain amount of tact and business knowledge, his architecture proves a losing game. In addition to the above "practical" requirements, there is also absolutely necessary the artistic side of the professional character, the cultivated taste which is the outcome of careful training combined with natural ability. The usual manner in which young architects are evolved is for the pupil to pay a premium of from twenty guineas to two or three hundred, according to the office he is entering, and then give his services three, four, or five years in return for the knowledge he is allowed to pick up. After he is out of his pupilage he considers himself an architect, and looks for a salary. I would advise A. F. B. to study for the Science and Art Examinations in such subjects as building construction, applied mechanics, etc. He will see that it is almost impossible to recommend books on the varied subjects named above, but the following, at all events, are valuable works: Rivington's "Building Construction," Vols. I. and II., 10s. 6d. each, Vol. III., 21s., Vol. IV., I think, 15s.; Col. Seddon's "Building Notes," about 15s.; Gwilt's "Encyclopædia of Architecture," 52s. 6d.; Gwilt's "Ancient and Modern Architecture," 12s.; Parker's "Glossary of Architecture," 7s. 6d.; Ferguson's "History of Architecture," in four volumes, varying from 31s. 6d. to 63s. each; Banister Fletcher's "Quantities," 6s.; Stoney on Strains, about 30s.—A. B.

Incubator.—D. A. (*East Cambus*).—Without more details I hardly know how to advise you. If you have followed my instructions to the letter you should get a good result, as others have done. As your chicks appear to die about the thirteenth day, I should be inclined to think your eggs are not from vigorous stock. If not, you will never succeed in hatching them in an incubator. Your perforated zinc is all right. If you will give me full details I will try and give you more explicit help, but without this it can only be guesswork.—LEGHORN.

Patents.—LEXINGTON.—If the invention LEXINGTON speaks of is of any value, he cannot be too careful in his proceedings if he desires to *create a property* in it, which, by being a property, shall be a something of value, and can, therefore, be beneficially dealt with. There is no law requiring an

inventor to apply for a patent only through an agent, and if he is wise, he will most carefully avoid the 25s. performances he speaks of. An inventor can, of course, prepare his own documents and make application himself for the grant of a patent, just as he may prepare and conduct his own lawsuit, act as his own physician, engineer, architect, or builder; but his own common sense ought to show him how far such a course is likely to be successful in either case, particularly if he is inexperienced in any of them. It would take up far more space than can be afforded in "Shop" to place all the points clearly before him, so that he may understand and realise the dangers and difficulties attendant on those who meddle with matters in which they have had no practical experience; but, in order that he may obtain some idea on patent matters, he should refer to, and read and consider, the particulars relating to patents in WORK, No. 44, Vol. I., p. 694; No. 136, Vol. III., p. 508; No. 151, Vol. III., p. 749; No. 158, Vol. IV., p. 29; No. 163, Vol. IV., p. 108; No. 174, Vol. IV., p. 285; also to No. 175, Vol. IV., p. 302. We cannot undertake to recommend a patent agent, but LEXINGTON will do well to remember that there are agents and agents, and he cannot be too careful in their selection.—C. E.

Beam Compass.—J. N. D. (*Thornley*) can obtain the beam compasses shown in No. 175 at any shop where drawing instruments are sold. I could give him addresses in London or Manchester, but these places are a long way from Thornley. Let J. N. D. take a run to either Durham or West Hartlepool, and I am confident he will soon find them. I think there is a dealer, called Harris, in Church Street, West Hartlepool.—A. B.

Patent Planing Saw.—A. R. (*Scorrier*).—The tone of your letter implies that you doubt the satisfactory working of the saw, but I may tell you that it has been at work for some time at the following places: Her Majesty's Dockyard, Devonport; Midland Railway, Derby; Great Northern, Doncaster; Great Western, Swindon; Ashbury Carriage Co., Manchester; Dan Rylands, Ltd., Manchester; and elsewhere. I give the replies to your questions in the order asked. (1) As the diameter of the saw is reduced by wear, and the cutting tooth requires resetting, the plane must be reduced in the same proportion, and he also reset, both plane and cutter teeth being set to the gauge which is sent with the saw, except in cases where, from special reasons, the timber to be cut requires a little more or less set, the difference between the set of the plane and cutting teeth always being the same, as shown in the gauge. (2) The answer to most of this question will be found in the first; it makes no difference whether the saw is 18 or 20 gauge in thickness. (3) The heat of the planing saw will, of course, be greater than that of an ordinary circular saw near the outside rim, as both the cutting and planing are done there; but, as the planing saw cuts a little slower than the ordinary circular, the difference is not found to be any serious disadvantage. (4) The manufacturers do not (so far as present experience goes) recommend planing saws of 50 in. or 60 in. diameter; but, if they should make them, they would recommend a gullet tooth of about 2½ in. pitch. (5) The following instructions are given for sharpening the planing saw: When sharpening the saw, be careful to keep the teeth well levelled, and in setting the same let them touch the setting gauge and not click. The knives must have a little more set than the teeth. If the saw should mark, just touch the sides with an oilstone whilst running. The plane is the same temper as the rest of the saw, but these saws are made of very fine steel, and can be made hard without breaking.—A. J. H.

Polish for Turned Ware.—YOUNG ENGLAND.—(1) Try the following plan: Dissolve 1 oz. of sandarach in ½ pint of methylated spirits; shave 1 oz. of beeswax into sufficient turps to make it into a paste. Mix the two together by degrees. Apply with a woollen cloth whilst the work is still in motion; polish with a soft linen rag or chamois leather. The work thus treated should have a highly varnished appearance. (2) Write the Britannia Company and other firms that advertise in our columns for price list. The former often have second-hand machinery and fittings on sale. (3) Sorry to learn the turning patterns you refer to have not given satisfaction. Try those issued by W. F. J. Walker, 41, St. Helen's Street, Ipswich. Second series, price 1s. 7d., comprises four sheets with about thirty designs of knobs for drawers, candlesticks, twine-boxes, spice-box of pyramidal form, vases, etc. They are spoken of very highly.—LIFEBOAT.

Spirit Varnish.—J. B. (*Accrington*).—If you buy direct from reliable firms, they, having the pick of the markets as regards gums, etc., coupled with an extensive experience, can supply you with a far better varnish than you can make yourself in small quantities. The addition of sandarach to spirits and shellac is hardly sufficient; you would gain a better result by using gum benzoin instead. I am just passing on to the Editor papers on Spirit Varnishing, which may appear in due time. Meanwhile, try the following firms in your neighbourhood—I have tried from both, and find them good varnishes, etc.—Mr. H. O. Milnes, Leeds Road Varnish Works, Bradford, and Messrs. B. Newnham, Slade Lane, Sheffield.—LIFEBOAT.

Boot and Shoe Repairing.—W. C. (*Nottinghamshire*).—Articles appeared in WORK, Nos. 112, 117, 122, 126, 130, and 137.

Umbrella.—RIBS.—An article on Umbrella Making appeared in WORK, No. 92, p. 649.

III.—QUESTIONS SUBMITTED TO READERS.

**** The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Elementary Carpentry.—WOODSPOILER writes:—"Can any reader recommend me any good, cheap work on elementary carpentry—a work that, if possible, treats both of method and the materials to be used for different jobs? and if it also treats on the choice, handling of tools, etc., so much the better. I have a good shop, and several good things therein that came to me free of cost, and think, therefore, I ought to make use of the same in my spare time. Any hints will be a help."—[Follow the articles in WORK on "Carpentry for Boys"; also "School Carpentry" series. You are bound to find in these all you want to know.—ED.]

Clockwork for Propeller.—S. C. S. (*Paisley*) writes:—"Would some kind reader tell me how to make a small clockwork machine to work a screw propeller for a small yacht, and the probable cost of cog-wheels, spring, etc.? Interior dimensions of boat: Length, 10½ in.; breadth, 3 in.; depth, 1½ in."

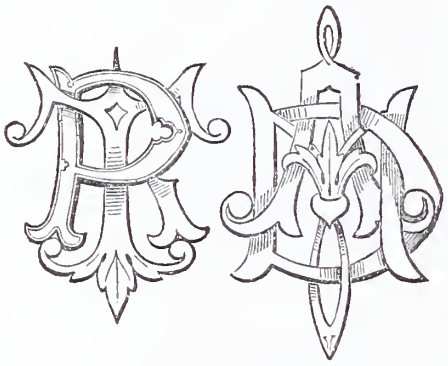
Botanical Anatomy.—W. E. J. (*Blackburn*) writes:—"Will any reader of WORK kindly inform me how skeletons of leaves are made, similar to those shown at the WORK Exhibition, and illustrated on p. 8 of the Exhibition number? It is there called botanical anatomy."

Bronze Cleaning.—A. B. (*Burslem*) writes:—"Will any reader kindly inform me of a good thing to clean bronze with?"

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Musical Glasses.—M. (*Bishop Auckland*) writes to MUSICAL (see No. 180, p. 382):—"These may be made from either tumblers or wine-glasses, but the latter are said to be best. They are tuned by pouring water into them, but should be selected as near the right tone as possible. Wetting the fingers with vinegar is said to give a better tone. The feet should be firmly fixed in holes bored in a piece of wood."

Monograms.—F. J. K. (*Tufnell Park*) writes:—"I send two monograms, one for R. T. (see No. 174, p. 286), and the other for A. M. D., on same page."



"R. T." and "A. M. D." Monograms.

Upholstery.—COUNTRY CABINET MAKER writes to W. W.:—"I am sorry I have been prevented answering the query of W. W. as to his stuffing, but will try to help him, if I can. The corners must be worked from the front and side, and sufficient stuffing put in to keep them up; and in stitching up, one stitch should be taken so that the needle comes down just *on* the angle: then this will keep it square. If the needle is put up in front and brought down behind the corner, the pull of the twine will tend to make a round corner, as W. W. may see by just trying the two plans. He may also find a little difficulty in turning his corners in cover. For a square corner, bring the cover from the side just on to the front rail, and secure with a couple of tacks; then make a cut up, just beyond the tacks, about three-quarters of the way up the border; then pull the front down and cut out the square piece, which will project beyond the corner, leaving only just enough to turn in, and then fold in the cut portion of the front border, and bring it down straight on the corner. I do not know if I can make this clear, for it is difficult to explain, though very easy to do; but if it is not plain, I will try and make it so if W. W. will write again. For a round corner, do not cut any out, but begin with putting one tack right on the angle, and then fold the cover in with small pleats, putting the tacks *between*, and not *in*, the pleats, until all the fulness is worked up."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—A. B. (*Waltham Cross*); W. T. T. (*St. Ives*); H. A. B. (*Middlesbro'*); T. P. (*Manchester*); SPLICE; F. H. (*Wilts*); W. & CO. (*Leeds*); T. B. (*London, W.*); ARTEMUS; C. H. (*Ipswich*); ONE IN A FIX; H. BROS. (*Huddersfield*); F. C. (*Stockton-on-Tees*); AMATEUR; G. D. C. (*Brixton Hill*); WISEMAN; A. F. (*Canning Town*); J. H. (*Edgbaston*); SHANKS; J. H. P. (*Pembroke*); T. D. (*Cambridge*); T. O. (*Collyhurst*); W. H. M. (*Airdrie*); P. J. (*Perranwell, R.S.O.*); B. R. P. (*Peckham*); J. C. (*Egremont*); A LAD; S. B. (*Upton Park*); H. L. D. (*Leicester*); H. T. W. (*Cardiff*); J. R. B. (*Newcastle-on-Tyne*); J. R. (*Glasgow*); S. B. & SONS (*Stourbridge*); F. W. (*Portadown*); BRITANNIA CO. (*Colchester*); S. W. (*Ashton-under-Lyne*); H. H. (*Bootle*); A WORKING LAD; P. E. C. (*Peterswood*); W. E. (*Notting Hill*); H. M. (*Bradford*); E. A. S. (*Greenwich*); E. R. (*Plaistow, E.*); AN AMATEUR; J. W. C. (*Polegate*); AXLE; W. D. (*Newington Butts*); W. G. (*Guildford*); S. H. B. (*Upton Park*); W. M. (*London, E.*); W. A. H. (*Redhill*); L. G (*Bradford*); AMATEUR PRINTER; T. A. C. (*Pendleton*); NOVICE; W. W. (*Sunderland*); A. M. B. (*Kenilworth*); R. H. M. (*No Address*); F. L. L. (*Richmond*); H. H. (*Ashbourne*); H. C. J. (*Gloucester*); SAW; THOMASO; AMATEUR; W. J. H. (*Lozells*); J. R. M. (*Keighley*); HARRY; G. W. R. (*Cheam*); W. P. (*Mullingar*); E. A. P. (*Beckenham*).

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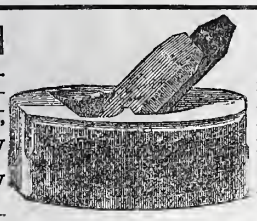

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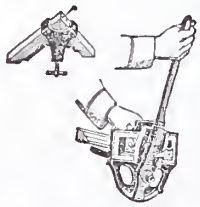

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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VOL. IV.—No. 189.] SATURDAY, OCTOBER 29, 1892. [PRICE ONE PENNY.

WORK WORLD.

A NEW process for rope-making turns out rope from straw and hemp at a cost of 1d. per pound.

* *

Existing survey maps are being severely commented upon, and the Government is to be asked for better ones, which shall also be kept up to date.

* *

The blacksmith who discovered the new method of tempering copper has tried the same process upon aluminium with perfect success.

* *

The Japanese Government will send to the World's Fair 2,000 of its middle-class citizens to learn about men and things. Bravo, Japan! But where is Old England?

* *

Polish workmen out on strike have been mowed down by Russian Cossacks, who were ordered by their general to spare no powder, nor show any mercy!

* *

A Californian company have raised and transported a block of asphaltum weighing 2½ tons, which is thought to be the largest block of this material ever mined.

* *

Tinplate working is going ahead in the States. Private residences in town, villas in the suburbs, and business blocks are entirely fronted and finished with tinplate, plain and ornamental.

* *

A new sliding scale for steel workers' wage is contemplated in South Wales. The basis asked for at the Abergavenny Conference was 40 per cent. above the old standard rate of wages.

* *

Metal ceilings are obtaining. The panels are held in place in such a way as to permit of expansion and contraction without bending or bulging. They give a neat and finished appearance to the ceiling or wall.

* *

A huge locomotive, just completed for the New York Central Railroad, weighs 120 tons. It has a cylinder 19 in. by 24 in., and its total length, including the tender, is 60 ft. The driving wheels, four in number, are 7 ft. 3 in. in diameter.

An aluminium bicycle has lately been ridden in Newcastle. It is an experiment to test the capabilities of that metal. The machine is an ordinary geared Safety, and, with the exception of tires, spokes, and spring, is entirely made of "the metal of the future." Its total weight, including saddle and pneumatic tires, is 20½ lb.

* *

Blackboards are being superseded in the State schools of America by an enamel laid on the school walls. Shellac, powdered pumice, lamp-black, chrome green, and wood alcohol enter into the composition of this enamel, which dries on the walls and boarding, and forms a surface resembling black slate.

* *

Experiments are being made in treating iron and steel castings with a current of electricity to retard their solidification, and thus allow them to become dense and homogeneous. This method can be used for adding a portion of metal to a casting by making the former an electrode, and allowing it to fuse with the latter.

* *

A smokeless fuel is made from coke breeze. It burns with a brilliant flame, is smokeless, and gives intense heat. Private trials in a locomotive and a steamer have given satisfactory results. It is made in the form of tenacious blocks suitable for railway or ocean transport. This utilisation of a hitherto waste product promises to become a thriving industry.

* *

For common use the Réaumur thermometer has been adopted in Germany, but recently a Ministerial decree orders the adoption of the Celsius centigrade thermometer in hospitals, lunatic asylums, bathing places, and schools. In the Réaumur thermometer the scale between the freezing and boiling temperatures of water is divided into 80 parts; in the Centigrade it is divided into 100 parts.

* *

A large increase in the number of out-of-works is feared during the coming winter. The Salvation Army are therefore preparing to cope with the inevitable destitution. The form of relief given will be food, clothing, and shelter in return for some kind of work done by the applicants. Gifts of cast-off clothing, of tools, and of orders for brushes, mats, furniture, etc., are invited.

Technical crafts are to be well represented in the near future at the Royal Agricultural Hall. An Engineering Exhibition is to be opened in November, and other exhibitions in course of preparation will cover the following trades:—Wood-working Machinery and Timber, Textile Machinery and Products, Ironmongers, Laundry Machinery, Furniture Trades, Electrical Machinery and Appliances, and Grocers, Bakers, and Manufacturing Confectioners.

* *

Copper wires, coated with gold, silver, and brass, are used in making the threads and tinsel employed in the manufacture of imitation gold threads and ornaments. These wires are drawn to a thinness rivalling that of human hair, and then passed between steel rollers, which flatten it into ribbon before it is wound over the silk and cotton which forms the core of the thread. The wire for this purpose is imported from France and Germany, because British metal-workers have not yet been able to cast copper tough enough for the purpose!

* *

Interesting and instructive has been the experiment carried out in America with reference to the merits of margarine as a substitute for butter. This substance was substituted for ordinary butter in an asylum of blind children without their knowing anything of the change. No difference was observed at first, but it was soon noticed that they gradually took less and less, and finally declined it altogether. On inquiry it was elicited that they did not refuse it because it was objectionable in any way, but simply that they did not care for it.

* *

Experiments are being made in the manufacture of glass for boiler gauge tubes to resist high pressures, and, as a result, tubes of composite material have been produced. Two qualities of glass are used, having different coefficients of expansion. That used for the interior of the tube has a lower rate of expansion than that of which the exterior consists; this, in cooling the outer layer, contracts upon the inner, as a heated wheel tire contracts upon a wheel, and thus the tube is made stronger to resist internal stress than if either kind of glass were used alone.

HAND-WORKING OF SPECULA FOR THE NEWTONIAN TELESCOPE.

BY EDWARD A. FRANCIS.

Testing the Curve of the Speculum (*a*) by the Foucault Shadow-test.

We must now consider the means by which can be ascertained the exact curve the polished or semi-polished concave glass possesses. If at any moment this can be known, the work will cease to be a matter of blind chance or "rule of thumb;" for the stroke can be at once modified to control the curve.

We shall deal first with the Foucault shadow-test, which is applied to the unsilvered glass surface in a closed and darkened room.

An artificial star is provided by shading a candle or lamp with an opaque screen punctured with a very tiny hole opposite the brightest part of the flame. The screen may be conveniently made of a thin metal tube (as in B, Fig. 21), and the hole may be pierced by a fine sewing-needle, after the surface of the metal has been thinned by filing.

The mirror being then placed in a darkened room, ten feet (twice the focal length) distant from the lamp, the rays stream out from the hole in the screen (D in Fig. 19, p. 454), and are reflected back and received entirely by the observer's right eye, the mirror, though unsilvered, appearing then to be bright, like a full moon.

The observer sits with the lamp close to the right side of his face, and brings slowly forward, edgewise, a mounted steel blade (A, Fig. 21), so as to cut right across the cone of reflected rays. Part of the full-moon mirror surface darkens as the blade shuts away the related rays. *The shutter is moved always from left to right.*

If the shutter be *inside* the focus, the speculum will appear shaded (as in Fig. 23, on next page), for the reason indicated in the diagram. If the shutter be *outside* the focus, the appearance will be as in Fig. 24, where also the cause is explained. If, however, the shutter cut the rays exactly *at* the focus, the mirror will present an appearance as in Fig. 25—*i.e.*, a kind of twilight, regular or irregular, will simultaneously cover the surface, and will as simultaneously fade into blackness as the shutter is moved more forward. *The testing is always performed with the shutter in this position—exactly at the focal point*—and this point must be carefully found by experiment. It is by the character and the intensity of the shadows which appear on the mirror, when the shutter is moved forward across this focus of the reflected rays, that the nature of the mirror-curve is determined. In the case of a spherical mirror, all the rays are equally affected, and the mirror becomes uniformly grey and black; but in the case of a mirror not spherical, the focus is only approximate, and as the shutter blocks away certain rays and leaves others free to enter the eye, some parts of the mirror surface only are darkened.

Of the curves, it will be remembered that the sphere deepens to the ellipse, and the ellipse to the parabola. There are, however, two other curves, which, for clearness, I omitted before to mention. One is the curve of the oblate (or flattened) sphere, the other that of the hyperbola. The oblate sphere comes in order before the sphere, and is a curve which needs to be deepened to make it spherical. The hyperbola lies at the other extreme, and is reached when the spherical curve has been too much modified in the attempt to parabolise.

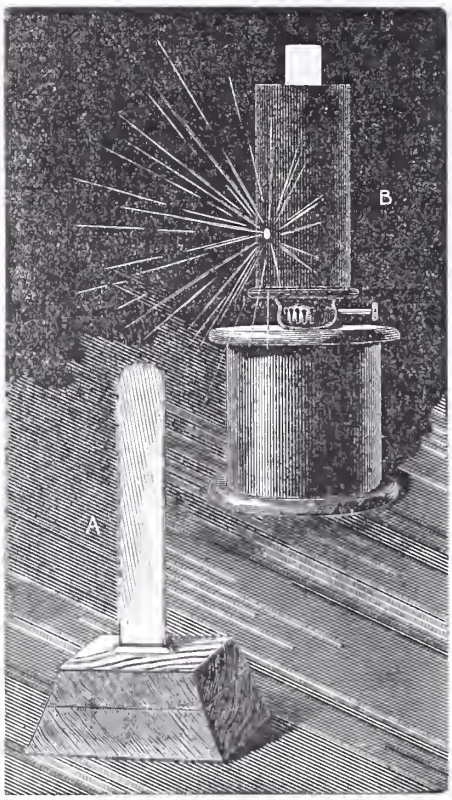


Fig. 21.—A, the Shutter; B, the Testing Lamp.

The shadow-markings read at the centre of curvature fall naturally into three classes, though it requires experience in testing to decide where the distinctive shading of the one class merges into that of the other, so delicate is the test.

The classes are:—

(*a*) The oblate sphere (Fig. 26).

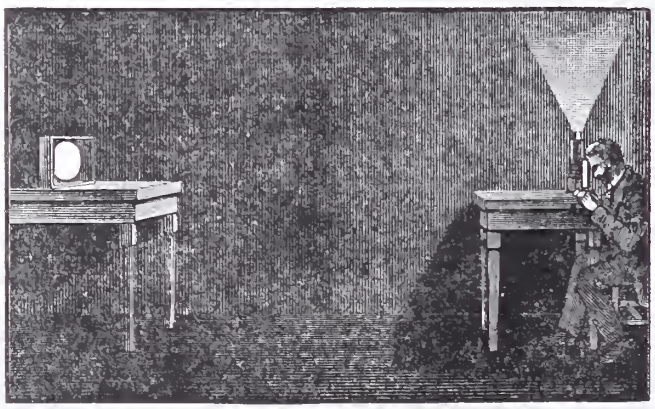


Fig. 22.—Testing the Speculum by the Foucault Test.

(*b*) The sphere (Fig. 27).

(*c*) The ellipse, parabola, hyperbola (Fig. 28).

In the third division the shadow-markings are identical in each case, the classification depending only upon the intensity of light and shade.

If desired, a section-surface may be projected by imagining light as streaming obliquely on the mirror from right to left, the direction opposite to that in which the shutter moves. Then (as in a lunar mountain) the existence of shade will import the existence of a hill to cast the shade, and the degree of intensity of light and shadow will give one an indication of the magnitude of the hill. This will be understood by a reference to the diagrams. In the sphere (Fig. 28), where the shade is diffused and regular, the section given is flat, while in the oblate sphere (Fig. 26) there is a noticeable elevation at centre and edge; and this order is reversed in the ellipse, parabola, and hyperbola (Fig. 28).

Let us see how these things guide the speculum worker.

To reduce the oblate sphere (Fig. 26) to the sphere (Fig. 27) it is necessary to polish away the central hill and the raised edges. For a reason which it would need much space and several diagrams to explain, these two things can be accomplished by the one process of carefully deepening the mirror from centre to edge. As the hill disappears, so the edge elevations will disappear.

In other words, if the speculum—as is very probable and most desirable—shows, under test, marked shadows of the character of Fig. 26, work should be continued with a short, straight stroke, carefully testing at intervals until the polish be complete. Then the stroke may be slightly lengthened, and the curve carried cautiously past the sphere until the faintest possible indication of the parabolic shadow appears (as in Figs. 29 or 30), either of which shadow-figures might be shown by a perfect mirror—the fainter shadow being proper to a speculum of long focus, and the stronger shadow proper to one of short focus. In any case, the speculum at such a stage should be tested, in the test-tube, on a star.

If, on the contrary, the shadow, as in Fig. 28, be noticeably marked, or, indeed, appear at all before polish is complete, immediate steps must be taken, by the use of one-fourth (or less) rigidly straight strokes, to bring back the curve towards the sphere—to wear away, that is, the slight elevation between the centre and the edge.

It is because of the difficulty of this last task (so difficult that it sometimes necessitates a return to the final stage of fine grinding) that it is desirable to test the mirror early, directly polish begins to appear, so that the proper stroke may be used in the polishing from the commencement.

NICKEL PLATING.

The bath is made of 1,000 parts of pure sulphate of nickel, 750 parts of neuter tartrate of ammonia, and 5 parts of gallic acid in 35 pints of water. The neuter tartrate of ammonia is obtained by saturation of a solution of tartaric acid by ammonia. The salt of nickel must be neuter. The entire mixture is first dissolved in 5¼ pints to 7 pints, and then boiled for about a quarter of an hour, after which it is diluted with water until there are 35 pints of liquid, which is filtered. The nickel is very white, soft, and homogeneous; no wrinkles are visible on the surface; the price is little more than that of copper. Only a slight current is required.—*La Métallurgie.*

PHOTOGRAPHIC EXPERIMENTS.

CURIOUS, AMUSING, AND INSTRUCTIVE.

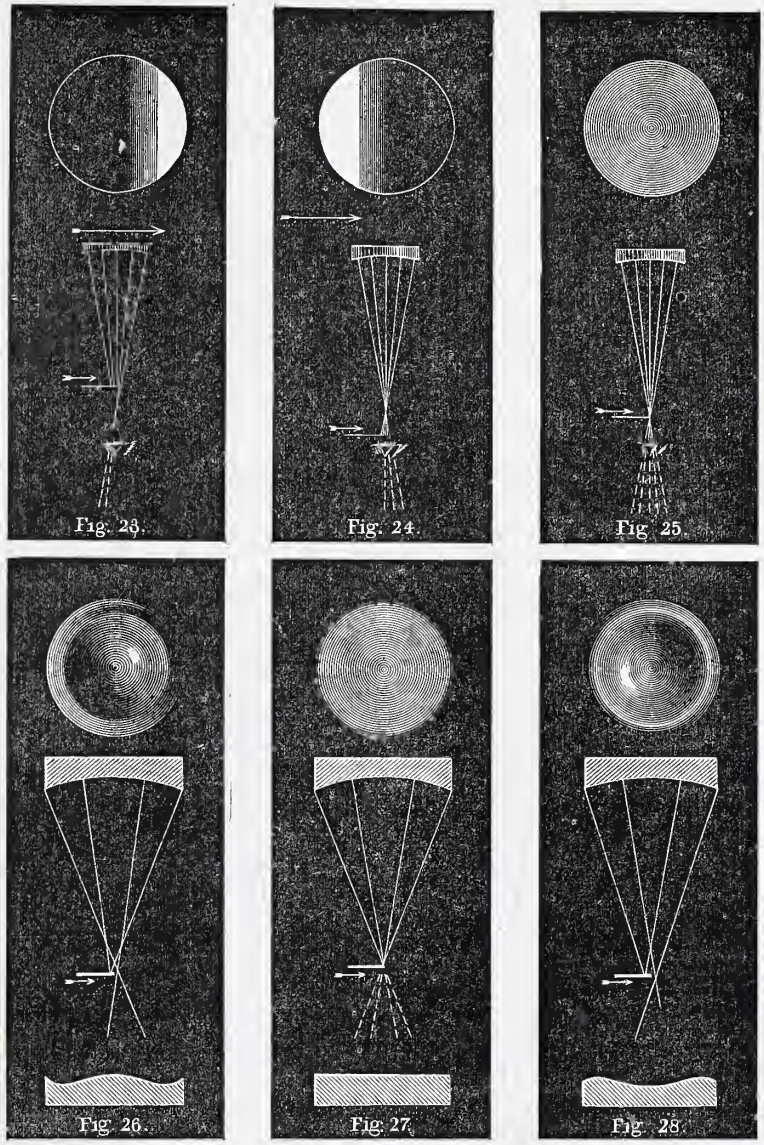
BY WALTER E. WOODBURY.

STATUETTE PORTRAITS—WIDE-ANGLE STUDIES—PHOTOGRAPHY AND DECEPTION—PRINTS ON JAPANESE PAPER—TO MAKE DISTILLED WATER—PHOTOGRAPHING IN THE STREET—HOW TO COPY A PICTURE.

Statuette Portraits.—These have rather a peculiar effect, and are easily made. Obtain an ordinary pedestal, suitable for a life-size head, and place it on the edge of a high table or wooden stand. The background should be of black or red cloth, so as not to be actinic. The person to be photographed stands behind the bust, and a white cloth, draped round the shoulders, and so neatly arranged that it apparently forms part of the pedestal itself. All other parts are carefully hidden by pieces of black cloth. The next operation is to powder the hair and face with rice-powder, so as to give a marble-like appearance. The photograph is made, and should give, in printing, a perfect marble-like statuette on a black ground. If any other parts not required show themselves, they should be cut out, so as to print quite black.

Another method, obviating the necessity of a black background, is to make the photograph without it, and to cut away from the negative all the film, save the head, shoulders, and pedestal; or to block it all out, except this, to print quite white, and, by a second printing, darken the ground, keeping the printed statuette portrait covered over.

Wide-angle Studies.—As is well known, a wide-angle lens is intended for use in confined situations. For instance, in photographing a building in a narrow street, we could only go as far away from it as the buildings on the opposite side permitted, and this would, perhaps, include only the doorway of the building intended to be photographed. With a wide-angle lens, however, it would be possible to photograph on the plate the whole of the building. The only drawback to the use of these lenses is their untruthful representation and false perspective; therefore, they should never be used except when unavoidable. Indeed, so exaggerated is the perspective at times, that it is possible to make the most amusing photographs by photographing objects near to, with a lens possessing an angle, say, of 100 degrees. The effect it has is that it enlarges objects near to, and diminishes them to an alarming extent as they recede from the camera. For instance, a boy wheeling a barrow would appear in this manner: The barrow would be of apparently gigantic proportions, stretching away for miles, with a little tiny boy at the end, apparently trudging along with a barrow thousands of times his own weight. A rider on horseback has also a comical effect. The horse's head is out of all proportion to the small dimensions of its rider and its still smaller hind quarters.



Specula for Newtonian Telescope. Fig. 23.—Shadow with Shutter *inside* the Focus. Fig. 24.—Shadow with Shutter *outside* the Focus. Fig. 25.—Shadow with Shutter *at* the Focus (of a Spherical Mirror). Fig. 26.—The Oblate Spheroid. Fig. 27.—The Sphere. Fig. 28.—The Hyperbola.

With a very wide-angle lens it is also possible to make a photograph of a little suburban garden, and it will appear to resemble a park or palace grounds. This

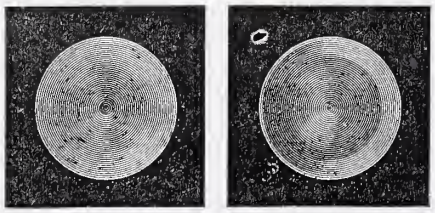


Fig. 29 **Fig. 30**

Fig. 29.—The Parabola (Long Focus). Fig. 30.—The Parabola (Short Focus).

is a trick often adopted by auctioneers and estate agents, so that, in viewing photos of property, it is really impossible to form any safe idea regarding the place itself.

Photography and Deception.—Another method giving results somewhat similar to those obtained by wide-angle lenses is to photograph an object near to, and another far away, in such a manner that they will appear together, only that the former will, of course, be of exaggerated proportions. Thus, for instance, you and your friend Jones have been out fishing together, and realised the truth of the old saying about anglers—*i.e.*, "a worm at one end of a rod and a fool at the other." You have, however, managed to catch a fish (any sort will do) about the dimensions of a good-sized sprat. It is the usual custom of anglers, I believe, to view their captures through magnifying-glasses before discoursing upon them. A better plan, however, is to photograph your fish, and then there can be no dispute whatever, because it is the popular belief that photography cannot lie. However, all that is necessary is to hang the fish in front of the camera to the bough of a tree, we will say, with a piece of black thread. You then retire several paces behind it, holding up your arm as if you were holding the fish. Your friend will then adjust the camera so that the fish just comes under your hand, focuses, places a very small stop on, so as to get everything sharply defined, and makes the necessary exposure. Thus it is possible, with a little trouble, to obtain everlasting records of your marvellous day's sport, for you can easily make yourself appear to be holding a fish of gigantic proportions—say, 5 ft. long, or so.

Prints on Japanese Paper.—Some very effective results can be obtained. Procure some thin Japanese paper, and salt it by drawing it through a solution made by dissolving 1 oz. of gelatine and 20 oz. of water, and adding to this 100 grains of ammonium chloride dissolved in as small a quantity of water as possible, and to this mixture is then added 5 oz. of a ten per cent. alcoholic solution of gum juniper, sandarach, or other white resin with vigorous agitation. The paper, after drying, is floated in a sensitising bath, made by mixing an ordinary ten per cent. ammonia nitrate of silver with an equal volume of the same bath neutralised with acid. After sensitising, the paper is again dried, when it can be printed, toned, fixed, etc., in the usual manner. The best effects in printing are obtained by using a large piece of paper, and masking the negative all round. If any difficulty be found in drying the paper after the different operations, it should be attached all round the edges to light wooden frames.

To Make Distilled Water.—There are many photographic formulæ in which distilled water is recommended, owing to its

freedom from all foreign matter likely to have an injurious effect. Distilled water is only condensed steam, and very easy to obtain. Get an old saucepan, and solder into the lid a long piece of tin pipe, carrying this into a pickle-jar placed in a bucket of cold water. The saucepan is placed on the fire, or a lamp placed beneath it, when the steam will condense in the pickle-jar, distilled water being the result.

Photographing in the Street.—Only a photographer knows the trouble and annoyance, when photographing in public places, caused by the crowd of unsoaped who persist in standing right in front of the camera, usually in a stiff, unnatural attitude, that would ruin the best picture imaginable. A very good plan to avoid this annoyance is the following:—Focus your camera on the desired object, and note exactly the position of the camera on the tripod. Then appear as if to alter your intention, and turn the camera round in the opposite direction, and await the result. Very soon the crowd of interested persons will gradually have slid round in front of the lens again. Place the slide in prepared, turn the camera smartly back to its original position, and make your exposure—and smile.

How to Copy a Picture.—To copy a picture, print, photograph, etc., first mount it smoothly on a flat surface, or, if this is undesirable, pin it flat to a board. Fix the board up perfectly square with the camera, so that, with a piece of string, the distance measured from the centre of the lens (lens-cap, to avoid dirtying the glass) to each of the four corners of the picture should be equal. A good plan is to fix the upright board holding the picture to a table or bench, so that the camera can be slid along, and maintain its correct position at any distance. A small stop will bring the image sharp all over. A clear and even light is required, without any shadows or false reflections. Use a slow plate, give full exposure, and use a developer strong in bromide and pyro.

WRINKLES.

Waterproof Paper.—Take 24 oz. of alum and 4 oz. of white soap, and dissolve in 2 lb. of water and 2 oz. of gum-arabic; then dissolve 6 oz. of ordinary glue in 2 lb. of water, and when all the articles are thoroughly dissolved mix all the ingredients together into a vessel, and when you want to prepare the paper make the solution warm and dip the sheets of paper into it, and then hang the sheets of paper so prepared on a line and leave them to dry.

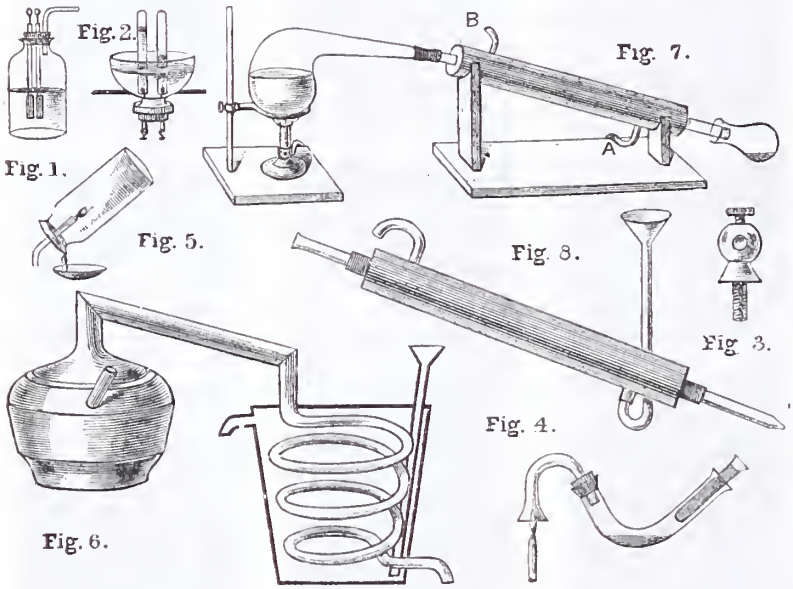
Summer-house Felt.—To waterproof felt for a summer-house, melt one pound of pitch in half a gallon of Stockholm tar. Apply boiling hot, and as the work proceeds strew it freely with dry sand and brush it over with a coarse broom. A little tallow added to above will cause it to flow more freely.

CHEMICAL APPARATUS: HOW TO MAKE AND USE IT.

BY H. B. STOCKS.

Decomposition of Water by the Electric Current—Apparatus Used—Voltameter: How to Make, and Materials Required for Collecting the Mixed Gases and Gases Separately—Apparatus to Show Formation of Water: How to Make—Simpler Form without Special Apparatus—Apparatus for Distilling and Condensing Water—Method of Connecting Condensers to Tap and Sink.

Following up our experiments, water is the next body that attracts our attention. It is known to many people that water is composed of hydrogen and oxygen, and this may be proved by using the apparatus shown at Fig. 1, which is called a voltameter, because by means of it the two gases which are evolved, when measured, show the strength of the electric current used. To make this apparatus, you will require an eight-ounce wide-mouth bottle, a cork to fit, some of the narrow glass tube, two pieces of platinum foil 1 in. by ½ in. (costing 6d. or 9d.), two pieces of platinum wire 1½ in. long (costing about 3d.), a little mercury (1 oz., costing about 3d.), and a piece of stout iron wire. Cut off a portion of the tube 5 in. long and bend to a curve; round off the ends in the flame. Cut another portion 8 in. long, and draw out in the centre as for the test tube, and cut off the capillary tube, so as to have two tubes with pointed ends. Now pierce each piece of platinum foil with a tiny hole, push through each a platinum wire, and secure by twisting. Take one of the pointed tubes, and pass the wire through into the tube; hold the foil with pliers, heat up the point of the tube, and as the glass melts force the foil against it so that the edge may adhere. When the tube has entirely sealed up, smoke and cool; the platinum wire should project inside the tube, and the end be quite free from melted glass. Proceed with the second one in the same manner. These are the two poles of the voltameter.



Chemical Apparatus. Fig. 1.—Voltameter. Fig. 2.—Other Form of Voltameter. Fig. 3.—Binding Screw. Fig. 4.—Apparatus for showing Formation of Water. Fig. 5.—Alternative Form. Fig. 6.—Still and Worm Condenser. Fig. 7.—Retort and Liebig's Condenser. Fig. 8.—Condenser with Funnel.

Bore three holes in the cork to fit the tubes, and place as shown in the figure; pour a little mercury into each tube containing wires, and cut off two pieces of iron wire; curve the ends into a crook shape and brighten with sand-paper, then place one into each of the tubes, pressing them down in the mercury; the connection is made with a battery by means of these wires, and the junction is at once broken by taking out one of the iron wires. The bottle is partly filled with dilute sulphuric acid, sufficient to cover the two pieces of foil, and the gas as it is evolved passes out by the exit tube, and may be conveyed to a tube or jar by means of a long glass tube connected to the exit by means of a rubber tube. An easier plan would be to draw the Pt. wires through the cork, and connect them direct with the battery wires, or by means of binding screws; but the platinum wires become brittle, and after once or twice breaking are too short to use again. I prefer the first plan. Two Bunsen or Grove's cells will give sufficient current.

The mixed gases may be collected in a stout soda-water bottle and exploded to show the remarkable action; but the bottle had better be corked and rolled up in a towel with the mouth out, the cork removed, and a taper applied, holding the mouth away from the operator. The explosion is a very loud one, but I have never heard of any accident from the experiment. The bottle must be thick, otherwise it will be shattered.

To collect the two gases separately, the apparatus shown at Fig. 2 is used. This may be made in the following manner:—Procure a large bottle, say half a gallon circular bottle—any kind will do; even a cracked one would be an advantage, provided the neck and top part were sound. Pour water into the bottle until it is about four-fifths full, stand the bottle on a table, and with a pen follow on the outside the line of water seen on the inside of the bottle: this will ensure an even line, the ends of which will meet; empty the water out of the bottle, and allow the ink mark to dry. If there is no crack in the bottle, we must proceed to make one. For this purpose a glass rod must be heated and placed upon the bottle somewhere lower down than the ink mark; a drop of water is then allowed to fall upon the hot place, and the alternate heating and cooling proceeded with until a crack has formed. The rod is heated and placed directly in front of the crack, and moved along towards the ink line; the crack will follow; the rod is again and again heated, and the crack led on to and then straight round on the line, taking care to hold the neck, as it is that part which we want; it is probable that the crack will not proceed all the way round. There is generally about an eighth of an inch which will not crack, because the tension upon the glass has now been relieved; a slight pressure will, however, break it, and the inner and outer sharp edges are taken off with a file, or the edge is made smooth upon a stone with ground emery and water.

A cork with two holes is fitted to the neck of the bottle, and two small pieces of tube

two inches long, fitted with platinum foil and wire, as in the last example, but with the wire projecting about one inch from the end of the tube, are inserted in the holes. A couple of binding screws (costing 8d.) are now obtained (Fig. 3), and each is fixed to a platinum wire by coiling the wire tightly upon the lower screw; the screws are then pushed into the tubes, and held there by filling with bicycle cement, which latter will be found very useful for many purposes. The battery may then be connected to the binding screws. The apparatus may be held in the ring of a retort stand, and it is nearly filled with water, acidulated with sulphuric acid; two small test tubes, filled with the same, are inverted over the pieces of foil, and the two gases collected separately. It will be seen that the volume of the gas is double in the one tube to that in the other; thus the volumetric composition of water may be noted, and the two gases examined.

To show the formation of water by burning hydrogen in air, the apparatus shown at Fig. 4 may be used. This apparatus consists of a jet from which to burn the hydrogen, a V-shaped tube, a small test tube fitting this V-shaped tube loosely, and a bent tube with a funnel-shaped opening. As the flame of hydrogen is an intensely hot one, it will be necessary to protect the jet with a small piece of platinum foil, otherwise it will be rapidly melted up, and become closed. Draw out a short piece of the narrow glass tube in the same manner as the test tube, and cut in two; procure a bit of platinum foil three-quarters of an inch by half an inch, roll it up into a conical tube upon the point of a lead pencil or on the tube itself, then slip it upon one of the glass jets, and cut off any of the capillary tube which might project beyond the platinum; heat up the glass and platinum in a Bunsen burner, and the two will adhere firmly; the platinum will prevent the glass melting. This jet must be attached to the hydrogen apparatus, and a steady current of gas must be coming off. The V-shaped tube may be made from tubing of one inch diameter. Cut off ten inches of it, and having made a welt upon each end in the same manner as the test tube, commence heating it in the blowpipe, turning it all the time, and when sufficiently soft, bend it slightly, and during the bending place a finger upon the short end and blow gently at the other, so as to prevent the glass falling in: which very often happens when bending tube of this diameter. It is most probable that this plan may be found difficult. In that case, place a piece of cork in one end of the tube, and in the other a cork fitted with a short piece of glass tube, to which is connected a piece of indiarubber tube long enough to reach to the mouth; by means of this a gentle blowing may be kept up during the time of bending, and after a little practice no difficulty will be found in making a neat bend. A piece of tubing, three-eighths of an inch diameter and six inches long, is now taken, and one end of it opened out by means of a long tapering charcoal cone into a funnel shape, and the tube is then bent as shown. After cooling, it is connected to the V tube by means of a cork. A small test tube filled with cold water is placed in the other end of the V-shaped tube: this serves to condense the water formed by burning hydrogen under the inverted funnel.

For those who do not wish to make this apparatus, the gas may be burnt under a gas jar, and the water allowed to drop into a small basin placed to receive it. (Fig. 5.)

Water never occurs in a pure state in nature: it is always more or less contaminated with mineral and organic matters which it has dissolved. It is necessary, therefore, for chemical use that the water should be purified; for this purpose distillation is resorted to. Upon distilling water, most of the impurities are left in the still or retort, but ammonia and volatile organic matter distil over with the water. To free the water from ammonia, collect the first small portion separately, and throw it away before collecting the bulk; if the original water was fairly pure there will be no ammonia after 100 c.c. have distilled over. To rid the water of the volatile organic matter (which is very seldom necessary), the distilled water must be again distilled with a small quantity of a solution of potassium permanganate made alkaline with caustic potash: this re-agent destroys the organic matter. The distillation of the water must never be carried so far that the residue becomes dry.

Two forms of apparatus are in use for the distillation of water: the still and worm condenser, and the retort with Liebig's condenser. On looking back, it will be found that I have given one correspondent a sketch of a cheap still, which, however, did not include the worm condenser, which is simply a coil of tin, or tin-lined pipe placed in a tub of water which is kept cool by a flow of the latter. This condenser is connected to the still, and the condensed water drops from the end of the pipe, which is carried through the side of the tub near the bottom.

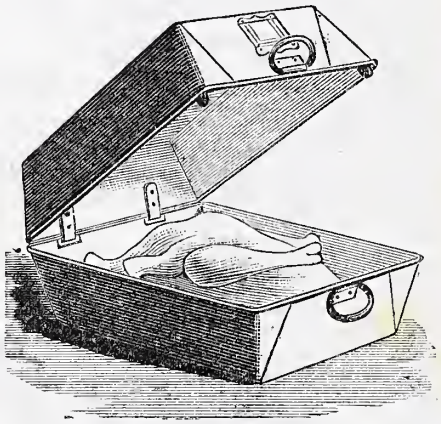
In using a still, it will be necessary to ask permission from the Inland Revenue authorities, even though the still may be only used for distilling water; otherwise, a person is liable to be prosecuted for not having a licence. This happened to a chemist only a short time ago.

The retort is the second form of apparatus used for distilling water, and when of large capacity is fully equal to a still. The water is condensed by means of a Liebig's condenser, which was described in WORK, Vol. IV., p. 10, and therefore need not further be commented upon. The arrangement of the apparatus is shown at Fig. 7.

It will be necessary in distilling water to have a constant flow. If the position of the still or retort is near enough to a tap, the best connection is made by means of "composite" pipe of about one-eighth of an inch internal diameter, which may be bought of lead and sheet-lead dealers, etc., and costs only about ½d. per foot. This tube may be bent in any direction similar to lead pipe. A piece of indiarubber tube is put upon the tap and wired; to this is wired a piece of glass tube half an inch in diameter, drawn out slightly at one end, and the glass tube is fixed to the composite pipe by means of a smaller piece of rubber tube; it would be found inconvenient to connect the composite pipe directly to the tap, owing to their different diameters. Next connect the other end of the composite pipe to the tube A (Fig. 7). Connect another piece of composite to B, and carry it alongside the first pipe back to the sink down which the water flows after going through the condenser. In the case of the still, a small flow is allowed to drop into the funnel, going down to the bottom of the tub, and displacing the warmer water at the exit pipe at the top. If all the rubber tubes are wired on, a very good pressure may be kept up, but care must be taken not to make it excessive, otherwise the rubber tube at the top will be blown out into a balloon and burst; a slight flow is all that is necessary. In the Liebig's condenser the reason for running the cold water in at the end furthest from the retort is that the inner tube being of glass, and having steam in the interior, will not stand a current of cold water played in at B, but the water passing in at A is slightly warmed as it passes through the condenser, and therefore the glass is not fractured. If there is no convenient tap, then the next best thing is to have a large barrel or receptacle of some kind with a tap, and placed upon a shelf over the distilling apparatus, and to fill it before commencing, then the condenser will require to be slightly modified, and have a metal funnel fixed upon a tube (Fig. 8) long enough to reach above the highest point of the condenser, and the waste water must be run into a bowl or tub under the bench. In this case the water may be allowed to drip only, so as to economise it; the condensation will be sufficient if the water in the receiver is not appreciably warm to the hand.

ROASTER AND BAKER.

An improved roaster and baker is represented in the illustration. The utensil is made of sheet steel, in three sizes, which nest closely. The fittings and attachments are also composed of heavy gauge sheet steel. It is claimed that cooking by means



American Roaster and Baker.

of this roaster is the most effective and economical method possible, as the steam produced by the process cannot escape, but is absorbed by the article in the case, and acts as a basting. The manufacturers state that as there is no evaporation there is no shrinkage or loss of weight, and all the flavour and nutritious qualities of the food are retained, while the food cannot be spoiled by careless cooks, the roaster itself doing the cooking if placed in a well-heated oven. Like most of these good things, it is an American idea.

Filling for brass signs and name-plates, which will stand exposure to sun, weather, and cleaning with acids, is made by melting together 2 parts each of gutta-percha and asphaltum, and adding 1 part of shellac. It may be mixed with smalt, vermilion, or other pigment, and should be used hot.

Varnish for Preservation of Flowers.—Ether, 500 parts; transparent copal, 20 parts; sand, 20 parts. The flowers are to be immersed in this varnish for two minutes, then allowed to dry for ten minutes, and the treatment repeated five or six times.

HALL CHAIR.

BY EDWARD C. ROE.

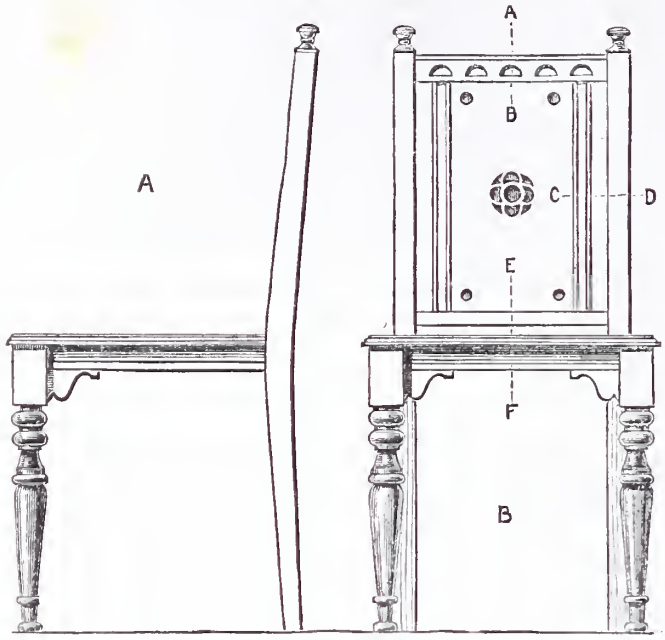
PROBABLY one of the most severely criticised—mentally, it may be—pieces of furniture in a house is the hall chair. One is apt to criticise a piece of furniture very minutely when compelled to sit on a similar article or stand thereby for, as is often said, a few minutes, but what may generally be construed into half an hour or so, awaiting a certain person's convenience. Also it may be added that it is an extremely useful provision, the use of which is gladly accepted after a walk.

What are the chief points to be considered in the design of a hall chair? It must be strong and look substantial; further than that, fashion governs, to a great extent. For instance, how seldom one sees such a chair upholstered—not that it is to be asserted that an upholstered chair is preferable: far from it; but custom has led us to consider a chair other than the plain-seated substantial-looking article peculiar and out of place. In deference to these thoughts which have occurred to my mind, I have adhered to the usual style, and have endeavoured to add little touches of ornament that are not difficult to execute or lengthy, considering time as an object.

The design will look well executed either in wainscot oak or walnut. I am afraid that the usual material, mahogany, would scarcely suit, but still, that is only a surmise on my part; opinions differ. Whatever class of material is used, if polished, it should be finished with a dull surface. The chair, of which Figs. A and B are side and front elevations respectively, is 3 ft. 1 in. in height, 16¾ in. from back edge of seat to front edge, which is 1 ft. 6 in. long, extreme measurement, and the width of back edge is governed by the legs, which are 14½ in. out to out (see Figs. D and C). The front legs are turned out of 2 in. square stuff.

The rails (see Fig. E for section) are either dovetailed into legs as sketched (Fig. I), or mortised and tenoned, as the back rails and back ends of side rails must necessarily be into the back legs. If pegs are used to secure the tenons in the mortise, they should not penetrate the outer face of the stuff, but be carefully made and fitted, that they will fill properly the tenon without it being necessary to drive them right through in the ordinary way; but screws, fairly stout and carefully put in, will answer capitally, although they do not possess the power of drawing up the shoulders on the rails that a peg would if fitted in a proper manner.

Inside the frame, just under the seat, must be fitted angle brackets; these must be well fixed. It is preferable that they should be fitted and screwed on dry in the first instance, and then removed and glued well before finally fixing.



Hall Chair. A, Side View; B, Front View.

In the rails a plough groove must be run (see Fig. E); this groove is provided to receive the lip of the buttons which will secure the seat to the frame. A sketch of the button is given at L. The lip of the button is cut to fit the plough groove in the rails. The method of use will doubtless be apparent from the sketch L, without further explanation.

The back will require to be fitted together before the remaining portion of the framing is glued up; in fact, the back portion must be taken up and finished off completely. The thickness of the back legs is 1¼ in. finished; the lines to which they must be cut are obtainable from the side elevation, Fig. A. The dimension between the inner faces of legs is 11¾ in. The width of the legs, both at the top and bottom, is the same as the thickness: viz., 1¼ in. Of the top rail a section is shown at G, also the sinkings in elevation at F and the section at G; it will be seen that they are semi-circular sinkings dying away into the face of the stuff. These are best cut in with a scribing gouge and round-nosed chisel, after having been marked out with a sharp pair of compasses; section of the vertical rails at side of panel at H. The sinking therein will be worked, as will the reeding in the rails under the seat, with a router.

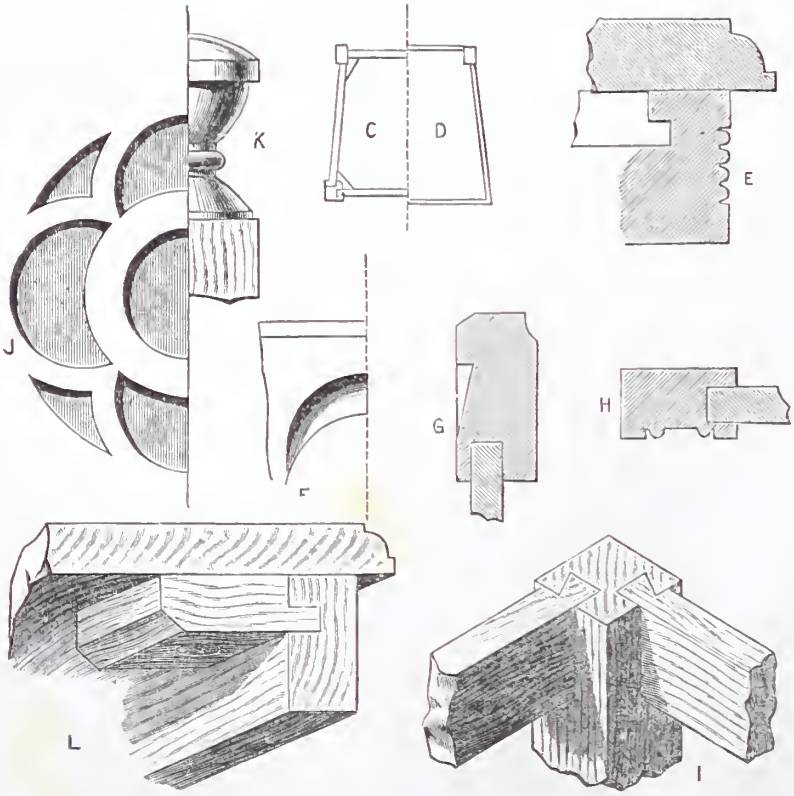
The panel in back is $\frac{5}{16}$ in. thick finished, and is perforated by a geometrical pattern; half elevation of this is shown full size at J. This may be cut out with a fret-saw; if a keyhole saw is used, care must be taken the back is not splintered. The four corner holes are simply ⅝ in. centre-bit holes carefully cleaned out. The seat is ⅝ in. in thickness finished, and is moulded on the edges with an ovolo (Fig. E). The top is finished quite flat, and is 1 ft. 6¼ in. from the floor. After the top is fitted between the back legs, it will be securely fixed by the aid of the buttons already described.

The two knobs surmounting the back legs will be separately turned, and then affixed with glue; half elevation is given (Fig. K).

The brackets in front and at side underneath rails are ⅜ in. finished in thickness, and may be fixed by screws judiciously entered.

The front angles of the seat should be slightly rounded, and the sharpness of the arrises generally eased.

One final note: Do not use glass-paper indiscriminately. On such work little or none should be used, except, of course, to the mouldings.



Hall Chair. C, Plan beneath Seat; D, Plan Top of Seat; E, Section Front Rail under Seat; F, Elevation of Sinking in Top Rail of Chair; G, Section of ditto; H, Section of Upright Rail at each Side of Panel in Back; I, Sketch showing how Rails may be dovetailed to Legs; J, Reduced Form of Fret in middle of Panel in Back; K, Half Elevation of Knob; L, Sketch showing Method of fixing Seat to Frame with Buttons.

BRASS BUSHES that have been turned a shade too small, so that they do not fit as tight as is desired, may be made larger by being tinned on the outside, the extra skin of solder causing the brass to be larger in diameter.

HOW TO MAKE A RAIN GAUGE.

J. GEORGE LISTER.

INTRODUCTION—GENERAL PRINCIPLES—KINDS OF GAUGES—MATERIALS—METHOD—PRECAUTIONS IN USE—CONCLUSION.

IN this paper I propose to give a simple method of making a rain gauge. Anyone who can use a soldering iron will find this a very easy matter.

The principle of all rain gauges is practically the same. The rain which falls on a large area is deduced from that which is collected on a small area. To some, this may seem a very simple and easy matter; but it is very difficult to obtain correct results.

The first rain gauge was constructed by Howard. It consisted of a funnel inserted in the neck of a "Winchester" quart bottle. The serious drawback of this form was its great liability to become fractured by frost or accident. This may be taken as the type of the rain gauges in use to-day. Glaisher improved Howard's pattern by substituting a copper holder for the glass bottle, by elongating the neck of the funnel, and by turning up the lower end into the shape of the letter U. The "Snowdon" gauge comes next. In this the straight funnel neck was restored, as it was found that, though Glaisher's bend prevented a slight loss by evaporation, it got choked with dust, dirt, and leaves. If snow fall into the gauge, some may be blown out by the wind. This would cause an error in the deductions, as the reading would be too low. Another improvement was effected by sinking the rim of the funnel and preventing this loss. The standard rain gauge of the Meteorological Office is a Snowdon, with this improvement. The usual size adopted is one whose funnel opening is 8 in. in diameter; another very general size is one of 5 in. opening.

The serious difficulty in the way of an amateur, who desires to construct either of these sizes, is that he requires a specially graduated jar. Few people have any opportunity of learning how to construct these; I therefore propose to give details of a 4·7 in. gauge. The great advantage of this size is that no specially graduated jar is needed; its place is taken by an ounce measure, which may be bought from a wholesale house for 8d. (unstamped), or stamped for 4d. extra; or they may be obtained from a retail chemist for a little over these prices.

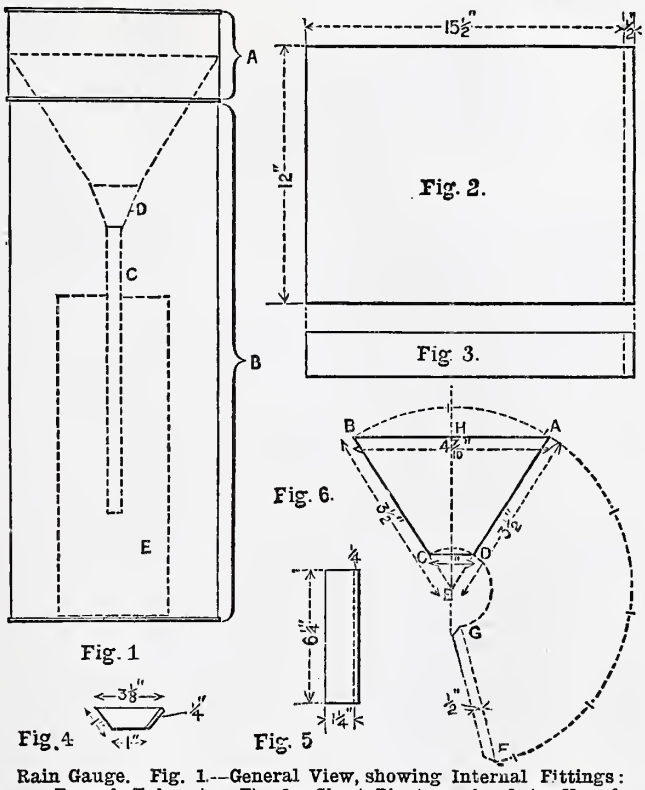
Besides the above-mentioned gauges there are many other forms, including float gauges for mountain observations and automatic and recording gauges, such as Beckley's, which show continuously the rate of fall.

The materials required are a sheet of tinplate large enough to make the outer and inner vessels, the funnel, and its long neck, a bottle of Brunswick Black, and an ounce measure.

METHOD.—*Outer Vessel.*—This may vary somewhat in height (12 in. is the usual height), but its diameter must be exactly 4·7 in. × $\frac{1}{16}$ in., or a little over $4\frac{3}{4}$ in. This added sixteenth is to allow for the thickness in making the *funnel.* To make the outer vessel, cut a piece of tin (Fig. 2) 12 in. broad and $15\frac{1}{2}$ in. long; but if the top edge is to be turned in, a little greater breadth than 12 in. will be required. The length of the plate allows $\frac{1}{2}$ in. for the joint. A circular piece $4\frac{3}{4}$ in. in diameter must be cut and soldered in to form the bottom.

Funnel, Connecting Piece, Tube, and Rim.—These are the most difficult and important parts of the whole gauge. On the accuracy with which the funnel is made depends the correctness of all our subsequent observations. It must be remembered that we deduce the rainfall of a very large area from the rain which is collected over a small area. Hence the slightest errors made in the construction of the funnel will be enormously multiplied in the deductions. This is repeated to show the great care needed in this portion of our work. We shall require four pieces of plate, cut to the shapes and sizes shown in Figs. 3, 4, 5, and 6. None of these present any difficulty except Fig. 6, which is the funnel itself. The best method of striking out this, and similar pieces of conical work, is to draw first the exact section of the finished piece. This is shown in Fig. 6, by the continuous lines, A, B, C, and D. Continue the sides, A D and B C, to the point E. With E as centre, and E A as radius, strike out the portion of the circle, B A F. With E as centre, and E D as radius, draw a portion of the circle C D G. Along the outer of these arcs (B A F) mark off six times the distance A H, and to these add one-tenth of the line A B. An additional $\frac{1}{2}$ in. must also be allowed for the joint. This will be quite clear on studying Fig. 6. The piece B C G F is then the piece required to make the funnel.

The Rim.—When this is finished it must be exactly 4·7 in., or $4\frac{7}{16}$ in. in diameter inside.



Rain Gauge. Fig. 1.—General View, showing Internal Fittings: Funnel, Tube, etc. Fig. 2.—Sheet Tin to make Outer Vessel, B, in Fig. 1. Fig. 3.—Piece to make Rim, A. Fig. 4.—Piece to make D. Fig. 5.—Piece to make the Tube, C. Fig. 6.—Method of striking out the Piece for the Funnel.

Inner Vessel.—A good shape and size for this (E, Fig. 1) is a cylindrical vessel about $7\frac{1}{4}$ in. high and $2\frac{1}{2}$ in. diameter. To make this, cut a piece of plate $8\frac{1}{2}$ in. long and $7\frac{1}{2}$ in. broad. In both these measurements $\frac{1}{4}$ in. is allowed for turning in, and for the joint.

The whole of the pieces of plate, when soldered together to form the various parts, must receive two coats of good Brunswick black inside and out, to prevent rusting.

Measuring Glass.—This has already been described. It will be found most useful when divided in the usual way into minims (8 minims equal 1 oz.). One ounce of rain collected is just equal to 0·1, or one-tenth of an inch of rainfall. The following table gives, in decimal equivalents of an inch, the readings as taken on the measure:—

1 oz. or	8 minims	equal	·1	in.
	7	"	·0875	in.
¾ oz. or	6	"	·075	"
	5	"	·0625	"
½ oz. or	4	"	·05	"
	3	"	·0375	"
¼ oz. or	2	"	·025	"
	1 minim	"	·0125	"

In practice it is not usual to carry the readings beyond the second decimal place, as the other figures are such minute quantities that they may be disregarded.

It will be seen that the great advantage which this gauge possesses over any other for amateurs, is that should the measuring glass be broken, another may be bought which will be just as accurate as the first.

Precautions in Using a Rain Gauge.

1. Treat the gauge with the greatest possible care. It must be remembered that no other figure contains the same area as a circle. Therefore if any indentation be made in the side of the rim or funnel, the size of the opening is reduced in area; and a very serious error will be introduced into the calculations.

2. Place the gauge in such a position that the loss by evaporation may be reduced to the lowest possible point. The best position is at the ground level, with the outer vessel half embedded in the turf. Another advantage of this position is that the gauge cannot be blown over by a high wind.

3. The gauge must not be sheltered by trees, walls, or buildings. Mr. Scott, of the Meteorological Office, says that no object should subtend a greater angle than 20°.

4. The gauge must not be elevated. It has been found that when placed on a wall 15 feet high, a gauge will frequently refuse to record any rainfall, even during a driving shower.

5. If snow fall into the gauge we must obtain its equivalent in rainfall. This is done by taking a known quantity of hot water to melt the snow. Pour this over the snow in the gauge, and deduct this amount from the reading.

Conclusion.—In conclusion it may be stated that England is the only country where rainfall is regularly and systematically measured. There are over 2,000 stations in this country where readings are taken at least every day.

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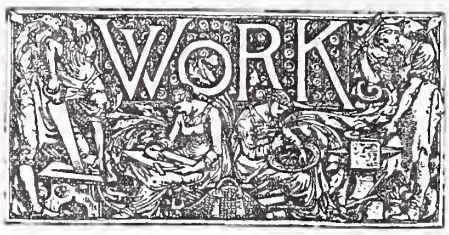

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Railway Carriage Lighting.—Our contemporary which boasts the "largest circulation in the world" has been adding to its usefulness by ventilating the question of defective railway light—a matter we offered some suggestive remarks upon before the question had taken hold upon the public as it now has. Our views had reference mainly to the London underground railway systems, which, we submit, are disastrously behind the age. With the advances in electrical science these recent years, the first direction where its application could have been expected was the subterranean passages through and around London, and along which thousands and thousands of passengers are hourly contented to be carried with the scantiest provision for their welfare—so far as light is concerned. In the absence of energy and foresight on the part of the railway companies, the solution of the difficulty has, it appears, devolved upon private enterprise. A handy lamp for use in trains and omnibuses is already on the market. There can now be obtained a small battery for the waistcoat pocket, which lights a lamp in form like a watch for an hour or more—the battery being rechargeable at a cost of twopence and a visit to a *dépôt*. This is all very well, but it is painful to think that this new article has to be added to the travelling paraphernalia of the business man and woman—for women read in trains. The necessity for this state of things being apparently inevitable we have one suggestion to make. It is that Messrs. W. H. Smith & Sons shall add to the comforts they already provide for railway travellers by establishing electric storage machinery at their bookstalls, to eke out this precious commodity to a beseeching and sorely-tried public. Then, an instructive article in Work on how to make one of these waistcoat-pocket electric lamps, and no reason will exist why every man should not only be able to boast of being his own lawyer, but also his own electric light!

American Pine.—There are several misconceptions in regard to the strength of American pine timber, and this is chiefly due to the fact that the different classes are not properly identified. The long-leaf pine is superior where strength and durability are required. In tensile strength it is superior to cast iron in tensile resistance, and in cross-breaking it rivals the oak, and is also stiffer. For the trestle bridges so commonly used in America it is very serviceable, and it is largely used in naval architecture. The finer-grained, and more especially the curly timber, is selected for finishing wood. Its hardness makes it suitable for planks and flooring, but unless it is quarter-sawed it is apt to "peel out." The only disadvantage in the use of this wood is that it is so resinous that it does not take paint readily; its hardness calls for special tools to work it, but this is a matter of detail. It is worthy of notice that tapping for turpentine does not weaken this timber; in point of fact, experiment has shown that it strengthens it to resist compression and cross-breaking, and also stiffens it. The Cuban pine is very similar in properties to the long-leaf timber. The short-leaf pine is almost free from resinous matter, soft, easily worked, and admits of a good finish; it is, therefore, better suited for the cabinet-maker than the long-leaf pine. This timber has only lately come into general use, because, unless it is "dry-kilned," it is apt to "blue," and to become useless for weather-boarding or wainscoting. The loblolly pine is not reliable; we may have one sample tough and strong, and the next one quite weak, and therefore it should not be used for permanent work.

Productive Co-operation.—The co-operative movement—whereby the workers have a direct interest in and share of the profits gained by their handicraft, in addition to the current rate of wages—is succeeding in the Midlands. The organisation is, for the most part, the direct result of strikes, for which it supplies an alternative, strike pay being turned into a more fruitful channel. The Co-operative Padlock Society at Walsall, under this movement, now owns the finest lock factory in the neighbourhood, with a wages bill of £150 per week, the workers frequently receiving ten per cent. more than is paid by other manufacturers, and the excellence of their work is shown by the fact that their product is supplied to Government stores. At Coventry there is a co-operative watchmakers' society, its members at present working at home with their own tools, though they hope soon to have a factory with all necessary machinery. Leicester and Bromsgrove both have a co-operative boot and shoe manufacturing society, while a more recent venture is the Alcester Needlemakers' Society. These examples are an indication of what may be expected on a more wholesale scale, as the knowledge of co-operative principles becomes more general. It is refreshing to feel that the hardships and sufferings oftimes brought about by differences between masters and men can be averted in this way, and if trades exist wherein employers and employed cannot get along without the periodical and prolonged strikes which have now for many years been crippling the industrial trades of our country, the sooner the men become their own masters under co-operative principle and government the better for them, their wives and children, and the future of this great country. Better try co-operation than see British trade extinguished.

CARPENTRY FOR BOYS.

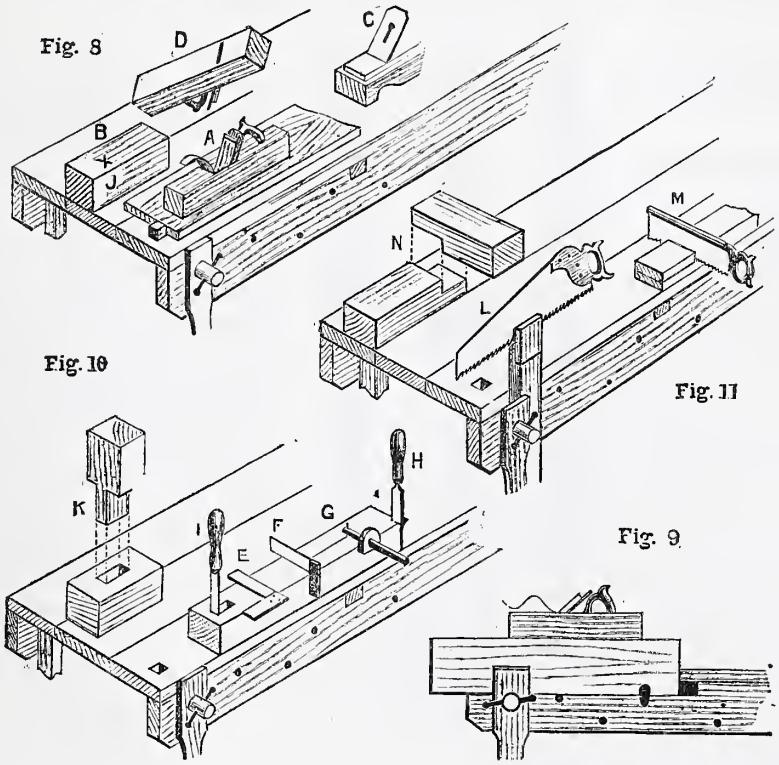
BY McDONALD.

BENCH TOOLS AND HOW TO USE THEM—SHARPENING OF EDGE TOOLS—CHISEL WORK—MORTISING—TENONING—SCARFING OR HALVING.

THE handling of tools with that degree of expertness peculiar to the trained artisan is altogether a matter of practice, and cannot be arrived at in a few days. The beginner will find their manipulation very awkward at first, but he will just have to plod on, bearing in mind that in this, as in other things, patience and perseverance will bring their reward. A few practical lessons would be highly serviceable.

Foremost among the bench tools may be considered the three planes—the jack-plane, the trying-plane or half-long, and the hand-plane. They are used, as shown in Figs. 8 and 9, for dressing, straightening, or reducing timber. In the former figure, dressing a face of a board is shown at A. The latter figure illustrates straightening, jointing, or shooting an edge. Here the board is held in position by the vice and bench-pin, while at A, Fig. 8, it is laid on the bench with its end against the stop. In all these operations the jack-plane is first taken, it being the coarsest, then the half-long to partly smooth and straighten the surface, and lastly, the hand-plane, which is the finest working, to finish up. Of course, in cases where straightness is of more consequence than great smoothness, as jointing or shooting, the hand-plane is not used at all, and where only a rough claw to take off the saw or other marks is needed, the jack-plane is sufficient.

Sharpening of Edge Tools.—The most important part in the working of tools, and also the most difficult to acquire, is the sharpening. Edge tools are first, or when they get too thick, ground on a grindstone, and afterwards set up to a fine edge on the sharpening stone, as shown at C, Fig. 8. This represents a plane-iron in the act of being sharpened. The operation requires great care. The iron is held in both hands, the forefingers extended down the front, and the thumbs at the back to steady it. It is then rubbed backwards and forwards on the stone without allowing it to roll, until the edge becomes invisible to the naked eye. The arms should move chiefly at the shoulders, very little at the elbows, and the wrists should be firm. Plane-irons work speedier and coarser if the edges are rounded lengthwise towards the corners; they work smoothly and fine when the edges are straight. The jack-plane iron should, therefore, be sharpened in the former manner, those for the trying-plane and hand-plane according to the latter. In all cases the corners should be slightly turned, so as not to leave ridges in the planed surface when working on it. The covers attached to plane-irons are for keeping them from tearing up cross-grained timber, and must be set more or less close to the edge, according to the nature of the stuff to be dressed. Coarse or twirly hardwoods demand very close setting, while clean, straight-grained yellow pine, under a good sharp plane, dresses best when the cover is $\frac{1}{16}$ in. from the edge, or even more. Old planes, when they get wide-mouthed, require closer setting than new ones. More edge is given to a plane simply by chapping the iron a little further through; less edge, or taking the iron out altogether, by tapping the plane on the top near the front end, or, as in the case of the hand-plane, tapping it on the back end. When setting up a plane—that is, putting in the iron, or looking to see the amount of edge to be given—it is held in the position shown at D, Fig. 8, the eye glancing along the sole with the front end towards it. Chisels are all sharpened in the same way as plane-irons. Gouges and other curved edge tools must be sharpened with slips. The oil generally used on the sharpening stones is sweet oil or spermaceti.



Carpentry for Boys. Fig. 8.—A, B, Planing; C, D, Sharpening. Fig. 9.—Jointing or Shooting. Fig. 10.—E, F, Squaring; G, Gauging; H, I, Chisel Work; K, Mortise and Tenon Joints. Fig. 11.—L, Tenoning or Halving; M, Shouldering; N, Halved Joint.

Chisel Work—Mortising.—Chisels are used for an almost endless variety of purposes, as paring, slicing, mortising, checking, and such-like. At H, Fig. 10, a chisel is shown paring end wood. In this, and all chiselling of a heavy nature, the chisel requires to be pressed by the shoulder, or struck by the mallet. At I, same Fig., a chisel is shown mortising. For this, the chisel ought to be the exact breadth of the mortise, and driven straight and steady in the direction of the same with the mallet. When the mortise goes right through the piece of timber, one half of it is done from each side. A mortise is set off or marked by the square and gauge. The square is held as at E, Fig. 10, already explained in the remarks upon cross-cutting, to draw the cross lines. These may be pencilled if the wood is rough; if dressed, a fine pointer is commonly used. The gauge should be a special one for the purpose, double-pointed, and called a mortise gauge. In the absence of this, however, the single gauge shown at G, Fig. 10, will do by setting and using it twice. The latter gauge is employed principally in marking parallel widths on faces of dressed pieces. Squaring a face is done by applying the square as at F, same Fig. At B, Fig. 8, a piece is shown dressed, squared, and gauged, as might be for framing or such purpose. In executing the like of this, one face is first dressed straight and out of twist, then another adjacent one is dressed and squared over from the first. This is called facing and edging a piece, and both are marked as at J and X on the piece B respectively. The other faces are gauged and squared from these, and in dressing and reducing them the gauge line ought to be split in two. For general purposes it is not necessary to square over the last or fourth face. It will be seen that gauging from both sides is sufficient.

Tenoning—Scarfing or Halving.—The mortise and tenon joint shown at K, Fig. 10, may be considered the principal one in carpentry. The tenon is just the counterpart of the mortise. To equalise the strength, the tenon or mortise ought to be rather more than one-third of the thickness, and put in the centre, when the timbers are flush on both sides. The breadth of the tenon should be about four times its thickness. There are numerous varieties of this joint, arising from inequalities in the timbers and other causes, but we will deal with these as they occur. Another form of joint common in framing is shown at N, Fig. 11. This is called scarfing or checking generally, but when the pieces are of equal thickness, as at N, it is more frequently called halving, because the half of each is removed for the joint to make them flush on both sides. This joint can be applied to pieces in the straight as well as those meeting at an angle. Other varieties will be noticed as we have occasion to employ them. Both scarfing and tenoning are accurately gauged from the face, the latter, of course, being the same as directed for the mortise. The shoulders are squared or bevelled over, as the case may be, and cut generally with the tenon saw, as at M, Fig. 11. For this and similar work the saw stops will be found useful. After shouldering, the removed portions may be chiselled off; but it is better, if at all practicable, to do this in the bench vice with the ripping-saw, as at L, Fig. 11. When the stuff is of small dimensions, the tenon saw may be used.

A GLOSSY ink for ticket-writers can be made by adding lampblack and gum to ordinary writing ink.

NOTES FOR WORKERS.

To examine fresh specimens of animal tissues under the microscope, use a 0·75 per cent. solution of common salt in water, as this, unlike water, has no action on them. Of course, it cannot be used for permanent preparations; for this glycerine or Canada balsam must be used.

To join two pieces of leather or indiarubber, dissolve 1 oz. gutta-percha in 6 oz. carbon bisulphide, and apply the solution to both surfaces. When dry, place a hot iron near enough to just melt the gutta-percha on both surfaces, and then press well together under pressure.

The volume of the moon is 5,298,700,000 cubic miles.

The total number employed during 1891 in or about the mines of Great Britain and Ireland and the Isle of Man was 707,411, of whom 6,112 were females. The total number of fatal accidents was 961, an increase of 62 over that of 1890; and the total number of deaths occasioned thereby was 1,030, a decrease of 176. This is one death for every 668 employed, whereas the ratio in 1890 was one for every 543.

The defence works at King George's Sound and Torres Straits, which are being executed at the joint expense of the Australian colonies, are nearly finished.

BRITISH WORKS AND INDUSTRIES.

NEEDLE MAKING.

The Material—Cutting—Rubbing—Pointing—Skimming—Stamping—Eyeing—Spitting—Filing.

To see the way in which needles are made, it is necessary to visit the busy little Worcestershire town of Redditch, for there, or in the adjacent villages comprehended in what is known as the "needle district," the entire needle industry of this country is concentrated. In none of the numerous factories of that district is to be found a more complete system of ingenious mechanical contrivances for assisting and economising labour than in the Washford Mills of Messrs. Henry Milward & Sons. Old age is by no means tantamount to failure of energy in this case, for these works date from 1730. It is to the courtesy of the above firm that the writer is chiefly indebted for opportunities of acquiring the information contained in the present paper.

The Material.—The raw material, so to speak, from which needles are made is steel wire. Redditch does not make this; it is brought from Sheffield, where it is specially prepared to meet the requirements of the needle manufacturer. To secure the very best qualities for high-class needles, what look like very high prices are paid. There are some fine needles, of which 40,000 go to a pound, the wire for which costs after the rate of about £240 per ton; such needles, however, when made, have a retail value of £22,400 per ton, so that it will be seen that even this high-priced material is but an insignificant item as compared with the labour expended. The wire is brought ready drawn to the gauges proper for the different sizes of needles. It commonly comes in coils, some 2 ft. or 2 ft. 6 in. across. But not invariably; sometimes it is cut to the necessary lengths before leaving the wire-drawing mill. As a rule, however, this is done by the needle-maker, so that we may consider the first operation to be—

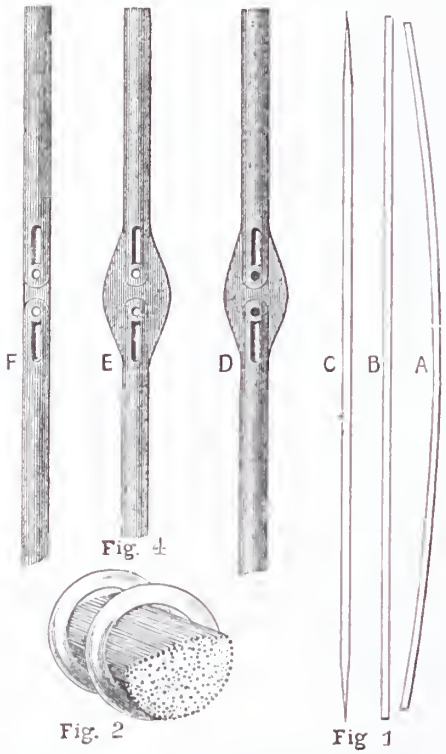
Cutting.—This is done with powerful shears. A "bundle" of wire is cut through, and a ring is passed over the loose strands to keep them together, the ends are brought flush against a piece of iron set by a gauge, at a proper distance from the shears, to give the length of *two* needles, and the whole of the wires, some thirty or forty perhaps, are cut off at a stroke of the shears.

It will be obvious that the lengths of wire thus cut will not be straight, but that each one will follow the curvature of the coil (see A, Fig. 1). They have to be straightened by—

Rubbing.—This is an ingenious process which reflects no small credit on its unknown inventor. The lengths of wire are laid in two iron rings, a ring towards each end (see Fig. 2), and heated to a low red heat in a furnace. In this state the rings and their contents are laid on an iron slab; a curved tool (technically, but improperly, called a file) is pressed on the middle of the wires, and the mass is rolled backwards and forwards. This forces each individual wire to rotate on its own axis, and in doing so it straightens itself against its fellows. B (Fig. 1) is the wire after rubbing. The heating has a second use: it anneals the wire, and thus fits it for further operations.

Pointing is the next of these. As each wire (known as a "stiff") will make two needles, it must be pointed at both ends. This is done on a fine grindstone. Fifty years ago a certain tragic interest attached to the men engaged in this operation—the old "hand-pointers." They were all young men who never lived to middle age. Needles are pointed dry, and the fine dust generated in the work caused a disease of the lungs known as the "pointer's cough," for which there was no cure—forty was an almost unknown age among these workmen.

But the hand-pointer and his cough have long since been relegated to the things of the past.



Needle Making. Fig. 1.—A, Wire as cut; B, ditto when Rubbed; C, ditto when Pointed. Fig. 2.—Wires placed in Rings ready for Rubbing. Fig. 4.—D, Wire when Stamped; E, ditto when Pierced; F, ditto when Filed.

First a fan was introduced which, by means of a pipe ending in a cowl over the grindstone, sucked away the deadly particles of grit and carried them out of the shop. This worked wonders for the health of the pointers, but, strange to say, found little favour in their eyes, as they saw that it would surely tend to lessen the abnormally high rate of their wages. This it, of course, did; but a more formidable innovator was to follow, when some twenty-five years since a pointing machine was found to work satisfactorily. For all ordinary work pointing machines have now superseded the older method.

The hand-pointer's procedure was to take a handful of stiffs—fifty, sixty, or more, according to the thickness of the wire—and, spreading them out between his palms, to press them against the face of the grindstone (which was driven at a high speed), whilst as he did so a motion of his hands caused each needle to revolve. This allowed all sides to be ground alike, and gave a true point.

The pointing machine has a grindstone with a concave face, to which the stiffs are fed in a continuous stream by a wheel which rotates transversely to its line of motion. This wheel is covered with an indiarubber band, which not only holds the wires tightly against the stone, but gives them that necessary rotatory motion just mentioned. The brilliant corona of sparks thrown off by the contact of the stone with the needle-points will not fail to be admired by the visitor to a needle mill. The pointing machine is furnished with its fan and apparatus for carrying off dust, and the most sensitive lungs may have free play in a modern pointing shop (such as that shown in Fig. 3). A single machine points about 250,000 needles in a day. C (Fig. 1) shows the wire after pointing.

Skimming.—The stiffs being pointed at both ends, they have to be skimmed—that is, the part of their centres where the two eyes will presently be punched has to be slightly polished. This is a precautionary measure that in stamping the eyes no injurious matter, such as the scale left on the wire by heating, may be stamped into the metal and thus cause a blemish. This is done in a machine. The face of a small wheel, not unlike a miniature grindstone, and covered with a dressing of emery powder, is brought in contact with a continuous stream of stiffs, which, as they pass it, are made to revolve by two plain wheels pressing against them at either end, and moving more slowly. After this, a quantity of stiffs with their bright middles and points, but otherwise dark, are decidedly pretty objects.

Stamping.—This is the first step towards making the eye. It does not actually make a hole through—that could scarcely be done at one operation—but by the stamp a deep impression for the eye is formed with a countersink leading to it, so also is the groove running up to the eye, if the needle is to have one of any sort; and the rounded head of the needle is also marked out. D (Fig. 4) shows the head of a needle after stamping, on a magnified scale. In the old days of hand-made needles, each needle was stamped separately by a punch with a blow from a hammer. But about the year 1825 a stamping machine was introduced, which, in the next few years, was so generally adopted as to throw most of the hand-stampers out of employment. Serious riots ensued, in which many stamping machines were broken; but in the end the operatives had to adapt themselves to the new order of things. The stamping machine of the old pattern had a heavy weight working up and down between two perpendicular guide bars. This was raised by the action of the foot in a stirrup, and fell on an anvil below. Both anvil and weight had dies the exact counterparts of each other; in the former of these the stiff was laid, and there were gauges to ensure that it should be exactly in the middle. This stamp formed impressions for the two eyes at one blow. Such facility did practice give to the stamper, who had to lay the wires separately by hand into the die, that he could turn off from 50,000 to 60,000 needles per day; whilst with such rapidity was the fresh stiff substituted for that which had been stamped, that the change was scarcely perceptible to a looker-on, and visitors would inquire, "why he kept on stamping the same needle time after time!"

This apparatus has been spoken of as if it were a thing of the past. It is not wholly so; but it has been partially superseded by a steam stamper, which looks less formidable, as it works horizontally. Fig. 5 shows machine-stamping in progress. In this machine the weight is actuated by a spring, and is released at the proper moment by a cam. Instead of hand-feeding, a hopper holds the wires, and a grooved wheel drops them one by one on a rest in front of the die; whilst, as soon as stamped, two little automatic forks throw them off into a proper receptacle. Ordinary sewing needles are mostly stamped in this latter manner at Messrs. Milward's, but for the larger varieties, and some other purposes, the older form of machine still holds its own.

Eyeing.—This is the actual piercing of the eye through the thin partition of steel left by the stamping. In the days of handwork this was done with a long, fine punch and a hammer, but what is now known as "hand-eyeing" is done with a press, in which twin punches are worked up and down by a screw, the wires being laid in a bed directly under them. This apparatus has by

no means fallen into disuse, and with it a skilled workwoman (women only are employed in eyeing) will pierce some 20,000 or 25,000 needles in a day; yet there are now machines driven by steam power for doing the work more rapidly, as may be seen in the Messrs. Milward's mills. The wires in these are fed from a plate to two endless revolving screws, which carry them forward to the eyeing-punches, a small fork pushes them away one by one as they are pierced, and others take their place. 100,000 needles can thus be eyed in a day. E (Fig. 4) shows the wire when it has reached this stage.

Spitting.—This is a trifling operation, and the work of boys. It is merely stringing a number of wires together in a row by two fine wires passed through the eyes. The row, when spitted, has something the appearance of a small-toothed comb. The object of this is merely to hold the wires together in the proper position for—

Filing.—A reference to D and E (Fig. 4) will show how, under the pressure of stamping, a burr has been formed round the heads by the lateral expansion of the metal. This has to be removed by the file before the wire can appear as shown at F, in the same figure. The row of spitted wires is placed on a block, and two blades of steel are brought down on its ends—that is, over the points of the needles—and tightened with the foot by a kind of stirrup. The burrs, of course, now stand up at right angles to the block, and the wires being held perfectly firm, can be removed at one operation with the file. Both sides are treated in the same manner.

Thus far the pair of needles have been as closely united as the Siamese Twins, but each has now to begin a separate existence. The workman slightly bends his row of wires backwards and forwards, and they part between the heads. They are now separate needles, and must so be called. He then takes the point end of one of the rows in a pair of broad-headed pliers, known as "clams," and files off the rough angles at the head left in breaking. Instead of filing, this last operation is sometimes done on a grindstone, but only when the needles are of the larger kinds or of inferior quality.

The needle may now be said to be made. It is rough, indeed, and so soft that it might be bent up in the finger; still, it is a needle, and could at a pinch be used as such. Before, however, it can become the smooth, bright, dainty little implement with which we are all so familiar, it will have to undergo various other processes—so many, in fact, that they will have to be reserved for a second paper.

Fig. 5.

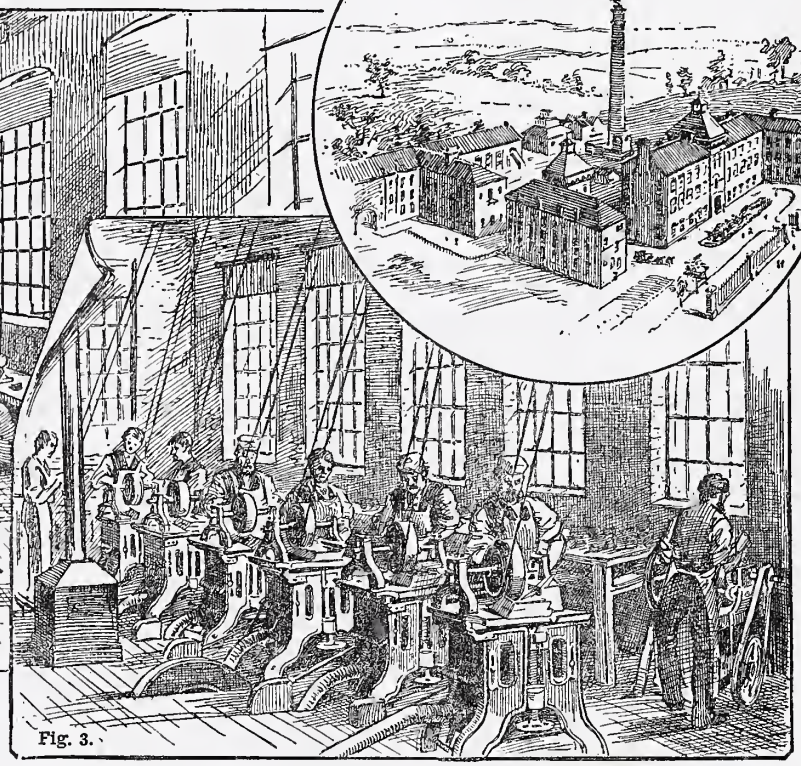


Fig. 3.

Washford Needle Mills, Redditch. Fig. 3.—Machine Pointing Room. Fig. 5.—Machine Stamping Room.

TRADE: PRESENT AND FUTURE.

*** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

SHIPPING TRADE.—At Liverpool port trade is better than it has been for some months; freights generally have risen. Quarantine being taken off, trade is proceeding in its regular course.

CYCLE TRADE.—Makers are feeling their way as to the machine for next season. It may be noted that the pneumatic tire, of which there are over a dozen different kinds now on the market, will bulk largely at both the Stanley and Crystal Palace Exhibitions.

FLANNEL TRADE.—This holds its own fairly well, thanks to the Government contracts and the well-known character of the flannel made in the Rochdale district.

BUILDING TRADE.—In the Lancashire district business is fairly brisk, and an advance in wages of ½d. per hour has just been conceded. The Amalgamated Carpenters' and Joiners' Society has only 858 members out of employment out of a total of 37,133.

STEEL TRADE.—Bessemer billets rule from £5 15s. per ton, and hematites are quoted at from 60s. upwards, delivered in Sheffield. The Lancashire steel trade shows a tendency to further decline, and low prices rule, both for raw and manufactured material. In the Midlands steel masters are fairly busy, but prices are cut very fine, owing to keen competition.

SHIPBUILDING TRADE.—The South Lancashire shipbuilding industry is depressed, but at Barrow builders are fairly busy, and several new orders have been booked. Our Liverpool correspondent writes:—There is nothing of an encouraging nature to report. Two sailing vessels of large tonnage are in course of construction. Messrs. Potter have on hand a four-masted steel barque, which is built for 3,000 tons gross. Messrs. Royden & Son are building a steel sailing vessel of 2,500 tons.

IRON TRADE.—Lowness of stocks and the cost of production keep up prices, both for raw and manufactured material. Only a very small amount of business is being done. In the Midlands a slightly improved tone prevails, while Derbyshire iron masters are very busy.

ENGINEERING TRADE.—The Lancashire engineering trade grows gradually worse. Hands are being discharged at many of the works, while others are on short time. One or two of the large stationary engine builders are still busy, as are also several firms of machine tool makers who are engaged on special kinds of work. Machinists are very indifferently supplied with work, and locomotive builders are almost idle. The strike at Barrow, which has continued for several weeks, is now practically at an end. Our Newcastle correspondent writes:—A large engineering firm on the Tyne contemplate closing through scarcity of orders. Great numbers of men are out of employment in this district, and only firms engaged on Government orders appear to be doing anything like well.

BOOT AND SHOE TRADE.—Bootmakers are fairly busy in Liverpool, though wholesale houses are complaining of want of work.

GLASS BOTTLE TRADE.—Owing to depression, a number of hands at one of the works in St. Helens are under notice to leave.

COTTON TRADE.—Our Rochdale and district correspondent writes:—At a meeting of "warpers," at which nearly the whole of the members in the district were present, it was resolved unanimously to resist to the utmost the proposed reduction of wages; and at a meeting of "spinners" it was arranged that, in case of a strike, those members who were still at work should be levied on at the rate of 4s. per week for the benefit of those who were out. This will enable each man on strike to receive 15s. per week, and 1s. per week in addition for each child. From our Lancashire correspondent we learn that the notices for a reduction of 5 per cent. in wages are being sent out to the operatives. As an uncompromising resistance has been unanimously decided upon by the various sections of the workers, a great struggle appears inevitable. It is computed that about 15,000,000 spindles will be stopped, and that about 14,000 men and 46,000 women, girls, and boys will be rendered idle in consequence. As both sides are well organised and fairly well supplied with funds, a protracted dispute appears probable.

CUTLERY TRADE.—Sheffield cutlery trade continues to slowly improve.

SHOP:

A Corner for Those who Want to Talk It.

*** In consequence of the great pressure upon the "Shop" columns of* Work, *contributors are requested to be brief and concise in all future questions and replies.*

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of Work *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given.*

I.—Letters from Correspondents.

Handicraft Education for Army and Navy.—Soldier writes:—"My reply to this article (see leaderette in Work, No 178) may be somewhat out of order, and I trust it may be accepted with the sense of feeling that it is written in the interest of the soldier. Having been in the military arm of the British service, I naturally feel interested in the subject opened up, and regret that such interest in the soldier's welfare as you are now propagating was not promoted in my time of service; and, accepting your courteous invite, I feel great pleasure in giving expression to my views on the subject, which I will do in as brief a manner as possible: I can, however, only do so in reference to the army and to the corps to which I had the honour of belonging. What I shall say may have, and undoubtedly has, been anticipated; but there are, to my knowledge - as you say—numbers of men in the army who have no resource whatever (as far as technical knowledge goes) thrown upon the labour market, and to whom the question of obtaining employment is one of the greatest difficulty. I (for example), as one of these, on leaving the service had no trade upon which to fall back or take up again, because, at the period of joining, I did not possess such knowledge; therefore, what a boon would the instruction you suggest have been to me! Had there, however, been any encouragement, by technical education in spare time, I should certainly have taken to a branch of trade whereby my chances of employment would have been facilitated, and many of my own comrades would have done the same. After the soldier's daily duty is performed, how is his time spent? Is it to obtain knowledge in the advancement of his own welfare? No; for the reason that he has no one to encourage him to take this interest in himself or to point out the advantages he would gain thereby, and in his walks seldom gives the thought of getting more intellectual knowledge one moment's consideration. Of course, we have all heard the remark (and in some cases only too true) that 'The man who enlists is lazy and good for nothing;' but, on the other hand, there are numbers of good men who enlist who should be held up as examples to very many in civilian life, and who are a credit to their corps; and it is to such men as these that the instruction now in question would be of advantage, and by them welcomed, that, while employing their spare time, they would be reaping some beneficial knowledge that would materially assist them on discharge. I venture to answer again for a great number, and express my confidence in them as making valuable servants in any capacity or in any technical branch it may have been their good fortune to obtain a knowledge of. Again, it would be the means of helping to keep the company and regimental sheets clear, thereby reducing drunkenness and other offences to a minimum, as the temptation to these is ofttimes the outcome of spare time and the absence of employment for the mind, and not (as is often supposed) always the man's inclination. I consider, therefore, if such inducements as the instruction mentioned were held out, we should have great numbers grasp the opportunity, and the prowess of our army raised to a still higher degree; crime and desertion would be reduced and recruiting promoted; thus elevating the men and placing them in a position to compete with others in the field of commercial enterprise, after having served their country faithfully and well in the British army."

Lathe.—F. S. G. (*Fenton*) writes:—"Referring to the description of the improved arbor for the eccentric chuck described in Work, I saw one over thirty-two years ago, made by Thomas Lockett, an ingenious mechanic of Hanley. His was of brass, with two folding leaves to form segments of circles. I made one on similar lines, but without the leaves. With it I can cut an eccentric pattern 5⅜ in. in diameter. I coned out the slide, screwing it to its place, and boring a large hole in the centre, putting the rest up to it. Then I coned it out with a three-sided hand tool, so that the hole was perfectly central. I then got a piece of brass a trifle larger than the hole, bored a ½ in. hole in the centre, and put it on a mandrel, turned it to the same taper, and ground it into the slide. Then I recessed it on the back side, and put three ¾ in. screws at equal distances apart into the back of the click-wheel carrying the nose, and it runs perfectly true."—[Why did you not describe Thomas Lockett's "folding leaves to form segments of circles?"—Ed.]

II.—Questions Answered by Editor and Staff.

Cement for Battery.—Electric.—Thoroughly dry the wood, clean the joints free from dust, then run in melted pitch. I know of no other cement that will prevent leakage in a wood box destined to hold sulphuric acid. But why use wood at all? Even when lined with pitch it is a miserable makeshift for a good glass or stoneware battery cell. The solution may be one part acid to twelve parts of water. Zinc plates are said to be amalgamated when coated with mercury—that is, quicksilver.—G. E. B.

Sectors of Induction Machine.—J. P. (*Hull*).—You are quite right. The brushes rub against the brass sectors on the outsides of the glass plates.—G. E. B.

Ebonite Cells.—J. P. (*Hull*).—Ebonite cells can be obtained of Messrs. King, Mendham & Co., Bristol. The nearest size they have to your measurement is 4 × 1⅞ × 1⅞, price 1s. per cell.—G. E. B.

Leyden Jar Battery.—J. M. (*Nantwich*).—The Leyden jar is a condenser or store for electric charge, but it is not the most portable, convenient, or best form of condenser. This jar or bottle form is adopted because it is easily grasped in the hand; but a battery of such jars is cumbersome. The condensers used with induction coils are the best types of condensing batteries. A glass plate coated with tinfoil, as you suggest, has been frequently substituted for a Leyden jar, and is named a "fulminating pane." Condensers built up of alternate sheets of tinfoil and glass make very compact and powerful substitutes for Leyden batteries. There is no more danger of the charge going over the edges of the plates (if the foil is kept away 1 in. from the edge all around) than its escape over the edges of paraffined paper. In charging a pane, connect one surface of foil to the machine and the other to earth. The two surfaces must not be connected together to charge them. When connected, they at once discharge their store.—G. E. B.

Fuller Battery.—G. D. (*Holloway*).—To force the necessary volume of electric current through the wire coils of an electric bell, pressure must be obtained, and this is named electro-motive force, represented by the letters E.M.F. Now the E.M.F. of one Fuller cell is 1½ volts. If we connect two cells together we double the pressure, and get an E.M.F. of 3 volts; consequently, we get enough pressure to send the current through the bell coils. I think this will clearly show you why the bell did not ring with only one cell. The formation of crystals is a natural consequence of working the solution in a Fuller cell. They may be easily dissolved in warm water. If you use chromic acid instead of bichromate of potash, you will do away with the crystals of which you complain.—G. E. B.

Transferrotype Paper.—Driller.—Eastman's transferrotype paper can be obtained of the Eastman Company, Oxford Street, W.—D.

Faded Photographs.—O. B. (*Wood Green*).—The only plan for restoring faded photographs or, rather, removing the yellow tint, is by placing the print in a 10-grain solution of bichloride of mercury in water, and washing. There are faded *and* faded prints; some may be improved by this method, and some not. If the detail has absolutely gone, no kind of known treatment will restore it; but if the print has yellowed, and traces of half-tone remain, the mercury treatment will very much improve it, by destroying the yellowness that partly obliterates the shading—thus giving it greater contrast between the lights and shadows, and rendering it more suitable for copying.—D.

Mouldings.—J. S. (*Derby*).—Write to Murells', of Great Saint Andrew Street, London, for their catalogue. They have a very large assortment of every kind of picture-frame mouldings, and are the cheapest people I know in the trade.—E. D.

Boot and Shoe Making.—Cobbler and others. Articles on Boot and Shoe Making appeared in Work, Nos. 165, 168, 173, 176, and 182.

Fortune-Telling Machine.—H. B. (*Brighton*).—An illustrated paper is in hand, and will be inserted in our next number.—Ed.

"Diamond" Frame.—A. B. (*No Address*).—To reply to A. B. fully would go far beyond the range of "Shop." A. B. will find all he requires if he will read up, in back numbers of Work, the series of papers on Cycle Construction.—A. S. P.

Replating Bicycles.—A. F. S. (*Slough*).—Any cycle shop will get bicycle parts replated; or send them direct to Brown & Evans, 63, Farringdon Road, London, E.C., or Diamond Plating Company, Spon Street, Coventry. There are scores of others about London.—A. S. P.

Waterproof Cloth.—Airproof will have to make application to the manufacturers of waterproof goods for information on this point. Apply to Chas. Macintosh & Co., 30, Fore Street, London, E.C., or Cambridge Street, Manchester.—A. S. P

Bicycle Parts.—Anglo-Australian.—(1) Steel springs are bent, before tempering, on mandrels. (2) The wire is steel, and the springs are tempered after being coiled. (3) The wire may be purchased of any of the numerous wire workers of Birmingham. Probable wholesale cost, 4d. to 6d. per lb.—A. S. P.

Tinman's Tools.—T. D. (*Marriston*).—The best firm to apply to for list of tinsmith's tools and machines is J. Rhodes & Sons, Grove Iron Works, Wakefield.—R. A.

Camera Fittings.—G. W. A. (*Borough, S.E.*).—The address of Lonsdale Bros. is 3, Cookridge Street, Leeds. They should advertise in Work.

Musical Box.—M. J. M. (*Southsea*).—An article on How to Repair a Musical Box appeared in Work, No. 54.

Zinc Working.—H. D. (*North Shields*).—Messrs. Treggon & Co.'s address is 19, Jewin Street, E.C.

Electric Shocks.—F. W. W. (*Leeds*).—I am no advocate for administering electricity to human beings, unless by medical men or people who are thoroughly competent. If you must have your own way, let me advise you to make your coil in such a manner that the strength of the current can be regulated either by yourself or the person operated upon, but on no account give single smart shocks. As to the laws and construction of coils, let me draw your attention to a series of papers now appearing in Work by Mr. Bonney, to be followed by others that will embrace all you require. Those that have appeared up to now are to be found in Vol. IV., Nos. 157, 160, 164, 168, and 170. You would do well to study these carefully.—J. B.

Mandoline.—R.W.B. (*Harebell St.*).—The Italian mandoline is an instrument which requires the greatest skill in the making, owing principally to the peculiar construction of the pear or canoe-shaped body. These require special appliances; in fact, it is a trade by itself, and one that is only to be acquired by long and diligent application. It is quite beyond the scope of "Shop." There is, however, a mongrel kind of instrument, a cross between a Spanish bandurria and a mandoline, and known as the American mandoline, which comes fairly within the capabilities of the amateur, and a description of which, with working drawings, appeared in Vol. II., page 229, of this journal.—R. F.

Pulleys.—Triple.—In the sketch sent us, the two pulleys shown only act as "fair leaders," and do not, and cannot, as arranged, give any increase of power; this could only be obtained by using the pulleys as in a double- and single-block tackle, and their application, as shown, gives no advantage over the use of the single pulley, B. In regard to the question of dealing with an unprotected invention—as to submitting it, in its unprotected state, to anyone, more especially to the mere commercial mind—we have so constantly placed the difficulties of the case before the public in our pages that we thought our readers would have pretty well understood it by this time. We can assure Triple that, unless the invention *will* "suit the purpose intended," he has nothing he could treat with, and nothing which is of any value. We can only advise Triple to submit the matter in confidence to a respectable expert in the line at a consultation, and pay him his usual fee, when he will learn if the invention is, or can be made, good for anything, and get some hints to guide him.—C. E.

Flow of Water.—Workite.—The velocity of water under any given head is, theoretically, that of a solid body falling from a height equal to that head, but the pipe friction, or that of an adjutage, modifies the velocity. I give you some practical formulæ, but, if you wish to know how these are determined, you should read Downing's "Treatise on Hydraulics." The constants are taken from "Smeaton's Experiments." Flow of water through orifices:—Let Q = cubic feet discharged per minute, h = height of water surface in feet above orifice, and S = area of orifice in square feet. Then:

$$Q = 297{\cdot}6\ S\sqrt{h}$$

$$S = \frac{Q}{297{\cdot}6\sqrt{h}}$$

Flow of water into conduit:—Let v = velocity in feet per minute, s = sectional area in square feet, l = length of channel in feet, and c = wetted perimeter in feet.

$$v = 774{\cdot}6\sqrt{\frac{h.\,s}{l,\,c}}$$

$$Q = 774{\cdot}6\sqrt{\frac{h,\,s^3}{l,\,c}}$$

Flow of water through pipes:

$$Q = 2356\sqrt{\frac{h}{l}} \times d^2$$

You do not state how the water is to be delivered, but one or other of the above formulæ must be applicable.—F. C.

Engineering Drawings.—J. W. G. (*Keighley*).—The best and quickest method of obtaining a few copies of working drawings for distribution in the workshops is to use one of the "blue-print" processes. In all of these a tracing of the drawing has to be made and exposed, in a glass-fronted printing-frame, to the daylight, with a sensitised paper behind the tracing. The cheapest method is the ordinary "blue print," in which the paper, after exposure, only requires washing in water to produce a copy of the original tracing in white lines on a blue ground. Other methods, giving blue or black lines on a white ground, require certain chemical treatments. The various papers and chemicals for any of these processes can be obtained at any stationer's where drawing-office materials are sold. If the querist is desirous of making his own materials—which is scarcely advisable, as they can be bought at reasonable prices—let him consult "Shop" in Work, Vol. III., Nos. 143 and 145; also Molesworth's "Pocket Book," back volumes of the *English Mechanic*, or any of the photographic journals.—A. B.

Roller Bearings.—H. C. M. (*Liverpool*).—Your query—"What is meant by 'independent' roller bearings?"—is somewhat vague. The term roller bearings may mean the bearings at each end of a roller, or a bearing constructed so as to have rollers lengthways along the journal or, rather, so that the shaft journal may lie and revolve within the aforesaid rollers, in the manner of a ball bearing. Please write more than three lines, and let me know for what class of mechanical work you wish or have heard they are used, and I will give you all the assistance that lies in my power.—T. R. B.

Bookbinding.—H. J. C. (*Hampstead*).—There are a good many books published on Bookbinding which profess to deal with the subject in a practical manner, but they all treat it too much in the high art point of view for my taste, and I am sure you would not find any of them to be of much use to you. A series of articles has been published in WORK, Vol. II., which is just what you want. You should write to the publishers for the numbers, and study them well.—G. C.

Telescopes.—H. W. (*Byfield*).—I am glad to find that you have succeeded in making a telescope which has excited your appetite for a better one. As you say, achromatic refractors are expensive as compared with silvered glass reflectors, though this must be remembered: that the fixing and adjusting of an object-glass is far less difficult than adjusting a speculum with its "flat." But this can be done by an amateur who has the desire for knowledge and also the aptitude which you evince. Nowadays, it is not worth while to make a speculum of metal. As you suppose, I have read the excellent articles by Mr. Francis on Speculum Grinding, and I am certain that you could, by carefully following out his instructions, produce work which would be beyond your present expectations. You say, "I am not a clever mechanic." What if you are not? There are but few such—I mean naturally—and all of these do not produce useful work. The true definition of genius is "hard work." Reading between the lines of your letter, I believe you can do hard work. You further say, "I am only a grocer's assistant." What in the world has that to do with it? Does a man's calling dignify him or give him brains? Surely not, but rather a man can dignify his work. What was Herschel? only a poor music teacher; Davy? an apothecary's apprentice; Franklin began life by helping his father to make candles; Faraday? an errand boy; and the last could be multiplied by thousands. The best work in the world has often been done by those who have created their own circumstances. No man speaks worthily of himself who says, I am only this or that. If you are a fairly young man, there is nothing to prevent you from doing splendid work, provided you have "stick." Do not begin a thing and then give it up because it is hard. My advice is, Follow out the instructions of Mr. Francis in all matters, and I am confident that, in the end, you will succeed. If another word of encouragement is needed, I would say that one of the finest speculums I ever used was made by a ministerial friend of mine of the name of Clarke, who some years ago went to America. He at first took it up as a means of recreation, having had no special training for it. He ultimately succeeded in producing the finest work. I think I may say this much—that there is not a writer on the Editor's staff but will be glad to help you all in his power.—O. B.

Polishing Fretwork.—A CONSTANT READER.—It is a most unusual thing to be asked to French polish the interstices of fretwork; the usual plan is to polish the flat surface only. Much of our best work, notably on pianos and organs, is thus treated, though on the former they are sometimes blacked inside. This is best done by—previous to the final cleaning off—brushing in some vegetable black mixed with weak glue-size, and allowing it to quite dry before cleaning off and glass-papering. The plan of oiling the interstices sometimes adopted cannot be recommended unless the precaution is taken to kill the oil on the back by scraping and giving a good wet rubber of polish. If you still wish to polish the cut-out portion, you must apply the French polish or spirit varnish carefully with a camel-hair brush, wiping off any surplus from the face of the work with the palm of the hand or pad of cloth as you go along, while it is still wet. Care must then be taken to keep the polish rubber quite flat when polishing the flat surface to avoid fat edges.—L FEBOAT.

Hellesen Dry Battery.—E. J. (*Plumstead, S.E.*).—Messrs. Siemens Bros. & Co., Ltd., have kindly supplied me with the following information respecting the Hellesen dry battery: "From the exhaustive tests to which we have subjected the elements in question, we have no hesitation in saying that they are the most satisfactory and efficient dry cells in the market. They are very constant, possess great recuperative power, furnish the greatest number of ampère hours of any dry battery, have small polarisation, are not affected by changes of temperature, are portable, always ready for use, and require no previous preparation whatever. The cells require no attention, are always clean, and, when once installed, can remain until completely exhausted. With regard to renewals, we do not recommend recharging when exhausted, as the old cells can only be recharged by taking them entirely to pieces and renewing nearly all the parts, and the value of such parts of exhausted cells as can be again utilised is too insignificant to be taken into account in comparison with the cost of labour for dismantling and remounting the cells. The most economical plan is to replace the exhausted cells by new ones. When fairly used for such purposes as telegraphing, ringing bells, etc., the cells last for a considerable time; but, being comparatively a new article of trade, we have not yet been able, from actual experience, to ascertain the duration of their life. We may state, however, that cells which have been in constant use for over two years are still working well. We do not recommend this class of battery for small electric lamps. The No. 1 size may be used for working induction coils.—G. E. B.

Zither.—G. H. (*Pietermaritzburg*).—(1) The most serviceable form of zither is the solo instrument—known as the "Horn" or "Prim" zither—an outline of which you will find given on p. 550 of No. 139, Vol. III., of WORK. The other shape is that of the "Elegie" zither, which is most suitable for slow movements, or as an accompaniment to the voice; hence its English name—the "Song" zither. A zither of the form I recommend costs, in England, anything from 21s. to £10; but a capital instrument, perfect in all the essentials, should be obtainable for about £2 10s. Naturally, a higher price will have to be paid in the colonies, in the chief cities of which zithers are, no doubt, obtainable. (2) As to how to learn, the best way is, undoubtedly, to find someone who plays, and get them to give you a few hints. In a place like Pietermaritzburg there are, no doubt, many Germans, and among these you will probably find a player. (3) The metallic strings are wires, either of steel or brass, covered in the same way as are the usual silk strings. Each is made specially to produce a given note, and, with care, these will outlast several sets of gut and silk. I have had metal sets in constant use for three years, which shows how much more economical they are than the ordinary ones, not to mention their great superiority in brilliancy of tone and "timbre."—OLD TEACHER.

Motor.—V. W. (*Dewsbury*).—If you have sufficient length, fix a pulley on axle of driving-wheel a little less than that on motor. If not, fix an intermediate shaft with 10 in. or 12 in. pulley, and a pulley about half the size of that on the motor, and connect as shown in sketch. I am afraid the ½ in. pipe is too small; ¾ in. would be much better. You might, however, try it as it is there, and if not satisfactory, fix a larger pipe. Fix them as far apart as possible, to get a longer length of belt. You might use a flat belt from motor to intermediate shaft.—M.

Indiarubber Moulds.—V. W. (*Dewsbury*).—The moulds are generally of metal, pressure and heat being applied. A little French chalk could be put in the mould to prevent sticking. A good description is given in Vol. I. of WORK, under the heading of Indiarubber Stamp Making, which would be of service to you. You might procure the indiarubber from the manufacturers of such goods, who advertise largely. The rubber can also be dissolved in chloroform, in which state it might be moulded. You might try the cement used for fixing bicycle tires. Thornton's is a very good make.—M.

Polish for Counter. — SPIRITS. — For public-house use these should not be French polished, as this finish is not spirit proof; only the moulded front edge should be thus treated, the flat portion being oil polished, the same as dining-tables—this being the only known method that will resist hot glasses, etc. First wipe over with red oil, made by soaking ¼ lb. alkanet root in 1 pint linseed oil; "fill in" with finely-crushed whiting coloured to match with Venetian red and made into a thin paste with turpentine. Wipe off clean, then give the whole a good wet rubber of polish to set the "filling," finishing off the front edge as advised. For the flat portion, 1 pint of linseed oil to be simmered (not boiled) for ten minutes, and strained through flannel, then add 1 oz. of turpentine; to be applied daily with soft linen rag and wiped off lightly.—LIFEBOAT.

Photograph Colouring.—H. S. C. (*Plymouth*).—The process our correspondent alludes to is one of a great number of similar plans under different fanciful names, which, when carefully done, produce pleasing results. The method is to procure two unmounted prints and a piece of curved glass similar to a watch-glass. They are sold oval and cushion-shaped—that is, oblong with the corners rounded off. Attach one of the prints, made thoroughly wet with a weak solution of gelatine, face to the concave surface of the glass, pressing it carefully so that there are no air bubbles enclosed between the print and the glass; allow it to dry, then with a little moisture and by dint of careful rubbing with the finger-tips remove as much of the paper as possible from the back of the photograph, leaving little else than the film of albumen on which the image is impressed. When quite dry, render this transparent by brushing over it some crystal varnish. The varnish being dry, paint rather strongly over the picture with suitable colouring; then, when these are dry, attach the other print over the first one in perfect register. Sometimes a little colour is put on to the second print; it is quite a matter of taste, and according to the effect desired. The two prints are now allowed to thoroughly dry, and then are backed up by filling the cavities on the back of the prints with Paris plaster. The painting must be done strongly, and no very great nicety is required, the light and shade in the photograph supplying the modelling. The pictures can be mounted on flat glass, but then the backing must be something different. This is the principle by which almost all the processes for colouring photographs that are supposed to require no artistic skill are done, although, it goes without saying, the more artistically they are done the better they are. The other method of colouring photographs is the same as usually adopted for ordinary water-colour paintings.—D.

Vulcanite.—F. D. (*Birmingham*).—The Indiarubber Co., of Silvertown and Cannon Street, London, are manufacturers of vulcanite. Most of the vulcanite sold in England is made in France.—E. D.

Certificate.—A. D. Y. (*Notting Hill*).—The meaning of the words "advancing money on certificate" in your case implies that the owner of the land, or his representatives, will advance you a certain sum of money on receiving the certificate from the architect, surveyor, land agent, or other qualified person that you have performed a certain amount of work. The amount of work and the rate of payment are generally specified and signed with the agreement.—E. D.

Sanitary Science.—W. H. J. (*Manchester*).—The examination for inspector of nuisances occupies a portion of two days, the first day being a written examination of about three hours, and the second an oral examination, with one or more questions to be answered in writing if deemed necessary. Fee, three guineas if in London, but when the examinations are held in provincial towns, one guinea extra is charged. The examination embraces the following subjects: The provisions of the Acts and model bye-laws relating to the duties of inspectors of nuisances; a knowledge of what constitutes a nuisance; methods of inspection of dwellings, cellar dwellings, dairies, milkshops, markets, slaughter-houses, cow-sheds, and nuisances especially connected with trades and manufactures; the physical characteristics of good drinking water; the various ways in which it may be polluted by damage to supply works or in houses, and the means of preventing pollution; methods of water supply; the characteristics of good and bad food (such as meat, fish, milk, and vegetables); the Sale of Food and Drugs Act; the regulations affecting persons suffering or recovering from infectious diseases; the principles of ventilation, and simple methods of ventilating rooms; measurements of cubic space; disinfectants and methods of disinfection; a knowledge of the general duties of the office; methods of keeping the necessary books and records; writing and spelling; the proper conditions of good drainage; the advantages and disadvantages of various sanitary appliances for houses; inspection of builders' and plumbers' work; scavengering and the disposal of refuse.—E. D.

Wire Picture Cords Gilt.—A WORKER.—Picture cords, as per samples, can be obtained at Messrs. Bramah & Son's, Fargate, at 1s. 3d., 2s. 6d., and 2s. per dozen yards; and I think I may safely say that you will not find the manufacture of this gilded wire pay you. A large majority of picture wire is made in France, and in Birmingham they also produce this material very cheaply and of good colour. But this colour will not last, soon turning black, caused by the sulphur from the coals, which is materially assisted by the consumption of gas; so that these cords are of little use, except in the country. If you want a really good picture wire, you must have the wire electro-gilded; this can be done by Messrs. Rylands, Limited, Eyre Street, Sheffield, at from 6d. to 9d. per running yard. This, of course, is expensive; but, should the wire become discoloured, you could take it down and wash it with hot water, using a *very soft brush*, and the least suspicion of good yellow soap, and after rinsing in clean water, the wire would look like new, so that the greatest expense in the beginning would really be cheapest in the end.—N. M.

Reeds.—W. J. (*Ruddington*).—In order to answer this question I have made three vibrators just like harmonium vibrators; one tongue of Italian walnut is the best, one of American black walnut next, and one of pear wood not so good; but the tone of all is better, I think, than brass. The largest gives C C 8 ft., the *mortise* of which is 2½ in. long and not quite ⅜ in. wide. The thickness is about $\frac{1}{16}$ in. near the fixed end, and at the free end a piece about ¼ in. square and ⅛ in. thick is glued on to lower the pitch. I have had no opportunity of trying other woods, but I believe box or rosewood would do well. It is only for pedals or sub-bass that I should use such reeds, and I believe anyone who tries will succeed in making them. Size has not much to do with the pitch, but weight and flexibility have much, and the safest plan is to make the tongue too stiff and file it down till it speaks; then glue block on free end, and if too flat in pitch, reduce the weight of the block with file.—B. A. B.

Playing Cards Case.—DOCILE.—A short illustrated paper appeared in No. 188.—ED.

Phonograph.—PHONO.—I do not know anything about your former question *re* above; but you must not confound the phonograph described in WORK with Edison's instrument with its hollow cylinders. The tinfoil in the instrument in WORK corresponds with the hollow cylinders in the other, and the foil can be removed and replaced upon the instrument at will. The plaster cylinder can be replaced by cast iron or brass, but still the tinfoil would be necessary to take the record. I trust that these remarks are a sufficient answer to your questions.—W. D.

Phonograph.—W. W. H. (*Winfield*).—You ask for my address that you may ask me a few questions and suggest an improvement in the phonograph described by me in WORK. Now, while I quite appreciate your kindness, still I cannot send my address, for two reasons: the first being that I prefer that all correspondence relating to the subject should appear in WORK, *pro bono publico;* the second that I am constantly travelling about, and am never longer than one week at a time in any place. Any questions you may have to ask please do so through WORK.—W. D.

Prepared Paint.—CAM.—This is a difficult matter, but you might try covering them with water, pouring it on gently. I tried an experiment with some tube colours which I had mixed on a palette, and kept them in order three or four days by laying the palette in a tray of water. There will be a difficulty in getting the water off, but you could draw it off with a syringe. The brushes should have the colour cleaned out of them with turpentine, then be washed with soap and water, and dried. If you are using small quantities of oil paint occasionally, you should get the colours in collapsible tubes. You could then take out only the quantity required.—M.

Whitewash.—NO NAME.—Wash and scrape off as much of the whitewash as you can, then brush the bricks with a weak solution of hydrochloric acid and water. If this does not remove all, brush the bricks over with a solution of green copperas—about 3 oz. to a gallon of water—keeping it off the joints.—M.

III.—QUESTIONS SUBMITTED TO READERS.

**** The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Fret Whatnot.—A NEWBIGGIN FISHER LADDIE writes:—"Would some reader, taking an interest in fretwork, tell me how to make a whatnot in fretwork; also, what kind of wood is best, and where to obtain it; or tell me where to get a pattern for same?"—[See WORK, No. 128.]

Inlays and Stringings.—A. W. (*Liverpool*) writes:—"A reader of WORK would like to know the best trade shops for inlays and stringings in London."

Cycle Tire.—CYCLIST writes:—"Could any reader of WORK inform me how to repair and fix a broken indiarubber tire of bicycle?"

Hot-water Apparatus for Warming Rooms.—W. T. (*Southsea*) writes:—"Could any reader of WORK kindly inform me of the address of a firm who would fix apparatus for warming my house by hot-water pipes at a moderate cost?"

Razor Grinding.—A. E. B. (*Ashford*) writes:—"Can any reader of WORK inform me of a reliable firm who undertake the hollow grinding of razors, as the hairdressers here send them to Germany, which takes sometimes six weeks in transit?"

Moles.—G. B. (*Elmstead Heath*) writes:—"Will any kind reader inform me how to make an inexpensive electrical contrivance for killing moles?"

Model Engineers.—L. C. (*Coventry*) writes:—"Will any reader kindly give me the addresses of model engineers in the Dominion of Canada?"

Model Engine.—G. S. (*Guernsey*) writes:—"Where could I get a good model of a steam or clockwork engine from which I could work?"

Chronology.—KRONOS writes:—"Will some kind reader of WORK inform me what is meant in chronology by 'year of the world;' also, what would be the approximate number of years B.C. of such dates as 3900, 2800, 1000, all 'year of the world' chronology?"

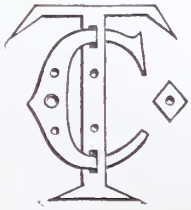
Monograms.—W. H. W. (*Castleton*) writes:—"Will anyone oblige me with designs for the monograms 'E. L. E.' and 'P. L. V.', suitable for fretwork?"

Conjuring Tricks.—A. B. C. (*No Address*) writes:—"Will some kind reader give a few conjuring tricks?"

Barometer.—W. T. T. (*Houghton-le-Spring*) writes:—"I have heard of a barometer or weather-glass made out of two bottles, with a glass tube passing from one to the other. Could any kind reader tell me how to make one?"

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

"C. T." to Carve in Oak for Panel.—C. K. (*Stratford*) writes:—"In WORK, No. 159, p. 46, M. (*Prince's Park*) asks for a monogram. I trust this one may suit him."



"C. T." Monogram.

Firewood.—M. (*Bishop Auckland*) writes to J. (*Penge*) (see No. 181, p. 398):—"You can procure a machine for cutting and bundling firewood from M. Glover & Co., Holbeck, Leeds. If you cut it by hand, put the wood into an iron ring for bundling. One of the cheapest methods of obtaining wood is to buy it from old buildings which are being pulled down. You can procure cuttings, short ends, and slabs from saw mills. Old railway sleepers are also sometimes to be had at a low price."

Musical Glasses.—J. T. (*Huddersfield*) writes:—"MUSICAL must procure glasses the proper note or 'pitch' required, as he would find it very tedious work keeping his glasses in tune with water. I remember a very nice-behaved and clever performer on glasses came our way once, and he had, perhaps, three octaves fixed in a mahogany frame; and the way he handled those glasses was a treat to hear. He asked for a broken wineglass or two, on the chance of them being some particular note he might want. MUSICAL must wash his hands very clean, get some clean water in a glass, and dip his fingers in again and again, and, rubbing round the edge of the glass, he will in a few minutes be able to make a sound which practice will perfect, water being all that is required."

"P. H. P." to Carve in Relief.—C. K. (*Stratford*) writes:—"VULCAN asks for a monogram. I trust this one may suit him."

Relief Monogram.

Carbonate of Potassium.—H. B. S. (*Liverpool*) writes to JEWELLER (see No. 166, p. 158):—"This is bicarbonate of potassium, otherwise bicarbonate of potash, so that if JEWELLER goes to anyone of the chemists he has been to and asks for the latter article, he will, no doubt, get what he wants. Strictly speaking, acid-carbonate of potassium is not the right name to use, because this salt is alkaline; but as the generality of this class of salts are acid, the name is sometimes employed instead of the prefix 'bi-.' The acid salts contain twice the amount of acid that is required to form the neutral salts, so that bicarbonate of potash contains twice as much carbonic acid as the neutral salt, which is also alkaline. The terms 'acid,' 'neutral,' etc., are only relative terms, not absolute ones."

Camp Cot.—V. D. (*London, W.*) writes to F. K. (*Staveley*) (see No. 167, p. 174):—"A description and illustration of this will, I understand, shortly appear in WORK."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—A. J. S. (*Watford*); W. H. H. (*Harboro'*); R. K. (*Newcastle-on-Tyne*); E. D. (*Hanley*); H. S. G. (*Macclesfield*); TYPER; R. C. (*Skipton*); J. I. (*Liskeard*); W. J. (*Stone*); H. K. (*Ipse*); OUT OF WORK; CONNISHMAN; G. M. (*Haverhill*); W. W. (*Brierley Hill*); J. R. (*Bishophill*); AN AMATEUR; THE DRAPER'S RECORD; E. T. M. (*Ealing*); VIBRATILE; W. M. (*London*); W. H. M. (*Cradley Heath*); SAWSTICKS; R. P. (*Stoke-on-Trent*); S. S. (*Kensington, W.*); A CONSTANT READER; P. E. B.; TIRO HUDD; ANXIOUS; W. J. (*South Wales*); W. C.; C. H. (*Newcastle-on-Tyne*); F. C.; J. C. L. (*Derry*); NOVICE; H. J. M. (*Bristol*); W. E. R. (*Bay View Terrace*); J. L.; J. W. E. (*Earlstown*); BUROY JOE; BONO; W. H. (*Stratford*); METRONOME; BANGOON; J. H. (*Stockton-on-Tees*); E. A. P. (*Beckenham*).

"WORK" PRIZE SCHEME.

FOURTH COMPETITION.

"Tourists' Road, Water, or Rail, Travelling Requisite" Competition.

To give zest to, and widen the field of original research, such an outfit might, for instance, combine with it some useful appliance to be used in case of emergency—such as life-saving, or in pleasure hunting while holiday bent. This we must leave to our readers' judgment, and feel sure that anything to make travel more enjoyable will be welcomed by the public and the readers of WORK who have to travel. By the time this announcement is made most of us will have had some experience of holidays and the pleasures (?) of luggage. For the three best suggestions for an "Improved Tourists' Travelling Requisite," the following prizes will be awarded—

First Prize, £3;

Second Prize, £2;

Third Prize, £1.

CONDITIONS AND RULES OF THE "TOURISTS' TRAVELLING REQUISITE" COMPETITION

ALL Descriptions to bear the WORK Prize Coupon, cut from one of the numbers of WORK in which the Prize Scheme is announced.

Each Description to be signed with an original *nom de plume*, and to have the writer's real name and address securely attached to the manuscript in a sealed envelope.

Each Suggestion should be fully described in respect to its purpose, construction, and working, and, where possible, should be illustrated with a drawing of the article itself and its various parts, to elucidate the description.

A Suggestion not illustrated will have an equal claim in the competition, provided the description be sufficiently in detail to convey a full idea of the article suggested.

In the work of judging regard will be had to the practical nature and utility of the suggestions, and their prospective popularity.

The Prize Suggestions and Drawings, and any others, to be published, if desired by the Editor, in WORK, but the copyright thereof to remain with the authors.

Copies of MSS. and Drawings to be retained by the competitors, as in no case can the return of MSS. be undertaken.

The Editor of WORK will supervise the judging of the Suggestions, and the selection, or decision, as determined upon by him is to be final.

All manuscripts intended for the "Tourists' Travelling Requisite" Competition must be addressed to the Editor of WORK, c/o Cassell & Co., Ld., Ludgate Hill, London, E.C. They must reach him on or before Saturday, October 29, endorsed, "Tourists' Travelling Requisite" Competition.

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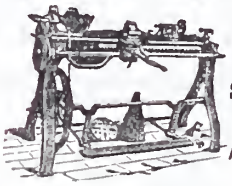

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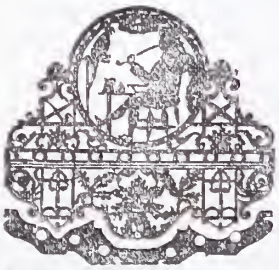

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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VOL. IV.—No. 190.] SATURDAY, NOVEMBER 5, 1892. [PRICE ONE PENNY.

WORK WORLD.

THE consumption of building wood in London is about 8,000 standards per week, and at £10 10s. per standard this represents a large amount of money expended on timber.

* *

There is now a pneumatic despatch tube from Paris to Berlin. Letters placed in the receiver at the former city reach their destination in an hour and a half, and sometimes as soon as thirty-five minutes.

* *

The largest rotary crane in the kingdom is being erected in the coke-yard of Saltley gasworks. It will have a radius of 75 ft., and will lift two and a half tons of coke at a time to any part of the area covered by its circuit.

* *

Gold output from Withwatersrandt was 4,600 oz. higher in September than in any previous month. If September's total of 107,851 oz. is maintained to the end of the year, the aggregate for the twelve months will represent a value of £4,200,000.

* *

Numerous tramcar accidents are caused by axle breakages. One great cause of failure exists in using "square collars." It should be remembered by those responsible for the construction of the cars that square collars often lead to a sudden snap.

* *

Ceylon has held the monopoly of supplying plumbago. Recently deposits have been discovered at Travancore, in India; the quality, however, is not equal to that of the Ceylon product. Plumbago deposits exist in Greenland, but difficulties of climate and transit prevent their being worked.

* *

Progressive is Japan. An electrical science periodical is now published in the Japanese language. This language appears to be incapable of accommodating itself to algebraic formulae, which has to be printed in the ordinary characters. This presents a curious appearance, set on end in vertical columns, with the Japanese letters between.

* *

English companies have enjoyed a monopoly in cable laying. Now, however, a cable has been laid from Marseilles to Oran, a distance of about 730 miles, by the "Société Générale des Téléphones Français." England, as usual. has expended her capital in experimenting and showing how a great work may be practically carried out with profit, and, thus taught, other nations follow.

* *

A coal-cutting machine at Eldon Colliery is driven by electricity. It stands 18 in. high, and weighs 32 cwt., and will cut stone as well as coal. It works at the rate of about 55 yards per hour when in full work, equivalent to 60 tons of coal. Thirty-two men have received notice to make way for this iron pitman, which requires only two men to work it.

* *

The Simplon Tunnel will, when completed, be the longest in the world—over twelve and a half miles in length. The power required to drive the drills will be obtained by damming the River Massa on the northern side of the tunnel, and from the River Cairasca on the South. The former will supply 1,550 horse-power, and the latter 2,760 horse-power. It is expected that the work will take eight years and a half for its completion.

* *

The telephone needs the open air to obtain the best results. To use wires placed underground, a metallic circuit will be necessary, similar to the one used on long-distance lines. To place the wires underground and to make a metallic circuit, which means to use two wires where one is used at present, will materially increase expenses, and the public must pay for the luxury. As the number of wires is increasing rapidly, it is evident that they must ere long be buried.

* *

One hundred and thirty bushels of wheat to the acre reads like fiction. General Sir Arthur Cotton has discovered a method of cultivating good wheat ground, by which it can be made to yield 130 bushels of wheat to the acre. The secret lies in deep digging and complete aëration of the soil before planting the wheat, then giving the wheat plants plenty of room to grow. He has tried the experiment on a small scale with great success.

* *

Burnley Corporation intend lighting the borough of that town with the electric light, and invite tenders for steam boilers, steam engines, fuel economisers, dynamos, accumulators, switchboards, cables, and travelling cranes. The Corporation of Accrington also propose the adoption of the electric light at a cost of £10,000 for plant. The Dublin Corporation have taken over the electric light works of that city. Increased activity in electric lighting is also observable in the metropolis, especially among private firms.

* *

Tin-bearing deposits of Burmah are of two kinds. First, there is the tin-gravel, which is found in most of the valleys, a mixture of rough white quartz pebbles with sand, garnet, black tourmaline, and grey cassiterite. The thickness of the gravel varies from one to six feet, and the yield is about 1 lb. of cassiterite—dioxide of tin—in 400 lb. of gravel. The country is uninhabited, and food has to be carried there. Chinamen are the chief workers. The second kind of tin-bearing deposit is eruptive rock, which is so weathered that grains of cassiterite can be washed out of it.

* *

Pennington's air-ship factory in Chicago has completed an aluminium car, which weighs 235 lb. The motor power consists of two beautiful little engines of alloyed aluminium. These engines each consist of four cylinders with four piston-rods attached to a single centre, and acting with reciprocal power. Hydrogen gas is exploded by an electric spark. One engine weighs a minimum of 45 lb., and has a maximum capacity of 15 horse-power. These engines drive the great wheel of four spoons that bores through the air auger-like and draws the ship after it, while the little fans on the sides elevate the ship or lower it.

* *

Packing rings made of cotton tubing filled with Portland cement are coming to the front. These can be used for making the joints of man-holes, flanges, and other connections, by wetting them thoroughly, laying them in place, and screwing them up, taking care to bring a uniform pressure over the whole circumference. Cement joints may also be made without the cotton covering. The cement is gauged into a thick paste with water, until it is of such a consistency that when plastered on a vertical wall it will neither fall off nor flow down. The surfaces to be jointed are carefully cleansed from grease, the cement laid on about ¼ in. thick, and the joint carefully screwed down to about ⅛ in. After setting for four to six hours, the screws are tightened again. This joint costs about one-twentieth as much as an indiarubber joint, and one-tenth that of asbestos and tallow.

THE ART OF STAIRCASING.

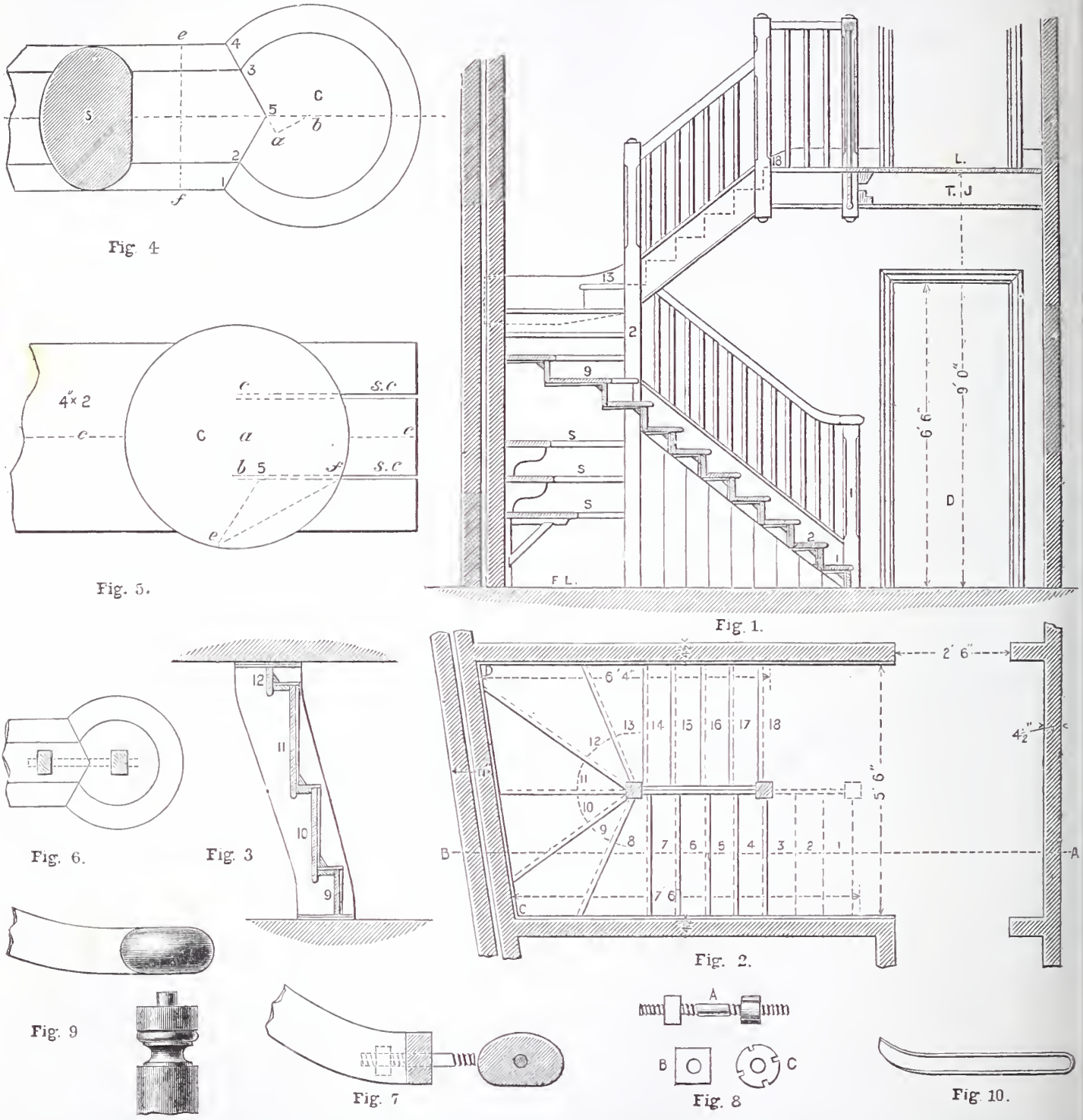
BY GEORGE F. CHILD.

STAIRCASE WITH HALF-SPACE OF WINDERS OVER AN OBLIQUE PLAN—SETTING OUT THE PLAN—SETTING OUT THE ELEVATION—LENGTH OF NEWELS—PLANNING STAIRS TO AVOID DOORS—CUPBOARD UNDER STAIRS—SECTION ON C D—DRAWING MITRE FOR CAP—BLOCK FOR CUTTING MITRE—JOINING RAIL AND CAP—NEWEL AND CAP—SKETCH OF BLOCK AND CAP.

Setting out the Plan.—As will be seen from Fig. 2, the arrangement of the staircase in our present example is over an oblique plan—that is to say, the outside (11 in.) wall is not at right angles with the walls forming the sides of our staircase. This often happens where the formation of the building plot is not square or at right angles with the frontage. The stairs having been set out as before described in No. 184, p. 441, the winders will present no difficulty, as they can be set out from one full-size drawing, which will, of course, have been drawn to the correct angle, as shown.

Setting out the Elevation.—The sectional elevation (Fig. 1) can also be set out as before. It will be observed that the line of section having been taken through the bottom flight from A to B, the portion of the winders cut by this line will also show as a section, as will the whole of the step or fliers below them, Nos. 1 to 7 inclusive. The upper portion will be as seen.

Length of Newels.—The bottom newel (1) must be rather longer than the newels we have seen before, on account of an easement on the rail, which terminates in a *cap*,



Staircasing. Fig. 1.—Sectional Elevation—F L, Floor Line; D, Door; L, Landing; S, S, S, Shelves; T J, Trimmer Joist. Fig. 2.—Plan—A, B, C, D, Section Lines; 1 to 18, Steps. Fig. 3.—Section on C D, showing Winders and String. Fig. 4.—Method of obtaining Mitre for Cap—S, Section of Rail; 1 to 4, Outer Line of Cap; 2 to 3, Line of Square; *f e*, Width of Rail; 1, 4 to 5, Mitre Line; *a b*, Width for Transference to Block; C, Cap. Fig. 5.—Block with Cap in Position—C, Cap; *c c*, Centre Line; *s c*, Saw Cuts; *e f*, Width of Rail; *e f* 5, Piece cut out for Mitre. Fig. 6.—Plan of Cap and Rail. Fig. 7.—Elevation of Rail, etched Portion showing the Mitre. Fig. 8.—A, Bolts; B, Square Nut; C, Round Nut. Fig. 9.—Connection between Cap and Newel. Fig. 10.—Handrail Punch.

as seen; the necessary length can easily be found by drawing the easement to the cap, which of course will be level on the newel.

Newel 2 may with advantage be long enough to take both top and bottom flights, and pass under the winders to the floor, thus forming a good support, and at the same time a post to which the door for the cupboard may be hung.

Planning Stairs to Avoid Doors.—Great care must be taken in all staircases to keep them clear of doors, etc., or otherwise unpleasant surprises may await us on taking them to be fixed. This can always be managed with a little attention.

Cupboard under Stairs.—It is often a matter for regret that more cupboard space is not provided in an ordinary house, as the housewife can always find a use for a good cupboard, no matter how large. In this particular the space available under a staircase is often neglected, when it might be turned to advantage at a very little cost.

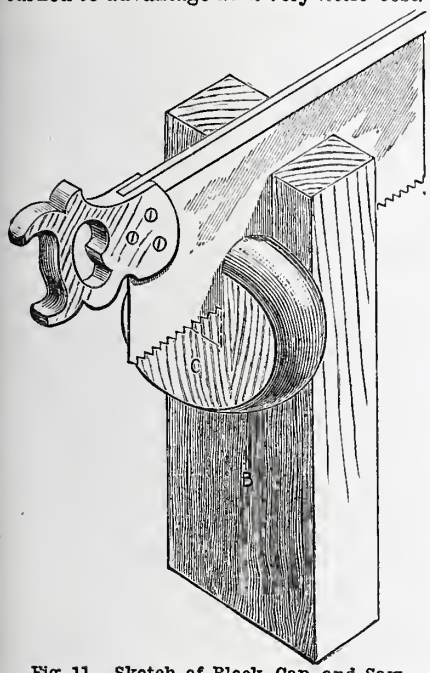


Fig. 11.—Sketch of Block, Cap, and Saw—B, Block; C, Cap.

In the present case a cupboard is shown in the section (Fig. 1), 1 in. match-boarding being nailed in the spandril under the bottom string, and shelves (s, s, s) being fixed on the walls, as found most convenient.

Section on C D.—This is merely a section to show the winders and string-board on the oblique wall. The method employed to set it out has been fully described in previous numbers of WORK.

Drawing Mitre for Cap.—This cap should be turned with the edge exactly the same section as the edge of the rail; this will, of course, depend on the shape of the rail. In the present case it is oval, as seen in section s (Fig. 4).

Draw the section s, also the lines *f*, *e* (these lines represent the width of the rail); now draw the outer line of cap 1 to 4. Next draw the line 2, 3, which gives the width of the square on the rail, and is for the balusters. Draw a line with the compasses on the cap, at the same distance from the edge, concentric with the outer line of cap. Now from the point 4, where the outer circumference of cap joins the line *e*, draw a line, cutting the point 3 where the inner parallel lines meet, and produce this line to 5. Now, by drawing a line on the other side through the points 1, 2 to 5, we obtain the mitre. This is as nearly correct as we can draw it without making a circular mitre.

Block for Cutting Mitre.—At Fig. 5 we have a method for cutting this mitre on the cap. Plane up a piece of quartering, say about 4 in. by 2 in., and draw a line down the centre, as *c c*; on each side of this line set off the distance *a b* (Fig. 4), as from *a* to *b* and *b* to *c* (Fig. 5). Now run a saw-cut down these lines, as seen at *s c*. Having thus prepared our block, mark on the cap C the extreme width of the rail as from *e* to *f*. Now bore a hole through the block on the centre line, and pass a long screw through into the back of the cap, thus fastening it securely. Now place the point *f* on the cap opposite the saw-cut, as seen, and run in the saw. Turn the cap over until the point *e* coincides with the other cut, and run that in also, thus obtaining the mitre. Other methods may perhaps be employed, but this is as good as any.

Joining Rail and Cap.—Fig. 6 shows the under side of rail and cap, with the holes cut to receive the nuts on the handrail screw. These are cut in to a convenient depth, and a hole bored in the centre of the *thickness* of cap and rail, with a twist bit of suitable size. The *square nut*, B (Fig. 8), is placed in the mortise on the rail, and the bolt is then turned in until it passes through the nut, leaving the other end to pass into the cap, as at Fig. 7.

The round nut is now dropped into the cap, and the bolt is pushed into it. Having started the nut, it is now driven home by means of the punch (Fig. 10), the thin end of which is passed into the slots on the nut, and gently driven with a hammer until sufficiently tight for our purpose.

Newel and Cap.—At Fig. 9 is seen a method of joining the cap to the newel. A pin is turned on the newel, and passed into a corresponding hole bored in the cap, into which it is glued and screwed.

Sketch of Block and Cap.—At Fig. 11 is shown a view of the block, with the cap fixed and the saw in position. This, it is hoped, will fully explain our meaning with regard to cutting mitre on the cap.

PHOTOGRAPHIC EXPERIMENTS.

CURIOUS, AMUSING, AND INSTRUCTIVE.

BY WALTER E. WOODBURY.

SPIRIT PHOTOGRAPHY—TO COPY DRAWINGS—PHOTOGRAPHING BRIGHT DISTANT LANDSCAPES—PRINTING ON SILK.

Spirit Photography.—Although spirit photographs are often believed by weak-minded persons to be the result of supernatural visitants, and have been a powerful agent in the hands of the fraudulent spiritualists, it is satisfactory to know that their manufacture is simple enough. While you are making a portrait of an individual, a confederate, dressed in a white sheet, should stand for a second or so behind the sitter. This will give a hazy sort of image, that can, with a fair stretch of imagination, be taken for any bygone relative. This method has its drawbacks, however, as the gliding in and out of your confederate is likely to attract the sitter's attention; then he might turn round, and spoil the fun. A far better plan is to make the spirit separately on the plate, either before or after exposure on the sitter. In a room made perfectly dark the draped figure, to represent the spirit, is posed in a spirit-like attitude in front of a black background. With a suitable lamp, light is thrown upon the figure. Next a fine piece of muslin gauze is placed close to the lens, which gives a cloud-like, indistinct appearance to the image. The exposure is made, and the latent image remains upon the sensitive plate, which is again used to photograph the sitter, with the result that, in development, the two images are made to appear at the same time, so that the sitter imagines that the spirit must have been hovering around him at the time the photograph was made. By the same means a variety of effects can be made—spirits floating in the air, mysterious hands, etc.

Another favourite method is to use a white background painted over with bisulphate of quinine, which photographs black. A spirit-like form is, however, left bare, and although not seen by the eye, this will appear as a white phantom in the picture.

To Copy Drawings.—There are three principal methods for copying mechanical drawings, tracings, sketches, etc. These are: (1) A process to obtain white lines upon a blue ground; (2) a process by which blue lines upon a white ground are obtained; and (3) a process giving black or violet-black lines upon a white ground.

The first process is undoubtedly the simplest, as after printing upon the paper it is developed and fixed by simple immersion in cold water; but, at the same time, the white lines on the blue ground are not so clear and effective as the other processes. The cyanotype paper, as it is called, can be obtained ready for use at any draughtsman's stores, but if you prefer to make it yourself, here is the recipe: Two solutions are made—20 parts of red prussiate of potash are dissolved in 100 parts of water, and 10 parts of ammonio-citrate of iron in 60 parts of water. These two solutions should be mixed together immediately before using, and the operation must be performed in the dark. Paper is floated on this solution, or applied with a broad camel-hair brush, and hung up to dry. If it is well dried and carefully preserved from light, moisture, and air this paper will keep for some time. After printing—which, when sufficient, should show the lines copied of a yellow colour upon a blue ground—the prints should be washed in several waters; and if a few drops of chlorine water or dilute hydrochloric acid be added to the washing water, the blue ground will appear much darker and the lines rendered clearer and whiter. By this method the commercial paper sold is generally prepared. The prints may, if desired, be changed from blue to black by immersing in a four per cent. solution of caustic potash until the blue is changed to yellow. After being well washed, they are laid in a solution of tannin.

In the process giving blue lines upon a white ground, it is necessary that the action of the light shall be to convert the iron compound into one that can be discharged from instead of being fixed on the paper, so that we obtain a positive from a positive. Abney describes the process as follows: 30 volumes of gum solution (water 5 parts, gum 1 part) are mixed with 8 volumes of a citrate of iron and ammonia solution (water 2 parts, double citrate 1 part), and to this is added 5 volumes of a solution of ferric chloride (water 2 parts, ferric chloride 1 part). This solution thus formed is limpid at first, but will gradually become thicker, and should be used soon after mixing. It is then applied with a brush to the paper (which should be well sized) and dried in the dark. Exposure is accomplished in a few minutes, the paper being placed under the drawing in the printing frame. It is then developed with

potassium ferrocyanide 50 gr., water 1 oz., applied with a brush until all the details appear of a dark blue colour. The print is then rapidly rinsed, and placed in a dish containing the clearing solution, made of 1 oz. of hydrochloric acid and 10 oz. of water.

The third process, which gives violet-black lines on a white ground, is the following: Make up the sensitive solution with water, 16 oz.; gelatine, 4 dr.; perchloride of iron (in a syrupy condition), 1 oz.; tartaric acid, 1 oz.; sulphate of iron, 4 dr. The paper is floated on or brushed over with this and dried. The exposure is about the same as with the last process. When sufficient, the greenish-yellow colour will turn white, except the lines, which should be somewhat dark. The developing solution is composed of 1 part of gallic acid in 10 parts of alcohol and 50 of water. When immersed in this solution the lines will turn blacker. The finish is then made by thoroughly washing in water.

Photographing Bright Distant Landscapes.—It is very difficult sometimes to photograph landscapes with dark heavy foreground and bright distance. If we expose quickly for the background we lose the detail in the foreground; while if we give the correct exposure to the latter, the distant view will disappear, or appear only in a mist. To avoid this the following experiment will often prove successful: Take one of your stops, and outline it on a piece of cardboard. Cut this out, and, instead of making a circular aperture in the centre, make a triangular one, thus—

Blacken it all over, and use this as a diaphragm. The effect this has is to allow much less light to come from the sky and distance, and more from the foreground. By its use natural clouds can often be secured where otherwise impossible.

Printing on Silk.—Photographs can be made very effective printed upon silk, satin, or other fabrics. There are several methods of accomplishing this. A simple one is the following:* The silk best suited for the purpose is that known as Chinese silk, and this is first washed in warm water with plentiful lather of soap; then rinse in hot water, and gradually cool until the final washing water is quite cold. Next prepare the following solutions: Tannin, 4 parts; distilled water, 100 parts. Sodium chloride, 4 parts; arrowroot, 4 parts; acetic acid, 12 parts; distilled water, 100 parts. The arrowroot is mixed up into a paste with a little of the distilled water, and the remainder added boiling hot, with the acid and the salt previously dissolved in it. When the solution is quite clear the tannin solution is added, and the whole allowed to get fairly cool. The silk is then immersed for about three minutes, being kept under without air in the folds, and then hung up to dry, or stretched out with pins on a flat board. The material is then sensitised by brushing over with the following solution: Silver nitrate, 12 parts; distilled water, 100 parts; nitric acid, 2 drops to every 3 oz. Other methods of sensitising are by immersing in or floating on the silver solution. After sensitising, the material is dried by pinning on to a board to keep flat. It is then cut up as required, and printed behind the negative. Every care must be taken in printing to keep the material flat, and without wrinkles or folds. It must also be kept quite straight; otherwise, the image will be distorted. Printing is carried on in the same manner as with albumenised paper. It is then washed and toned in any toning bath. The sulphocyanide gives the best action. Fix in a ten per cent. solution of hyposulphite of soda for ten minutes; wash and dry spontaneously. When just damp, it is ironed out flat with a not over-heated iron. Black tones can be obtained with a platinum toning bath, or with the uranium and gold toning bath, made up as follows: Gold chloride, 1 part; uranium nitrate, 1 part. Dissolved and neutralised with sodium carbonate, and then added to sodium chloride, 16 parts; sodium acetate, 16 parts; sodium phosphate, 16 parts; distilled water, 4,000 parts.

Very effective results may be made by printing with wide white margins, obtained by exposing with a non-actinic mask.

Another method is the following: Ammonium chloride, 100 gr.; Iceland moss, 60 gr.; water (boiling), 20 oz.

When nearly cold this is filtered, and the silk immersed in it for about fifteen minutes. To sensitise, immerse the silk in a 20 grain solution of silver nitrate for about sixteen minutes. The silver solution should be rather acid.

Or immerse the silk in water, 1 oz.; sodium chloride, 5 gr.; gelatine, 5 gr. When dry, float for thirty seconds on a 50 grain solution of silver nitrate. Dry slightly over print, and tone in the following bath: Gold chloride, 4 gr.; sodium acetate, 2 dr.; water, 29 oz. Keep twenty-four hours before using. Fix for twenty minutes in hypo, 4 oz. to the pint of water.

* From the "Encyclopædia of Photography," by the author.

TARTARIC ACID.

Some light on the natural formation of tartaric acid is afforded by the recent discovery of a simple way in which this acid may be synthesised. A French chemist starts with glyoxalic acid—an acid found in gooseberries, grapes, and other fruits—and acting upon it with nascent hydrogen liberated from a mixture of zinc dust and acetic acid, obtains eventually tartaric acid, or rather the optically inactive form of it known as racemic acid, equal molecules of the dextro and lævo varieties being apparently produced. The explanation of the action is very simple. Two molecules of glyoxalic acid are merely brought together by two hydrogen atoms. Glyoxalic acid is $C_2H_2O_3$, while tartaric acid is $C_4H_6O_6$, a formula which, as will be readily seen, contains two molecules of the former acid joined together by two atoms of hydrogen. It is well known that oxalic acid, $C_2H_2O_4$, is formed most readily in vegetable tissues, and is closely related to glyoxalic acid. Having regard, therefore, to the reducing tendencies which are known to characterise chlorophyl, it is not improbable that the natural building up of tartaric acid may be thus explained.

Timber Coating. — To make wooden posts that are in the ground last as long as iron, mix boiled linseed oil with pulverised coal to the consistency of paint, and coat it over the timber, and there is no man who will live to see it rot.

Tempering. — Very thin blades, flat springs, small drills, and sewing-machine needles can be effectively hardened and tempered by heating them and thrusting them into a mass of mineral wax—crude paraffin.

HELICAL GEARS.

BY J. H.

Wheels Made in Cores.

General Conditions—Method of Formation and Division—Description of Core-box.

General Conditions.—When helical wheels are made by means of cores, essential methods of marking and working the teeth are, of course, precisely those already described; only, instead of fastening the teeth to a block, they are put into a box of suitable size (Fig. 13). It does not really matter how many teeth are put into the box, but they would usually range from about three in small wheels to six or eight in larger ones. Since the object in using cores for wheel making is to save the cost of repetition in working out of pattern teeth, in cases where no wheel machine is available, their number will obviously bear an economical proportion to the number of teeth in a given wheel and the number of cores that will have to be rammed.

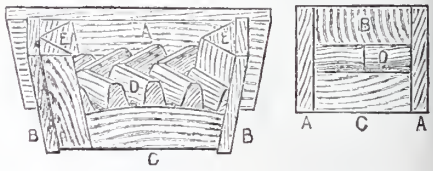


Fig. 13. Fig 13A

Fig. 13.—Core-box with One Side removed. Fig. 13 A.—Cross Section.

Method of Formation and Division.—When making teeth for a core-box, they will properly be divided along their middle planes for convenience of marking out. It will depend on the size of the wheel whether joints will be carried through any or all of the inter-tooth spaces. In a pinion of relatively small diameter, and quick curvature and wide teeth, it will be necessary or desirable to part the teeth in this way. In a wheel of large diameter, flat curvature, and shallow teeth, like that in Fig. 13, the teeth may be all in one piece. It becomes simply a question of the free withdrawal of the teeth without fracture of the sand. The same remarks apply, without exception, to core-boxes for both spur and bevel helical wheels.

Description of Core-box.—The illustration (Fig. 13) requires little remark; my notes thereon will be brief. It represents a core-box in perspective, with the nearest side removed to show the teeth, and also a cross section (Fig. 13A) through the box. There are two sides, A, two ends, B, and a bottom block, C, curved to the radius of the wheel rim, and fitting within the sides and ends to carry the teeth, D. The blocks, E, are cut to the same diagonals as the teeth, and form the joints of the cores. Note that it is not usual to joint the teeth along the centre, which would leave marks of the joints on the castings, but along one edge. Thus the whole breadth of the point of the left-hand tooth is visible at that end of the box, while on the right the face of the tooth terminates at the block, E. Thus the portion of a tooth at one end is the complement of that at the other, and when the cores are laid end to end, the teeth formed at the joints are like those formed in the body of the cores.

I have now described, as fully as I can in the space at my disposal, the construction of helical-wheel teeth. The methods of making striking-boards and arm core-boxes being common to wheels in general, do not come within the scope of these papers.

ATCH AND CLOCK CLEANING AND REPAIRING.

BY A PRACTICAL WATCHMAKER.

Repairing.

Fit a New Set-hand Arbor.—Sometimes, ough using a key too large, the square comes fixed in it, and is broken off in the empt to get the key out again. In such ase a new arbor must be fitted. Procure ough one from the material shop. Hold in the pin-vice by the square (having st seen that the said square is of the rect size, the *least trifle* smaller than the nding square). and file it slowly with a ooth file, very ghtly taper, on box-block; re-ce it till it exactly s the centre pinion to the square d turns friction-ht. To do this perly is not so sy as one might ppose. It must t be done hur-dly, and must be ed in constantly. ving done this, it in the same nner to the can-n pinion, but ther tighter. Then t it off to the cor-t length, allowing the minute-hand, d round up the d nicely. Trans-it to the sliding gs, and again grip the square, but e other way up, d reduce the height the square with file till it equals e winding square. en smooth-file it, vel off the edges trifle, and burnish e top.

To Fit an Hour-nd.—Select one the correct length, d with a centre ich fits tightly on the pipe of e hour-wheel, and ess it down *level* th it. If the pipe the hand is too ng, stick it upon peg cut slightly taper, cut the peg off level ith the bottom edge of the pipe, and re-ce it with a file peg and all till correct.

To Fit a Minute-hand.—Select one of the rrect length, and broach the centre out refully to fit the centre arbor; when almost rge enough to push on, rest the movement he set-hand square) upon a stake in the ce, and laying the hand upon the centre bor, give it a smart tap on with the mmer. Be careful that the *square only* sts upon the stake.

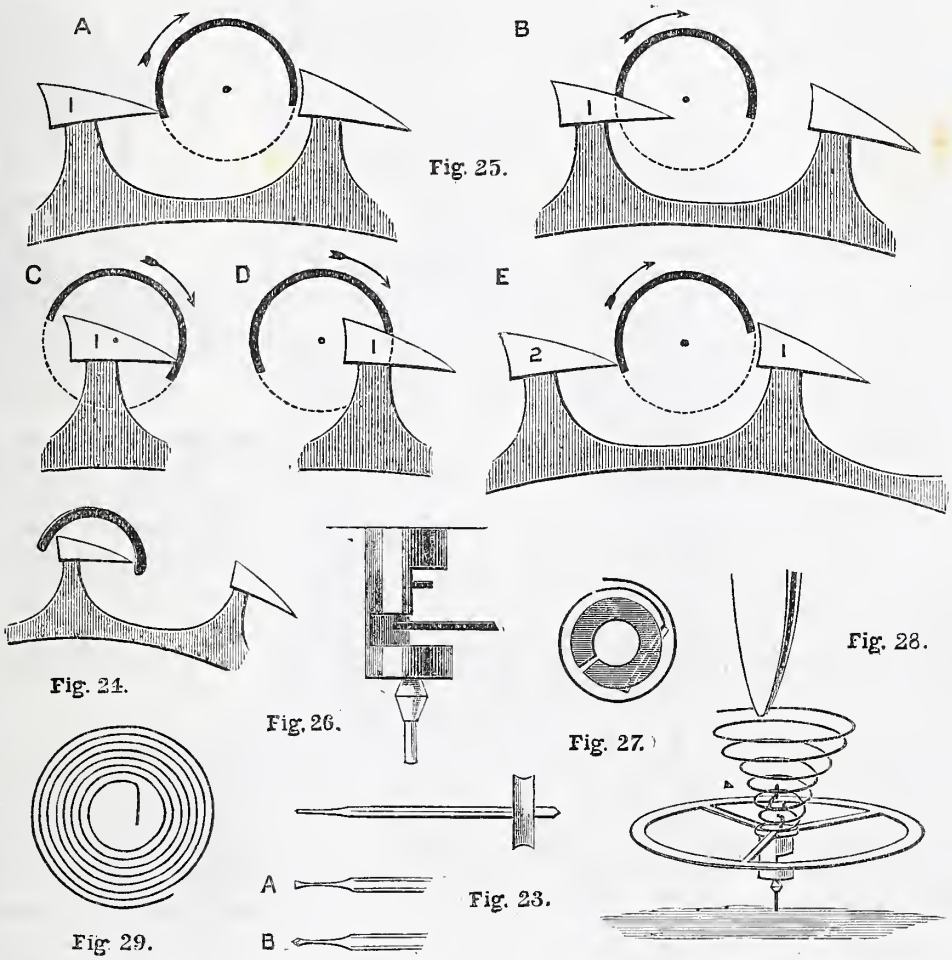
To Fit a Seconds-hand.—Select one to atch the other hands; with the nippers cut to the correct length. Then hold it in the ppers by its edge just at the centre, so at the brass pipe rests flat upon one jaw the nippers, and with a slitting file cut e pipe to the correct length. Open it ith a pivot broach till it pushes on tightly, ut not too tight, on the seconds pivot, and take care it does not touch the dial anywhere, or stick up too much and catch in the other hands.

To Open a Hole in the Dial.—Sometimes the hour-hand pipe or the seconds-hand pipe will foul the edge of the hole in the dial through which it passes. In such a case, take off the hand in question, and notice between which hours the hole requires opening—say from the nine to the twelve, it requires freeing. Take off the dial, rest it flat upon a piece of cork in the vice close up to the hole, and with a round file and a little turps, using down strokes only, carefully clear it out. Take care not to let the file jamb in the hole, but hold it firmly at such a point that your finger first comes into contact with the dial. The file cannot then jamb by any possibility. In replacing a dial which is secured by screw studs, always secure it by turning these studs *in a direction which will unscrew them.* This will naturally draw up the dial feet, and prevent the dial from rattling or being loose.

To Adjust the Shake of the Motion Wheels.—If the hour wheel has too much shake under the dial, it will often cause the hands to catch. In such a case, a small circle of writing-paper or thin copper spring can be cut and dropped on it. Sometimes the minute wheel is so low down that it will not engage properly with the cannon pinion. In this case the same remedy can be applied, only underneath it instead.

Making Taps and Drills, etc.—Before passing on to a consideration of the escapement, as taps and drills have been mentioned in the foregoing repairs, the method of making them will be first explained. To make a *tap*, procure a good piece of steel a little larger than the required tap, and heat it to a dull red in a spirit-lamp flame to soften it thoroughly, and let it cool slowly. This done, taper it slightly with a file in the pin-vice, and proceed to cut a thread upon it with the screw-plate. This operation must be done most carefully; a half turn in and a quarter back must be the method of procedure, thus, as it were, advancing a quarter turn at each time. Use plenty of oil, and do not let it stick. Cut it till you have a full deep thread. Then rest it upon the boxwood block, and cut the end off square and round edges a little. At the extreme end the thread should be very slight, increasing up the tap to a full thread. Then with a smooth sharp file form it into a triangular shape, almost to perfect points at the extreme end, the flats not being quite so wide higher up. Triangular tops in such small sizes are not so likely to bind and break as square ones, and cut much more easily. This done, harden it by making it a bright red, and quickly cooling in cold water. Then brighten one face of it, and carefully warm in the flame till a pale straw colour steals over it. This operation is called "tempering," and has the effect of toughening what would otherwise be a far too brittle tool. Afterwards file notches in the handle end to indicate the number of the hole in screw-plate to which it belongs.

Drills are made as follows:—Procure a piece of good steel larger than the required drill, and with the pin-vice file it to the shape shown in Fig. 23, and knock a ferrule upon it, as shown, for the bow to work upon. These ferrules can be easily turned from brass rod in a lathe, or can be bought ready-made very cheaply. Having done this, hold it by the ferrule end, and rest the blade upon the edge of the stake, and with the hammer give it one or two smart taps to spread it, as at A. Sharpen this to the shape shown at B, and harden and temper the same as the taps. This is for comparatively large drills. For very small drills, after forming them, make the blades hot in the lamp flame and withdraw quickly—*i.e.*, "flirt" them in the air; this hardens them by suddenly cooling, the same as if they were plunged into water. With such small articles, plunging into a liquid of any sort is impossible. They are cold the moment they leave the flame.



Watch and Clock Cleaning and Repairing. Fig. 23.—Shape of Drill. Fig. 24.—Scape-wheel Teeth. Fig. 25.—Action of Escapement. Fig. 26.—View of Cylinder. Fig. 27.—Hairspring Collet. Fig. 28.—Method of holding Hairspring. Fig. 29.—Hairspring.

The Escapement.—Before proceeding to any repairs relating to this part of a watch, a thorough knowledge of its action is necessary. This will now be explained as clearly as possible. Upon examination with the eye-glass, the scape-wheel teeth will be found to be of the shape shown in Fig. 24, which also shows a section of the cylinder at the point at which the scape-wheel teeth act upon it. The face of each tooth is an inclined plane, or nearly so, which acts upon each edge of the cylinder in turn, and gives it an "impulse." In Fig. 25, at A, the point of one tooth is resting against the cylinder which is moving in the direction of the arrow. When the edge of the cylinder arrives at the point of the tooth, the latter advances, and in doing so the inclined plane drives the edge of the cylinder forward as it passes, as at B, and the point of the tooth comes to rest against the inside surface of the cylinder, as at C. The cylinder continues its motion till the force is spent, then, under the influence of the hair-spring, it returns, and permits the escape of the tooth, as at D. The point of the next tooth then falls upon the outside of the cylinder, as at E, and the same process is repeated as long as the force of the main-spring lasts. Each tooth, in turn, gives impulse to first one, then the other, side of the cylinder. Fig. 26 shows a side view, from which it will be seen that there is a slot cut in the cylinder to accommodate the arms that support the scape-wheel teeth. These arms must neither touch the bottom nor the top of this slot. This is a very important point, as, if these parts touch ever so lightly, the watch is sure to stop. It will thus be seen that if the balance (or cylinder) has much "end-shake," the bottom or top of this slot is sure to touch the wheel. If this is the case, it can generally be heard if the watch is held to the ear in its case, first one way up, then the other. Thus, if when dial up, a grating noise is heard which evidently proceeds from the cylinder, it shows that the bottom of the slot touches the wheel, and *vice-versâ*. Its remedy lies in a nice adjustment of the end-shake of the balance, which can be accomplished by packing up with paper under the balance-cock, or the bottom "chariot." When once the precise action of the escapement has been mastered, its adjustment and correction become easy. For instance, sometimes the points of the teeth, instead of falling upon the faces of the cylinder, fall upon the edges, and proceed to give impulse at once. In such a case the "depth" between wheel and cylinder is too shallow—*i.e.*, the cylinder requires moving bodily nearer to the wheel. This can be accomplished by bending back the pins of the "chariot" underneath, and so forcing it forward. In fact, a remedy will suggest itself for each little defect observed.

To Set the Escapement "in Beat."—When "in beat" properly, the balance will have no more tendency to stop on one side of the scape-wheel than on the other, and it will tick or beat evenly. If it does not, the small brass collet to which the centre of the hairspring is fixed must be turned round a trifle (it is friction-tight upon the cylinder). To do this, hold the balance in the fingers, and insert the blade of the oiler into the small éut in the collet, and gently turn it to the required distance.

To Set the Banking Correctly.—In the rim of the balance will be found a very small pin—the "banking pin." The function of this pin is to prevent the balance vibrating more than half a turn on either side of zero. If it did this, it would stop by reason of the scape-wheel teeth getting on the wrong side of the cylinder. It is effected by the banking pin coming in contact with a brass pin fixed in the balance cock at the back, at such a distance as to just clear the balance as it vibrates, but to stop the pin. It is therefore evident that when the balance is at rest, and the escapement in beat, this banking pin should be just opposite (half a turn from) the stop pin in the balance cock. If it is not, file it off, and, with a very small drill, drill a hole in the right place and put in another.

To Time the Watch.—The regulator, of course, is for this purpose, and it does so by means of the curb pins, between which the hairspring should play freely, just touching both of them at each vibration. By advancing the regulator, the acting portion of the spring is shortened, and by putting it back it is lengthened. This only acts within small limits. If it is desired to make a further alteration in amount, more than can be effected by the regulator, the hairspring must be unpinned at its outside end, and "let out," or "taken up," as the case may be. It must always be remembered that lengthening the spring makes the watch go slower, and shortening it faster. Of course, after any alteration of this kind, it must be put in beat afresh by turning the collet round as described above.

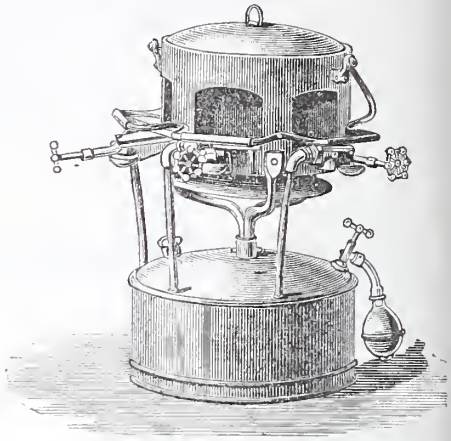
To Put on a New Hairspring.—Unpin the old one from the outside stud, and with the small blade of a pocket-knife carefully remove the collet from the cylinder. Then, with the pliers pull out the old spring, when it will come, pin and all. It will be seen to be fastened, as shown in Fig. 27, by a small pin cut off flush with the collet. Pick out another spring of the right outside diameter to pin in the stud properly. Put the balance on the stake with the cylinder through one of the holes, and lay the hairspring upon it in position, and push on the collet on the top to hold it temporarily. Then hold the outside end in the tweezers, as in Fig. 28, letting the bottom cylinder pivot just touch a watch-glass laid upon the board, and set it in vibration. Alongside of it on the board lay a watch with a seconds-hand, which goes fairly well to time. Watch this, and count the number of vibrations (double vibrations) the balance makes in half a minute under the influence of this hairspring. It should be seventy-five, for a Geneva watch ticks three hundred to the minute. Try one after another till you get one which suits, or which you can make to suit by taking up a little. Then break away with the tweezers and a needle point the centre coils till it will pass easily over the collet, then bend it sharp round, as in Fig. 29, and put the collet upon a broach to hold it conveniently. Then put the end of spring into the hole in collet, and carefully pin it tight; afterwards with the tweezers so bend the spring at the sharp bend that the collet is quite central. This is important. When the collet is replaced on the cylinder, see that the spring lies flat. Then pin it in, set in beat, and try it, altering till correct.

I now think most of the ordinary repairs to Geneva watches have been dealt with, except *turning* jobs, which have been purposely avoided, and in my next the *lever watch* will be considered.

LUBRICANT.—A good lubricant for leather belting is obtained by mixing resin oil with 10 per cent. mica. New belting must be coated until the leather will absorb no more oil, and the belting is then ready for use.

TINNERS' AND PLUMBERS' FIRE POT.

IN the accompanying illustration we present a general view of a three-burner fire pot for tinners' and plumbers' use. It is an American novelty. The makers claim that this device has a capacity for heating more round irons or coppers than five men can use, and will also keep a pot containing 100 lb. of metal hot enough to wipe. The fire pot is referred to as being well adapted for use when lining tanks, making solder, pouring Babbitt metal or large soil and water-pipe joints. By simply removing

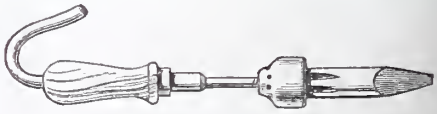


Tinners' and Plumbers' Fire Pot.

the spring pin the top may be taken off, leaving the burners exposed. The latter are movable and can be reversed, thus making a brazing forge, or the device may be used as a torch to melt out soil or water-pipe joints. All the burners have clean-out screw plugs, which render it an easy matter to keep them in order.

NEW SOLDERING SYSTEM.

WAGANDT'S gas and air soldering system, which is finding much favour in America, for which are claimed many advantages, consists of a self-heating soldering iron, heated by a combination of air and city gas, the air-blast being created by steam-power air pumps. The gas is conveyed through the building in pipes in the same manner as if for illuminating purposes, and the air is similarly carried, but in different pipes from the gas. The combination of air and gas is made at the operator's bench, and is also regulated at that point. The soldering irons, one form of which is shown in the accompanying illustration, consist of a hollow



Wagandt's Soldering Iron.

handle to which is attached the copper, the flames passing through the hollow handle and striking the back and sides of the copper. At the further end of the handle, as shown in the cut, there is a rubber tube attached, which allows the iron to be used in any position desired. The manufacturers state that this system is used on all kinds of work, from small toys to large galvanised work, in can factories, etc. It will be seen that there is no time required to start the system, it simply needing to be lighted. There is said

to be absolutely no danger from fire, and it can be used without skilled labour. Another point to which reference is made is the saving in coppers, due to the fact that the copper only is renewed and the iron handle does not have to be replaced. The flame strikes the back and sides of the copper and so prevents excessive wear on the point.

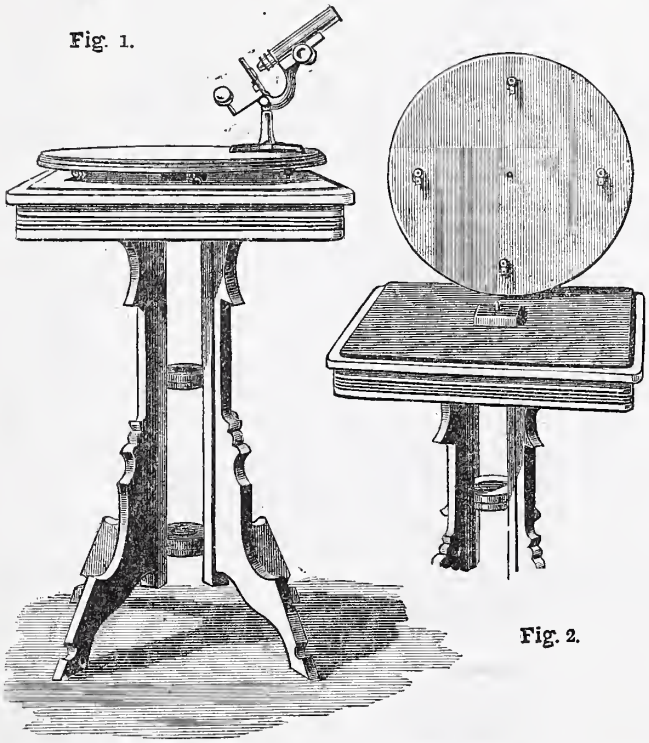
REVOLVING TABLE FOR MICROSCOPISTS.

BY F. S. MORTON.

The readers of Work who have a microscope will bear me out in the assertion that it is almost useless to attempt to entertain a company of friends with the instrument for an evening without a revolving table, or some substitute therefore. It can be done, of course, but the aching joints and dizzy heads of the party at the close of the exhibition are uppermost in the mind, and the wonders they may have been shown are forgotten in the thoughts of what a hard job it is to "look through the microscope." Revolving tables are sold by all dealers in microscopical supplies, but they are expensive luxuries; and even if the matter of expense does not have to be considered, there are not many who have room to stow away such a large piece of furniture when it is used so seldom. The following description and illustration will show how a revolving table may be made by anyone at a little expense, and one that will take up but little room when not in use. The secret of how these two results are both reached is that only a top is made new, any stand or small table answering for a support for it. Fig. 1 shows the table top on a small fancy table, with the microscope in position ready for use.

Get a small round table top sawed out, about 18 in. in diameter, and about 1 in. in thickness. Soft wood will do just as well as any, and will be a great deal easier to work on. If one is fortunate enough to live in the vicinity of a wood-worker's shop where such work is done, a small top like this can be procured at a very small expense, as it can generally be sawn from the board. If two boards have to be glued together to get the requisite width, of course the expense will be more. The edge should be moulded, or at least carefully smoothed off, so as to look well. Next procure four small castors at the hardware store. These are always kept in stock in various patterns, and the style best adapted for the purpose will be seen as soon as the work is begun. Castors with wheels ½ in. or ¾ in. in diameter will be plenty large enough. The bolt to which the truck frame is attached is generally much longer than can be used for the purpose, so it must be cut off, so that about ¾ in. will be left to go into the wood. Now fasten these castors on the under side of the round board, about two inches from the edge, and at equal distances from each other. Fig. 2 shows their position on the board. Adjust the trucks so that the four will all rest on the top of the stationary table, so there will be no tipping of the upper and revolving top. If there is any difficulty in adjusting the castors, use only three of them equally distant apart, and then any little inequality will not show.

Next cut a piece of thick millboard, such as bookbinders use, the same width as the revolving table, but square instead of round. In the exact centre of this fasten a block of wood, and into that drive a smooth piece of ¼ in. iron, allowing it to project about an inch above the top of the block. The thickness of the block will be regulated by the height at which the castors bring the table from the one below it. There should be about a quarter of an inch between the top of the block and the under side of the table when the latter is in place. In the centre of the round table now bore a hole from the under side nearly, but not quite, through to the top. Drive into this hole a piece of brass tubing large enough to fit on over the iron rod just fastened into the block on the millboard.



Revolving Table for Microscopists. Fig. 1.—Table Complete, showing Microscope in Position. Fig. 2.—Under Side of Table, showing Castors and Pivot.

The table is now ready for use, and the method of using it is as follows:—Place the millboard on top of a small table, the block and pivot coming in the centre. Drop the round top down over it, the pin entering the socket in the centre. This pin acts simply as a pivot on which the table revolves, and must work perfectly free. If this and the castors are rightly adjusted, it will be seen that the table will revolve very easily and freely.

The top should be varnished to keep it from warping, and if looks are an object, it should be stained or polished also. A second piece of wood may be used in place of the millboard, although the latter is very much lighter, and answers every purpose. If the trucks make much noise in running over it, a circle of felting can be glued on the track over which they run. I think the microscopist will find this table a perfect substitute for the regular revolving table, and it is certainly much less expensive, and can be made by anyone. Microscopists might inform their friends of it.

TRADE: PRESENT AND FUTURE.

**** Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

Railway Material Trade.—In Sheffield inquiries for railway springs, wheels, tires, and axles are numerous. Good orders have been received from abroad, notably one from the Madras Railway Company for a large quantity of spring and cast steel.

Coal Trade.—Sheffield coal trade prices are unchanged. Home manufacturers' sorts very slow of sale, shipping quiet, London lines dull, house coal an improved market, gas coal and coke in moderate request, and small stuffs a fair sale. The West Yorkshire pits are working less than five days per week.

Silver Trade.—Complaints as to overstocking in the sterling silver and electro-plate industries are ceasing. The renewed activity in this branch of Sheffield trade tends to show that stocks have been reduced, and better business may be expected for Christmas and the New Year. Already, indeed, there is a distinct revival in the silver trades.

Timber Trade.—Recent sales in London consisted of Baltic and Canadian planks, deals and battens, floorings, matchings, etc.; also a lot of pitch pine and Dantzic timber, and some mahogany, cedar, rosewood, and other kinds of furniture wood. Among the prices realised, the following may be mentioned: 1¼ in. 1st yellow flooring, 12s. per sq.; 1 in. ditto, 8s. 3d. per sq.; ⅞ in. ditto, 6s. 9d. per sq.; 3 in. by 11 in. 1st pine, £28 15s. per standard; 3rd ditto, £9 per standard; 3 in. by 9 in. 3rd yellow deals, £12 15s. per standard; 3 in. by 11 in. 1st white deals, £11 10s. per standard; 3 in. by 9 in. 2nd white deals, £7 15s. per standard; pitch pine timber, 50s. to 56s. per load; Dantzic, 35s. to 63s. per load; mahogany, 3¼d. to 1s. 2d. per foot; American walnut, 1s. 8d. to 3s. 7d. per foot; rosewood, £5 to £5 10s. per load.

File Trade.—File makers are very quiet, but the home trade in files is improving.

Mineral Trade.—The following prices are now ruling at Liverpool: Sulphate of Baryta, "Angel White" No. 1, 70s., No. 2, 60s. to 65s., No. 3, 45s.; pumice-stone quiet; emery stone, best quality in demand, No. 1 lump, £5 10s. to £6, smalls, £5 to £5 10s.; fuller's-earth quiet, best lump, 55s., fine ground, £7, "Emerald" brand, ground, 80s.; plumbago, Spanish, £5, Italian and Bohemian, £4 to £12 per ton, "Founder's," £5 to £6; Blackwell's "Mineraline," £10; French sand, 22s. to 22s. 6d.; ground mica, £45 to £50; China clay steady, common at 18s. 6d., good medium, 22s. 6d. to 25s., best, 30s. to 35s.

Ivory and Pearl Trade.—Most of the ivory and pearl cutters in Sheffield have full employment. Bone cutters are also better employed. The Liverpool ivory market prices are high. Medium teeth were £2 dearer; Angola, £42 to £46; Gaboon, £42 to £46; Lagos, £48; Cameron, £46 10s.; West Coast Africa, £46 10s.; Congo, £44: all per cwt.

Shipbuilding Trade.—A very small amount of new work has been secured by the Mersey shipbuilding firms, while at Barrow new orders are scarce.

Steel and Iron Trades.—These trades in Sheffield remain unchanged, and the prices for hematites and Bessemer are unaltered. A new company, with a capital of £200,000, has been formed to manufacture steel by a new process, which is said to be much more economical than any now in use. The orders for machinery have been placed. Only a small business is being done in the Lancashire pig-iron trade, and prices exhibit a downward tendency. For steel plates of boiler-making quality prices of £6 15s. to £6 17s. 6d. are ruling; for common tank plates, £6 5s. and £6 2s. 6d. are usual rates.

Flannel Trade.—This is beginning to feel the effects of the crisis in the cotton trade, though, at present, the look-out is nothing serious, there being a good number of orders on hand, and most of the mills working full time.

NOTICE TO READERS.

Next week's Work (No. 191) will contain, among other illustrated papers, the following:—

The Way French Sabots are Made.
How to Learn Drawing Office Work.
How to Make a Simple Coin Case.
Shop Candlesticks and Tall-boys.
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*** The Editor makes this intimation in the hope that readers, having friends interested in any of these subjects, will bring the same to their notice.

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Building Construction.—By Charles Mitchell, of the Polytechnic Institute, London.

Civil Engineering.—By O. G. Jones, B.Sc. Lond., Master in Physical Science at the City of London School.

Carpentry. / **Cabinet Making.** } By B. A. Baxter.

Cotton Spinning.—By Henry Riddell, Belfast.

Cutting Tools.—By R. H. Smith, of Mason's College, Birmingham.

Design in Textiles.—By Thomas K. Ashenhurst, of the Bradford Technical College.

Dyeing of Textile Fabrics.—By J. J. Hummel, F.C.S., of the Yorkshire College, Leeds.

Electrical Engineering.—By E. A. O'Keeffe, B.E., of the City and Guilds of London Technical College, Finsbury.

Jute Spinning.—By Henry Riddell.

Metal Plate Work.—By William Henry Greenwood, F.C.S., A.M.I.C.E., M.I.M.E.

Machine Construction.—By O. G. Jones, B.Sc. Lond.

Photography.—By T. C. Hepworth, F.C.S.

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The Steam Engine. / **The Gas Engine.** / **The Oil Engine.** } By Archibald Sharp, B.Sc., Wh.Sc., A.M.I.C.E., of the Central Institution of the City and Guilds of London Institute.

Woollen and Worsted Spinning.—By Walter S. B. McLaren, M.P.

Weaving.—By Henry Riddell, Belfast.

Watch and Clock Making.—By David Glasgow, Vice President of the British Horological Institution.

*** *With* **Part I** *is issued a large and striking* **Presentation Plate,** *consisting of a handsome reproduction of* **"The Industrial Arts applied to Peace,"** *by* Sir Frederick Leighton, P.R.A., *reproduced from the fresco at South Kensington; and the Part also contains a* **Coloured Plate of the Bessemer Steel Process.**

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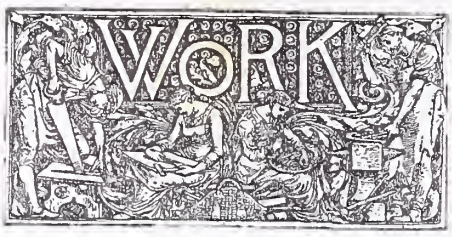

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*** All letters suggesting Articles, Designs, and MS. communications for insertion in this Journal will be welcomed, and should be addressed to the Editor of Work, Cassell and Company, Limited, London, E.C.

NOTICE.

WORK correspondents are wanted in every Town.

Validity of British Patents.—Probably the most glaring defect in the British system of granting patents is found in the fact that novelty is not insisted upon in the inventions protected. In point of fact, the office will take fees from two or more inventors for precisely the same invention. Moreover, patents are freely granted for physically impossible inventions—perpetual motion and the like. In America and Germany a search of the records of previous inventions is made before a patent is granted, and unless the invention possesses novelty and utility a patent is not granted. The granting of a patent under such conditions becomes a guarantee of novelty and validity. A movement for rectifying this evil in connection with British patents is being made, and it is expected that an effort will be made to establish a system of preliminary examination, whereby an applicant may have the option, on payment of a nominal fee, of obtaining a report by an official examiner upon the question of the novelty and validity of his invention. This examination would not preclude the applicant from making private searches, either himself or by his agent. The putting in force of this system would involve the employment at the Patent Office of competent engineers and other experts; but there is little doubt that these could be found at salaries not exceeding those now paid to the present examining clerks. It is to be hoped that some measure of this sort will be laid before the next session of Parliament.

Foreign *versus* English Trade.—A comparison with the Continental and American iron and steel trades shows that our rivals in business do not suffer equally with ourselves. In Austria the iron market continues favourable. Belgium, where trade is but poor, shows an increase of 70,424 tons of pig iron manufactured in excess in the year 1891. From France we gather that business is dull, but that rates are steady; in Germany there is no alteration, the recent improvement being maintained; in Spain the imports have declined, but there has been a development of exports during the first seven months of 1892 to the extent of 44,841 tons; and in America the iron trade is fairly steady; while in England there has been a "slump" in the steel trade equal to 19·3 per cent., and in pig iron of 24·9 per cent.

Mind and Miners.—It is a curious thing, but the physical gloom that miners spend their working hours in does not seem to have in any way communicated itself to their mental vision. On the contrary, they appear to see much further ahead than any other section of the working classes. Only just now is labour in general awakening to a sense of the importance of political power. The miners, however, have awakened to that sense long ago. So far back as 1874, when, as yet, there was no labour movement, the miners of Northumberland had a paid representative in Parliament, and the miners of Northumberland now work less than eight hours a day without any compulsory Act of Parliament. In the present Parliament the miners have at least six paid representatives forming the bulk of the labour members, and pledged to the miners' programme. Has any other class of workman a representative? Not one. Of course, there is an explanation for this as there is for everything. Miners are all congregated round about the mines in which they work, and as a consequence their voice in these districts is the preponderating voice. Still, the fact that the voice is united is an indication of discipline and mental activity. Cheers for the miners!

Electricians' Competition.—It will be no surprise to our many thousands of subscribers to be informed that the subject of electricity is one which commands the interest of a large section of readers of Work. The leading subject of this scientific age, it has a world of students and workers, who are constantly concerning themselves in tests and experiments in order to extend and develop the possibilities of the old-age element—the most remarkable development of which has been its sudden advent as an illuminant for public and private purposes. Its prospects and possibilities do not, however, end here, since in the near future there must be a great region opened to it as a motive power both on land and water. The interest of the subject being, then, assured, we have every justification in devoting one of our prize competitions to a matter which cannot fail to be interesting to our readers and the public at large. As will be seen from another column, we offer three prizes for the best suggestion for the application of electricity to some useful domestic, commercial, or scientific purpose. This, doubtless, opens up a very wide field; but as the suggestions will need to be original, and will be adjudged according to their practical value and prospective utility and adoption, the range which land, sea, or air may afford may not, after all, prove unwelcome. We shall hope to find that the competition will elicit some interesting ideas which, if they do not succeed in gaining prizes, may yet be worth publication. Young readers as well as old may engage in this competition, and there is no reason why every schoolboy should not make a bid for the prizes—the subject of electricity being one upon which boys are, we know, especially keen.

FORTUNE-TELLING MACHINE.

BY P. B. H.

INTRODUCTION — THE REVOLVING CARD — THE REASON FOR IT—DESCRIPTION OF MECHANISM—THE METHOD OF BALANCING COIN RECEPTACLE AND OPPOSITE END OF LEVER—SHAPE OF COIN RECEPTACLE—THE METHOD OF WORKING THE SAME — AN ALTERNATIVE METHOD OF DRIVING BY CLOCKWORK—THE METHOD OF TAKING MONEY OUT OF THE BOX.

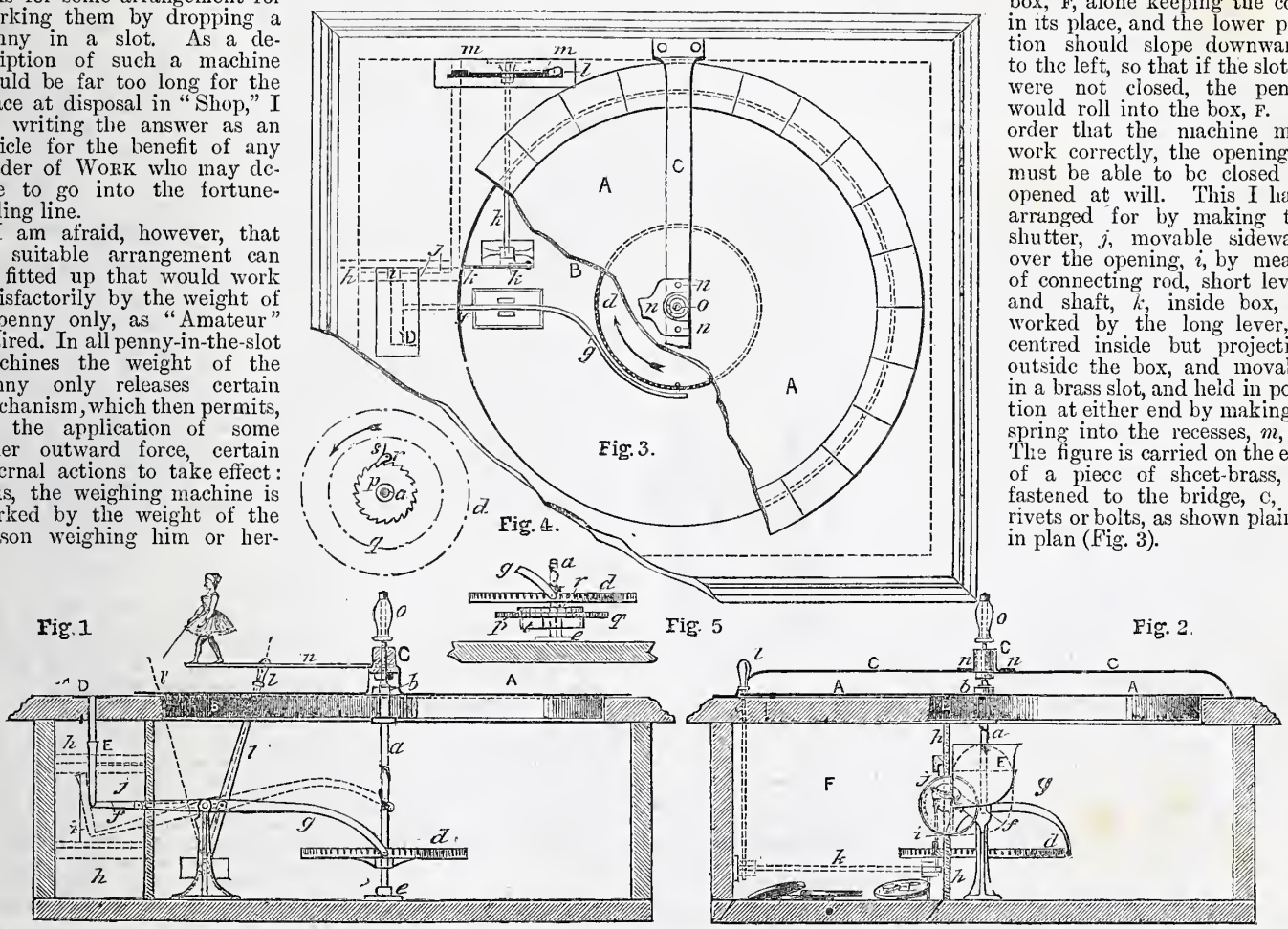
"AMATEUR" writes saying he possesses a metal balance and fortune-telling card, and asks for some arrangement for working them by dropping a penny in a slot. As a description of such a machine would be far too long for the space at disposal in "Shop," I am writing the answer as an article for the benefit of any reader of WORK who may desire to go into the fortune-telling line.

I am afraid, however, that no suitable arrangement can be fitted up that would work satisfactorily by the weight of a penny only, as "Amateur" desired. In all penny-in-the-slot machines the weight of the penny only releases certain mechanism, which then permits, on the application of some other outward force, certain internal actions to take effect: thus, the weighing machine is worked by the weight of the person weighing him or herself; the sweets, matches, etc., are obtained by drawing out the drawer after having dropped in a penny, which releases the bolt that before prevented it being opened, and the pushing back of the drawer relocks it, not the penny which had been inserted.

I would suggest some such an arrangement as shown in Figs. 1, 2, and 3, where the penny, dropped into a slot, releases the wheel, and allows each person to turn the card for him or herself. I should make the *card* revolve for several reasons: the principal one is, that it would run more smoothly and with much less friction, and therefore much longer than the figure, which I should have fixed, as shown in Fig. 1, pointing to the card in front of the box. Thus, the fortune always appears in one place, where it can be easily read; whereas, in the case of the *figure* revolving, the box would often have to be turned round when wanting to read the fortune, as the figure would not always stop in the front of the box.

I will now proceed to describe the mechanism. The fortune card, A, should be pasted to a circular piece of moderately heavy wood, B, through the centre of which passes a spindle, *a*, provided with collar and nut, *b*, for holding the same. It is carried in footstep, *e*, on the bottom of the box, and held in a vertical position by the bridge and boss, C, through which the spindle, *a*, passes, and to the top of which latter a small handle, *o*, is fixed for turning the same, together with the card. On shaft, *a*, just under boss, C, a loose collar is fixed, to prevent the shaft being lifted out of the footstep, *e*, while below a toothed wheel, *d*, is fixed to it, the use of which can be easily seen. D is the slot through which the penny is dropped into the receptacle, E, which, from the extra weight of the penny, falls together with the end of lever, *f*, to which it is fixed, the other end, *g*, rising to position shown by the dotted lines, releasing the toothed wheel, *d*, and thus allowing spindle, *a*, together with the card, to be rotated. The lever, *f g*, is carried by a fixing from the bottom of the box; this fixing has a snug cast on on the left-hand side, near the top, so that the lever, *f*, will not fall below the position shown by the dotted lines, as in that case the copper would not fall through the slot, *i*. I may here state that the end, *g*, of the lever must be so much heavier than the end, *f*, together with the *empty* coin receptacle, that when this latter is empty the end, *g*, must drop down by its own weight, thus allowing the small pin in the end to engage in the teeth of wheel, *d*, and thus prevent any rotation of the card; and again, when the penny is put in E, *g* must rise out of the wheel. Thus the best plan, when making this lever, would be to make the two ends, *f*, *g*, balance when a halfpenny was in E. If they balanced with this amount in E, it is evident *g* would drop if the halfpenny were removed, and it would rise if a penny were inserted.

For the shape of the receptacle, E, see Figs. 1 and 2, the latter more particularly. Its diameter should be rather larger than a penny; the left-hand side of it (see Fig. 2) should be open, the end, *h*, of the money-box, F, alone keeping the coin in its place, and the lower portion should slope downwards to the left, so that if the slot, *i*, were not closed, the penny would roll into the box, F. In order that the machine may work correctly, the opening, *i*, must be able to be closed or opened at will. This I have arranged for by making the shutter, *j*, movable sideways over the opening, *i*, by means of connecting rod, short lever, and shaft, *k*, inside box, all worked by the long lever, *l*, centred inside but projecting outside the box, and movable in a brass slot, and held in position at either end by making it spring into the recesses, *m*, *m*. The figure is carried on the end of a piece of sheet-brass, *n*, fastened to the bridge, C, by rivets or bolts, as shown plainly in plan (Fig. 3).



Fortune-telling Machine. Figs. 1 and 2.—Sectional Elevations. Fig. 3.—Plan: Part of Card removed and Figure. Fig. 4.—End View of Shaft, *a*, looking from Below. Fig. 5.—The same View as Fig. 1.

I will now explain the working in this, its simplest form. Suppose lever, *l*, were in position shown in drawing, and a penny were dropped into slot, D, E would fall and *g* would rise, thus releasing the fortune card, but only for a moment, as the slot, *i*, with lever, *l*, in position shown, is not closed, so the penny rolls out into the money-box, F, and E rises again, while *g* falls into position as drawn, the persons thus losing their money. This is so that anyone attempting to take an unfair advantage not only loses his money, but his fortune as well. In order for it to work properly, the lever, *l*, must be pulled back into position, *l'*, this action closing the slot, *i*, by sliding the shutter, *j*, in front of it. If a penny were inserted now, E would fall as before, and *g* would rise and remain up till the penny is released. The card can now be turned by means of the handle, *o*. The fortune having been told, the lever, *l*, is put forwards: the shutter, *j*, at the same time slides back and the penny falls out,

when E rises and *g* falls, thus blocking the mechanism till another penny is inserted.

A good plan would be, instead of allowing people to lose their pennies by placing them in D while lever, *l*, is in its forward position, to arrange a shutter to cover slot, D, worked by lever, *l*, when being moved from *l'* to *l*, and to open it, on the motion being reversed.

Should it be more preferable to drive the card by clockwork, it might be arranged as shown in Figs. 4 and 5, where I have redrawn the bottom portion of shaft, *a*, with wheel, *d*, footstep, *e*, and end of lever, *g*, just as in preceding figures, and lettered the same parts with the corresponding letters. I have redrawn them in order not to create any confusion in the first three figures. Fig. 4 is an end view of shaft looking under wheel, *d*; Fig. 5 is the same view as Fig. 1. Suppose the shaft to rotate in the direction shown by the arrows, as this is the most convenient. On the boss underneath wheel, *d*, cast or otherwise, fix a ratchet-wheel, *p*, with teeth inclined as shown in Fig. 4. Thus, if *d* were turned, *p* would also turn, and if *p* were turned *d* would turn together with shaft, *a*. Close against ratchet-wheel, *p*, fit a spur-wheel, *q*, to which must be pivoted the pawl, *r*, held in position against teeth of ratchet-wheel by small spring, s. Get wheel, *q*, fitted with smooth drum, *t*, as shown in Fig. 5: this wheel must run free on shaft, *a*, so that if it were held, shaft *a* might revolve in the direction of the arrow, without hindrance, as the pawl, *r*, would slide over the teeth of *p*, but if turned in a contrary direction, the wheel, *q*, being still held, the shaft, *a*, could not revolve.

Suppose you had some clockwork, the last wheel of the train gearing into wheel, *q*, care being taken that *q* is driven in the direction shown in the drawing by the arrows. If you wound up the spring of the clock, *q* could not turn, as the pin in end of lever, *g*, holds *d*, which again holds *q* by the ratchet-wheel. Drop a penny in machine; then lever, *g*, rises and releases *d* and *q*, and the clockwork now drives round the whole apparatus, together with card. You will, if no other means are available, have to wait till the spring unwinds, which would be very tedious. In order to prevent this long delay, I would suggest that by means of a second lever (similar to *l*) placed on the *right-hand* side of the box, a brake be applied to the drum, *t*, on wheel, *q*; by this means the clockwork might be stopped gently without the spring running down, at the same time allowing the fortune-telling card to whirl round till stopped by friction alone, as the pawl, *r*, would allow it to turn in that one direction, though wheel, *q*, were still. In the case of clockwork, great care should be taken that lever, *g*, does not fall while the wheel, *d*, is revolving rapidly, as the pin or something else would break. I should strongly advise the use of the simpler method.

I have shown the method of getting the money in the box. It can be got out by making a door to open sideways or downwards, or the bottom might be cut out with bevelled ends, as shown (Fig. 2), being hinged centrally by a pin passing through it. You have only to lift the right-hand end with your finger, and the coins will slide out.

To clean Indian brass-work, first rub all over with some lemon juice, then scrub well with soap and hot water. Dry with a cloth, and then rub and polish with a chamois leather.

BRITISH WORKS AND INDUSTRIES.

NEEDLE MAKING.

WIRE BURNISHING—HARDENING—TEMPERING—SCOURING—HANDING—GRINDING, SETTING, AND CURING—FINISHING—CALYX-EYED NEEDLES—WRAPPING—CONCLUSION.

WHEN we left our needle it was roughly made, but nothing more. Let us trace it through its later stages.

Wire Burnishing.—The rudely-formed needle of early days was necessarily rough in the eye, and must often have cut the thread, to the no small mortification of the seamstress; and as much as a century ago we find ingenious men bringing forward inventions to remedy this defect. The origin of the system of wire burnishing before us is to be found in a contrivance by one of the Morralls, of Studley—a name long connected with needle making—which was patented more than fifty years since. The needles are threaded on fine wires which are slightly roughened, so as to give them something of the quality of a file. The wires, fixed by their ends to uprights, are stretched across a kind of table, the top of which can be worked backwards and forwards by a crank. This causes the needles to swing and dance wildly from side to side, and they are made to continue this violent exercise for some forty minutes. However salutary it may be for the eyes of the needles, the spectacle of a shop in which whole ranks of burnishing machines are going at the same time is to the human eye decidedly bewildering. The result of this process is to wear the aperture smooth on every side.

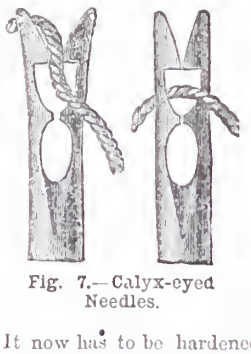


Fig. 7.—Calyx-eyed Needles.

Hardening.—Hitherto the steel of the needle has been quite soft. The processes which it had to undergo could be best performed while it was in that state. It now has to be hardened. The hardening of all steel implements is essentially much the same—they are heated to a high temperature, and then cooled by plunging them suddenly into some cold fluid. For hardening needles, much skill and judgment are required, and a good hardener can often earn an income which might move the envy of many a professional man. In former times it was usual to harden needles in water, but far back in the present century it was discovered that oil was far less liable to render them crooked. The best cod oil is used for the purpose. The heated needles are slid into the vat of oil on a kind of sieve, and as they are at once cooled, they are lifted out almost immediately by raising the sieve. They have to be washed with soapsuds and dried with dust.

Tempering.—The needle is now hard, but brittle, and to make it tough and elastic it must be tempered. The old way was by exposing to a low heat in a furnace, and then allowing of a gradual cooling. The larger varieties of needles are still treated thus, but a gas flame is used for ordinary sewing needles. The Messrs. Milward have a patent arrangement peculiar to themselves, and it is not one of the least beautiful of the many admirable pieces of mechanism in their mills. An endless band of wire gauze carries a continuous stream of needles through a gas flame, and delivers them, tempered, on the other side.

Scouring.—As yet the needles are black, rough, and unsightly—they have to be scoured. A quantity are laid in a strip of canvas with emery, oil, and soft soap (though I believe the so-called emery is more properly powdered quartz). This delightful mixture when rolled up, tied at the ends, and bound with twine, has a certain resemblance to a roly-poly pudding, only perhaps a little longer and not quite so thick. In the scouring mills (see Fig. 6) are solid tables, known as "runner benches," on which heavy wooden slabs, called "runner blocks," are pushed backwards and forwards by cranks. A roll of needles is placed under each end of a runner block, and the runner is set going. The needles pressing against and rolling over their fellows in the revolving bags are mutually helpful in scouring each other, and the friction is kept up on an average for some nine or ten days, the rolls being occasionally taken out and opened for the addition of more moisture. As the process proceeds, the grit applied is finer; and towards the end, after a washing with soapsuds, putty-powder (oxide of tin) is substituted for the emery. The so-called emery gives a scratchy white surface, but the putty-powder produces that beautiful dark gloss known in the trade as "colour." Scouring is succeeded by a thorough washing.

Scouring, as thus described, is no recent introduction, and formerly it was chiefly carried on by water-power. The Washford Mills, which give name to the Messrs. Milward's Works, were originally water-mills on the neighbouring river, Arrow. But steam has become the ordinary scouring agent, and the above-mentioned firm have now transferred their scouring operations to their factory in the town of Redditch.

The rough treatment undergone by the needles in this process causes many to be broken, bent, or otherwise injured; there is also danger of the entire roll heating, and thus becoming spoiled.

Handing.—From their troubles in the scouring mill, the needles come in a state of apparently hopeless tangle and confusion; but the ease with which they are straightened in skilled hands—by a few shakes in an iron pan and a touch or two with a trowel—seems almost magical to an outsider. They now have to undergo a careful sorting for the removal of such as are blemished. This is the work of women. Each needle has to be taken separately under the finger; but practice makes the sorter expert, and she will get through a packet of No. 10's, containing some 68,000, in a couple of hours.

It should be noted that through the earlier stages needles are apportioned in packets of 50,000 or upwards, and pass from shop to shop carefully labelled. This is to prevent their getting mixed with needles of other sizes.

In the later and lighter processes, many expedients for economising labour strike the visitor to the Washford Mills as noteworthy: as, for instance, the means by which all the needles in a packet are brought to lie with their heads in one direction, and their points in another. The ends of a row of needles lying promiscuously are pushed over the edge of a table; those of which the points project remain where they are, but those of which the heavier heads project fall to a ledge below, where they all lie in one direction, and the separation is complete.

Another simple, yet most ingenious, contrivance is the "handling machine." Though in every packet of needles the wires were originally of precisely the same length, some are sure to become shorter than others in the process of grinding. The difference will not be great: an ordinary observer might not notice its existence; but the trade requires accuracy, and each length in the size has its own particular use. The old mode of separation was to raise the longer needles from among the shorter by pressing them at the ends between the palms of the hands; hence the term "handing." The machine which is to be seen doing this work at Messrs. Milward's has a wheel with transverse grooves on its face, which takes up the needles from a hopper, and as it revolves the ends of the longer ones come in contact with a small stud, which throws them off, and they are shot down a spout to their proper receptacle; a second stud, set a little more closely, shoots off the next length down a second spout; and so on with the others.

Not less interesting is the automatic counter. This, like the last machine, has a grooved wheel which takes up the needles. Each of these in passing through moves a cog-wheel, and this motion is transmitted through other wheels to the hand of a disc; the number that have passed is thus indicated. A check in the machinery

calls attention to each completed thousand. This instrument is chiefly employed to divide the large packets into dabs of 2,000 each, for convenience in after and lighter processes.

Grinding, Setting, and Curing are terms, the first of which is applied to rounding off the heads, and the second to sharpening, and at the same time rendering slightly more obtuse, the points, on a small grindstone; the last means removing from the countersink of the eye any possible sharpness that may remain. The curing apparatus is a little cylinder stuck full of pin points and revolving rapidly, against which the eyes of the needles are held.

Finishing is giving a final polish to the implement. A revolving cylinder, covered with buff leather, dressed with a polishing composition, and driven at a high speed, gives the required finish to the needles which are pressed against it. The finishing of ordinary sewing needles is, at the Messrs. Milward's Mills, done by a machine invented by a member of the firm. In this, three or four times as many needles are finished in a given time as could be turned out if they were held to the buff by hand. Small rollers, covered with rubber, receive the needles from a hopper, and press them against the buff, giving them, as they do so, the lateral revolution needed to enable every side to be polished alike; the finished needles are then carried forward to the receptacle which waits for them.

Calyx-eyed Needles.—Before leaving the subject of needle making, a word should be said of this patented speciality of the Messrs. Milward's, and upon which they appear to look as, possibly, the needle of the future. The different schemes brought forward from time to time to facilitate so small a thing as the threading of a needle might furnish subject-matter for a volume. At the present time there are two self-threading needles (so-called) in the market: one, made at various Redditch factories, which threads through a slit at the side of the eye, and this, which threads through its top. It is claimed for the calyx-eyed needle that it can be threaded with ease in the dark. The form of its head is shown in Fig. 7. Also in the figure may be seen the method of threading it by pressing the thread through the nick at the top, and the needle as it appears when threaded. Of the two eyes, the upper one only is for the thread. The lower one, connected with it by a slit, is merely to allow the sides of the head, which act as springs, to have sufficient play; a single long eye would have given the thread too much liberty.

The making of these needles calls for especial care throughout. For the eyes, the hand stamp only is used. The slit is cut by a delicate revolving saw, the needles being fixed in ranks for that purpose: the dainty little automatic machine which does this is one of the most interesting sights of the Washford Mills. To ensure due elasticity in the sides of the head the steel needs to be tempered with the nicest skill. That these must cost more than ordinary needles is therefore a necessity.

Wrapping.—Formerly it was usual merely to fold up the needles loose in little packets, but at the present day it is usual before wrapping to stick them upon cloth. The method of sticking them is ingenious. Down the centre of a long strip of paper a narrower strip of cloth is gummed by its two sides only, the middle being left loose; this is known as a "strap." A small steel band is pushed along the opening between paper and cloth, and a narrow line of cloth is thus made to stand up in relief from end to end of the strap, through which the needles can readily be thrust. The work-woman has a small, flat, topless, metal box, in which she places a set of needles with the points projecting. The set is generally 10, 12, or 25, and there are automatic machines for counting out the needles in assorted sizes or otherwise. The box holding the needles in an even row, the work-woman can push them all at once through the cloth, and she then rubs them home with the side of her box. Spaces are left between the sets, and through these spaces the strap is afterwards divided with scissors.

The portions cut off are then enclosed in the well-known wrappers of purple paper, which have already been cut to size, and creased ready for folding by machines for those purposes. It may be interesting to mention that the use of purple wrappers for needles did not originate in any arbitrary fancy, but because this paper would, by turning red, reveal the presence of any acid likely to cause rust.

The packets, when labelled, are stored in heated rooms. This is to obviate, as far as possible, all danger of rust through dampness; for rust is the great enemy of the needle.

Conclusion.—In what has been said above little more has been done than to give a sketch of the manufacture of the ordinary sewing needle. But there are other needles, of which Redditch produces a vast variety—as sewing-machine, sail, surgeons', packing, darning, tambour, embroidery, and many more—to describe the making of all which would take far too much space. In the needle capital and its district some 20,000 persons live by the needle trade and its minor allied industries. As a class, the needle makers are respectable, intelligent, and well-to-do; crime and poverty are rare among them. The heavier and rougher parts of the work are, of course, done by men, but of the workers in the factories the great majority are females, manual quickness and patience being rather demanded in most of the processes than strength; thus the mother and her girls often do more towards the support of the family than its head.

The needles made in Redditch are sold in every part of the globe. There are before mo estimates of the entire annual and daily outputs of the district. The figures are startling, but as they appear to be based on no very certain data, I forbear to give them. It may, however, be mentioned that Messrs. Milward's alone produce something more than a million each working day.

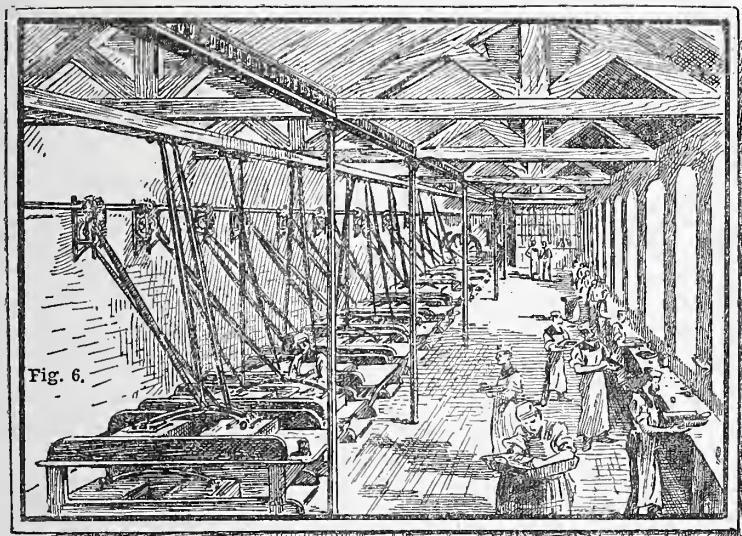


Fig. 6.

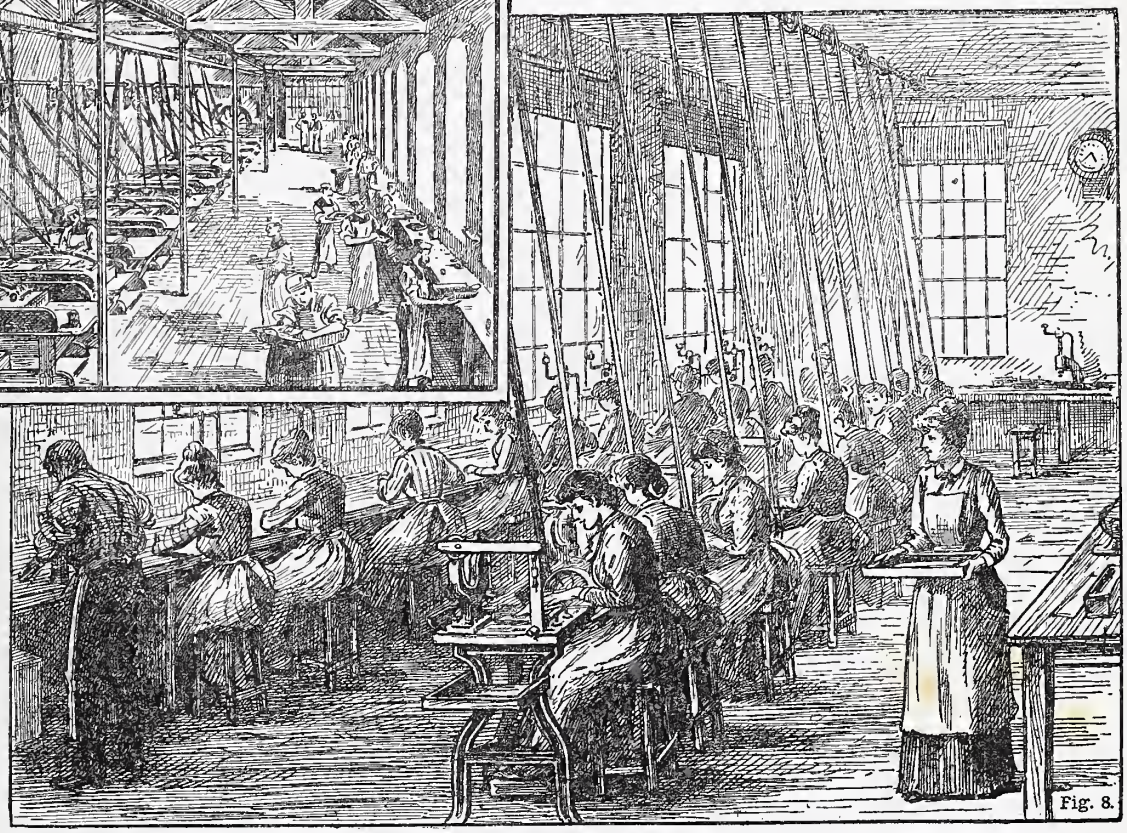


Fig. 8.

Washford Mills. Fig. 6.—Scouring Room. Fig. 8.—Eyeing Room.

It is believed that the world's population is increasing at the rate of nearly 6,000,000 a year, and that it is, at the present time, about 1,480,000,000.

According to Professor Roberts-Austen, gold passes from the liquid to the solid state at 1,045° C. (= 1,913° F.), and palladium at 1,500° C. (= 2,732° F.).

SHOP:

A Corner for Those who Want to Talk It.

**** In consequence of the great pressure upon the "Shop" columns of* Work, *contributors are requested to be brief and concise in all future questions and replies.*

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of Work *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given.*

I.—Letters from Correspondents.

Arithmetic.—F. B. C. writes:—"Student, in his problems on p. 364, No. 179, has transposed his A's and B's in both cases. They should have been written:

A	99,992-B	A	3,692-B
A	29,999	A	1,000
B	70,000	B	8,999
A	00,007	A	0,101
B	99,992	B	9,898
Total ..	299,990	Total ..	23,690

In working this, use is made of the facts that 9 is one less than 10, 99 one less than 100, and so on. In adding together rows of 9's, the answer must be the number of rows followed by as many 0's as there are 9's in the row minus the number of rows. Thus:

	9,999
999	9,999
999	9,999
2,000−2	30,000−3
which is 1,998	which is 29,997

In our problem the unit (2 in the cases above) B places in the first row is the same number as times that A and B intend now to add lines. Leaving for a minute the first line, examine the others. Whatever A puts down, B follows with a row which, added to A's, makes all 9's. Thus:

29,999	00,007	1,000	0,101
70,000	99,992	8,999	9,898
99,999	99,999	9,999	9,999

We see, then, that in both sums the last four lines are the same as if they were only two lines, but all of 9's, and B has only to mentally add together two lines of 9's. We have seen that to do this he has to take the number of lines of 9's (in both cases here it is two), and add as many 0's as there are 9's in the row—thus, 200,000 and 20,000 in each sum respectively—and then take away from these results the number of lines of 9 added; but this figure he has purposely added to the first row, and may, therefore, ignore it both here and there. The answer will always be the first row of figures with the added unit transposed to the other end of the row and a nought put in its place; thus: A puts down 9,999, to which B adds 2 as 99,992; answer will be 299,990."

A Big Band-saw.—A Correspondent writes:—"Messrs. T. Robinson & Sons have completed a monster band-sawing machine, which they claim to be the best machine for heavy work which has yet been made. The Gloucester Wheel and Waggon Company ordered a machine capable of cutting oak logs from 4 ft. to 5 ft. in diameter, and they sent up a log of 4 ft. in order to test the machine. This was done quite recently, and the result was in every way satisfactory, for, though the log was a rough curly tree 10 ft. long, the saw cut it through in three minutes: which certainly cannot be called bad work. The band-saw is 42 ft. long and ⅝ in. thick, and runs on wheels 6 ft. in diameter, the bottom wheel being the driving one. The machine altogether is beautifully made and fitted, and can be stopped instantly by a touch of a lever. The pulleys are fitted with ball bearings, thus reducing friction to a minimum."

Erratum.—On p. 369, No. 180, third paragraph, "boiler parts should be lubricated," etc., should read, "such cylinders should be lubricated," etc.

II.—Questions Answered by Editor and Staff.

Brickwork.—S. B. (*Haydock*).—You can obtain prices of brickwork from Laxton's or Lockwood's "Builders' Price Book;" but as you are, no doubt, aware that materials and labour vary in price in different districts, no book will give you exactly what you want. For any district you might get a list of prices from a builder in that district, or you may calculate it yourself in the following manner: Find how many bricks will build a yard of one-brick wall, or 9 in. thick. Then, if the cost of bricks be 30s. per thousand, one-tenth will be the cost of bricks in 1 yard, or 3s., if one hundred bricks build a yard. In the same manner the quantity of mortar may be found, and the labour by calculating how many bricks can be laid in an hour—which will vary according to the class of work. You will find a good deal of valuable information in the price books which will assist you in making your calculations. There are some articles on Bricklayers' Work in Vol. II. of Work, which will give you the methods of measuring different kinds of work.—M.

Boot and Shoe Repairing.—T. O. (*Harpurhey*).—Articles appeared in Work, Nos. 112, 117, 122, 126, 130, and 137, and are being continued.

Gilding Pier Glass.—Name-maker.—There are three chief methods whereby picture frames and similar ornamental woodwork are gilded. The cheapest class—known as "German gilt"—is cheap "white" metal, laid on in leaves, and coated with a yellow shellac lacquer, which brings the white to a gold colour. The other processes are known as "water gilding" and "oil gilding." Water and oil gilding mean that a gelatinous or an oil size is used as a means of affixing the gold leaf to the prepared surface. The former process is beyond the work of an amateur, requiring much preparatory knowledge of an experienced and practised nature. In Vol. III., No. 121, you may find a very condensed but able article on the water-gilding process. This article you should study, in any case. But, assuming you have a frame, previously gilded and now shabby, your best plan is as follows: First, well wash with a little warm soda-water, to remove dust and grease. Next coat it carefully with a finely strained and quick-drying coat of white lead paint. Stop all holes, etc., with a little white lead stiffened with whiting. Then coat all over with gilders' *oil gold size*, purchased, ready for use, at the oil and colourman's. If all is as it should be, you then stand the frame away where it will be free from dust and damp until the next day. It will then be dry, but "tacky"—*i.e.*, sufficiently sticky to make the gold adhere. The gold you purchase in books of twenty-five leaves; cost, about 1s. 3d. If you can use the gilders' "cushion and tip" (see article alluded to), well and good. If not, then buy transfer gold, and place each leaf against the size and gently press the paper at back with cotton-wool. After gilding, carefully dust off and coat with thin patent or clear size. Japan gold size is much used by the amateur and for trade gilding purposes, when the work has to be completed right off. It is a kind of varnish liquid, and dries fit for use in from fifteen to thirty minutes; but gilding on this is not nearly so good a job as on oil gold size. The best colour leaf for ordinary purposes is termed "extra deep." Liquid golds—viz., bronze powders in a solution of oil or spirit—are not to be compared to gold leaf. Either the nature of the solution takes all the brilliancy out of it, or else, if this is retained, it is at the sacrifice of the lasting qualities.—F. P.

Marbling.—H. T. R. (*Hamilton*).—To treat the subject of "painted imitations of marbles" in a *practical* manner will require considerable space; and Work does not "do things by halves." You must therefore wait until the requisite opportunity presents itself, and, meanwhile, get all the value you can from the various papers, dealing with other departments of the decorative trades, that you will find appearing in Work. The Editor is pleased to learn the "Trade News" and "Work World" paragraphs are valued so highly. Readers' letters and suggestions are, I know, always carefully considered and studied, with a view to increasing the usefulness and popularity of the paper.—London Decorator.

Plumbing.—Subscriber.—Our correspondent, who adopts the above *nom de plume*, wishes to know what constitutes a plumber, or, in other words, what kind of work they ought to undertake, and makes the extraordinary statement that it is not a trade at all, but simply an infringement on other trades, especially that of the whitesmith. He denies their right (and capability) to do hot-water work, bell-hanging, and spouting, and indulges in considerable criticism on the style and quality of the work. I will therefore endeavour to throw a little light on the matter, if possible; and while admitting that there is a deal of truth in his remarks, will try to show that plumbers are not so black as he has painted them. In the first place, things have altered very considerably since "Subscriber" entered the trade of whitesmith some fifty years ago. At that time the line of demarcation between trades was more rigidly kept. It was then quite as much as a man could do to learn and keep himself up in his own particular branch, and he could, if a good hand, always get work; but now, owing to the increased thirst for knowledge, and to the valuable aid afforded by such magazines as Work, it is easier to learn three trades than it was to learn one fifty years ago. Then, again, a man is often compelled, by force of circumstances, to do work that does not strictly come in his trade. Take, for instance, an ironmonger's shop employing, say, a whitesmith, plumber, and tinsmith. Now, each of these men will, at times, have two-handed jobs, and, as labourers are the exception and not the rule in ironmongers' shops, they will have one or the other of their fellow-workmen to assist them. This, naturally, gives them an insight into each other's work, enabling them, on an emergency, to supply their place; and if they "chum" well together, they impart to one another useful hints and valuable information; and just in proportion to the extra knowledge they acquire, so much the more valuable do they become as mechanics, whether in that situation or another. I am writing from actual experience, so I know what I am talking about. With regard to bath and hot-water work, I do not know what a master plumber would say to a man who applied for a job and said that he knew nothing about it. Respecting bad work of this class, I am prepared to prove that for one bad job done by a practical plumber there are a dozen botches made by whitesmiths and others who attempt plumbing work—in the South of England, at any rate. As the plumber was originally the man who fitted up all the water-pipes of a house when they were of lead, it is quite natural that he should not like to be shut out from the work simply because of a change of material. Whitesmiths certainly cannot carry out bath work with satisfaction, as they cannot make the wiped joints which necessarily occur in all good work. At the same time, I do not cavil at their doing it, if they can. With regard to spouting, I think most plumbers consider that class of work *infra dig.*, and leave it to tinsmiths and carpenters. To sum up, the whole affair is in a nutshell. A man's trade is just what he feels and proves he has the ability to do; and, as I have frequently remarked in these columns, the more versatile his knowledge, the better his chance of success in the battle of life.—R. A.

Anaglypta.—Lincrusta.—*Anaglypta*—signifying "surfaces in relief"—is one of the most successful of decorative materials. It is made from a special waterproof pulp, and, when soft, is subjected to great pressure from metal rollers bearing the design. Its chief qualifications for interior decorative purposes are lightness, the great amount of relief that can be obtained, and its beauty of designs and great capacity for economical decorative treatment. The Company supplies the decorative trades with beautiful sets of patterns at a nominal sum, and if you write to Queen's Mill, Lancaster, they will send you an illustrated trade list. Private buyers must purchase through local agents or decorators. At a later date, should there be any demand for it, I will submit for the Editor's approval some practical notes on decorating the material—in effects of Japanese leather—of solid wooden ceilings and dados, imitation fabrics, and so forth, by the best and cheapest methods.—London Decorator.

Water.—B. (*Fulham*).—The hardness of water is chiefly due to the presence of carbonate of lime. This is insoluble in water free from carbonic acid gas, but as all water, excepting distilled, contains this gas, so does it contain carbonate of lime in solution. Dr. Clark's method of softening water consisted in adding a little lime or lime water. This combines with the free carbonic acid gas, and settles to the bottom as carbonate of lime; whereas the carbonate of lime originally in the water is no longer held in solution by the gas, and therefore also separates out and settles to the bottom. The precipitate, as it settles, carries down with it some organic and suspended impurities, and this purifies the water to some extent as well as softening it. For domestic use, add a little powdered lime or some lime water to your water till it just shows faintly alkaline to litmus paper by turning red litmus paper (sold at 2d. per book) blue. Allow to stand till clear, and then decant off the clear, softened water from the sediment of carbonate of lime. The hardness of water is further due to the presence of sulphate of lime, but this cannot be removed. The only way to make perfectly soft water is to distil it and condense the steam, but this would not be required for any domestic purposes.—F. B. C.

Dyeing Rabbit Skins.—J. R. (*Canterbury*).—Your safer plan will be to dye them as sealskins are dyed—that is, not to immerse the whole skin, but to brush the dye into the fur, repeating the process till the proper shade is gained, and carefully drying between the dressings.—M. M.

Dents in Woodwork.—W. H. (*Fraserburgh*).—The bruised surface can generally be brought up level by means of several folds of wet brown paper or rag being laid on the damaged portion, and then pressing a hot iron against it. A poker may be used, or, better still, a flat piece, or a worn-out file—in fact, anything that will give heat extending a little over the width of the bruise. The iron should not be *red hot;* use only sufficient heat to draw up the bruise; any excess may, especially in the case of veneered goods, cause a blister instead. Should this means prove ineffective, or the dents be too deep to allow of their being drawn up, use the hard stopping, full particulars of how to make and use which refer to Work, No. 150, p. 726. It is against our rule to send replies by post; the answers are framed as far as possible so as to be useful to others besides the querist.—Lifeboat.

Hydraulic Lifts.—A. E. P. (*Vauxhall*).—A leakage in the starting valve would certainly cause the lift to rise slightly if the waste valve is not left open. Anything wrong with the packing causing a leakage there would produce the opposite effect. It is time to re-pack when the gland packing leaks. The rams are usually packed with U-shaped leather rings inverted, with a copper ring inside to prevent collapse. Water entering the collar from the cylinder presses it against the ram when the pressure is on. I have had under my notice an accumulator packed with gasket, and working at a pressure of 1,400 lb. per square inch; one packing lasted fifteen months. I do not know of a book on Hydraulic Lifts, but you might find one in Messrs. Lockwood's (Stationers' Hall Court, E.C.) catalogue of books.—F. C.

Canterbury.—W. S. (*Oswestry*).—Your only way to get this Canterbury design will be to get No. 105 of Work, through Cassell & Company, or elsewhere, taking care you get the supplement.

Mica.—G. W. (*Birmingham*).—If you will refer to the London Directory, you will find many mica merchants. Messrs. Defries, of Houndsditch, could

probably supply it, and there are sellers of it in Hatton Garden, London, E.C.

Hairspring.—J. H. B. (*Pendleton*).—The clock gaining so much shows that the hairspring is too strong. If you cannot get a weaker one, take the one got off the staff and off the collet, and rub it down on an oil-stone, pressing it with a cork and rubbing in a circle, occasionally shifting its position on the cork so as to cut it equally: this will weaken it by making it narrower. There is always a difficulty in getting duplicate parts to all these cheap clocks, so that accounts for the clockmakers saying they are not worth repairing, as the manufacturers of many of them do not sell parts.—A. B. C.

Wiping Joints.—C. H. (*Swansea*).—You ask for a mixture that is used by plumbers to wipe a joint without the use of irons to keep up the heat. I know of no mixture except the usual one of lead and tin of the proper proportions—viz., one of tin to two of lead, with a little variation either way, according to the nature of the work. As to keeping up the heat, that can be done without irons, by means of a blowlamp or by continual application of hot metal from the solder-pot. The best work on plumbing that I know of is that by Mr. P. J. Davies, published by E. & E. N. Spon, Charing Cross. There is a book by S. S. Hellyer, called "The Plumber and Sanitary Houses," publisher, Batsford, Holborn. It is a very good book, but it is not so comprehensive as the first-mentioned work.—R. A.

Battery.—W. T. (*Houghton*).—The Editor now has a paper of mine under consideration as to making bichromate cells in a very simple way; but you will find that any form of bichromate or chromic acid cell will work the model motor (Vol. III., No. 154). You will require two cells at least, connected in series. Any good ironmonger will either sell you or get you the silk-covered copper wire that you may require, as now every ironmonger keeps electric bells, etc. If that will not do, write to any of the London electricians that have been mentioned from time to time in WORK—for instance, Messrs. Orme & Co., 65, Barbican, E.C.—and they will supply you. I am glad you have been so successful with the weather-glass you made from WORK.—J. B.

Bagatelle Board.—W. C. L. (*Manchester*).—You should advertise this in the "Sale and Exchange" column of WORK.

Lantern.—R. W. (*Keighley*).—Your question will be answered in an article of the series on "Bent Iron Work."—J.

Selvage.—B. H. (*Winsford*).—To avoid the expense of engraving blocks to illustrate elementary construction, let me advise you to purchase Sexton's "Boiler-Makers' Pocket Book," published by Spon, at 5s., and the "Boiler-Makers' Assistant," by Courtney, published by Lockwood, at 2s. 6d., where you will find the development of steam boilers and other forms worked out.—J.

Furnace Charcoal.—LIMPRICHT.—I fear it will not work, nor supply the cylinders with enough steam. There is generally a bother with these small engines, the steam supply soon running down.—J.

Battery for Electric Light.—R. G. B. (*London, W.*).—Mr. G. Bowron, Praed Street, W., can supply you with all materials required to make a battery. He is the nearest tradesman to your residence. The cost of a battery to light a lamp of from six to eight c.-p. will be about thirty shillings.—G. E. B.

Electric Light.—H. Y. (*Poplar*).—It seems a pity to discourage your aspirations for a better light in your "parlour of a Sunday evening," but the truth must be told, and this is: you cannot get a better light from an electric lamp and battery costing fifteen shillings. You will get a better light by investing the 15s. in a good paraffin lamp, and oil to burn in it. Electric light from a primary battery is the most costly light in use at present. There is no such thing as cheapness about it, so you cannot have it cheap. Electric light is more costly than gas. You will have to wait until one of the electric light companies lay their mains down in the High Street before you decide on replacing your present dull light with electric lights.—G. E. B.

Automatic Models.—E. N. (*Bristol*).—Messrs. I. & J. Soar's address is 21, Blake Street, Ilkeston, Derbyshire.

Chemical Chest.—E. W. N. (*Shrewsbury*).—I think the best way to fit up your chest would be to have a hinged cover and three or four removable trays divided into compartments for the chemical boxes, and lay the trays in the chest over each other. Another idea for such a chest is to make it like a miniature chest of drawers. There need not be any rails between the drawers, the points being made higher than the sides; and each drawer should have a lock and key, locking into one side of the chest.—F. J.

Electric Light from Primary Batteries.—F. T. J. (*Keighley*).—In calculating the resistance of an electric light circuit to find the available volume of current, you must take into consideration the resistance of the lamps and the conducting wires, as well as the internal resistance of the cells. I think ·11 ohm will represent the resistance of your cells. I should advise you to use No. 16 copper wire as a conductor of current between the battery and lamps. This has a resistance of ·2013 ohm per lb. If you can get two 8 c.-p. lamps, requiring 1·3 ampères, at a pressure of 18 volts, you might be able to light both of them in parallel with current from your twelve cells in series. You may do as you propose with the reserve cells, but do not switch in more than one at a time. I suspect you will find, as I did, that lighting by means of battery is an intolerable nuisance. Information relating to resistance of cells, wires, etc., may be found in Mr. Bottono's shilling "Guide to Electric Lighting."—G. E. B.

Electrotyping.—R. A. R. (*No Address*).—Daniell cells are the most constant, and the best type of battery for electrotyping, but you will not be able to cover large surfaces with copper deposited with current from four cells of pint size. The surface of zinc in each cell should at least equal the surface of the anode, and this should be slightly larger than the surface to be electrotyped. The size of the vat is of no consequence whatever in determining the size of the battery.—G. E. B.

Electrical Engineer.—T. H. H. (*Birkenhead*).—If you wish to become a practical electrical engineer, it is necessary for you to serve a term of years in a good electrical engineer's shop. You may learn the theory of the science by studying books, and thus read up to pass a science examination. After this, you may call yourself an electrician and teach the science; but knowledge thus obtained will not equal that obtained by practice.—G. E. B.

Cement Mortar.—F. H. M. M. (*Alexandria, Va.*).—The most satisfactory method to adopt for keeping the water out of your cellar will be to plaster the outside of the walls down to the foundations with cement mortar, mixed in the proportion of one of cement to three of clean sharp sand. If this mixture is slow in setting, add more cement; it should be at least ¾ in. thick. When moderately set, fill in round it with dry rubble or half bricks, packed loosely, about 1 ft. thick, and carry a drain from the lowest point of the foundations; the water will sink through the stones, and run off at the drain. If you cannot get to the outside, you might try a thicker coat inside, but a drain and rubble round the outside will still be necessary; in the former case the wall would be kept drier. The bottom laid in the manner you propose, with concrete, will answer in either case. It will be best to have the wall moderately dry when the cement is put on. Or you may use asphalte outside instead of cement, giving two or three coats till it is about ¼ in. thick, but the wall must be dry, or the asphalte will not adhere. If you do it outside you could clear one side, or a portion of one side, at once. Am glad to hear that you are pleased with WORK and have secured new subscribers; the more subscribers that are obtained, the better will the magazine be. If every subscriber made it a point to obtain one new weekly subscriber WORK would have a truly phenomenal circulation.

Spirit Varnishing.—J. B. (*Accrington*).—A short paper shall appear shortly.—ED.

Carbon for Dry Battery.—W. A. (*Edinburgh*).—The carbons employed in the construction of the Gassner dry battery are hollow cylinders of about 1½ in. in diameter, with solid tops for connection with the binding screw. Carbons for these batteries may be hollow or solid, square, rectangular, or round, or mere flat plates, and one, two, or more of these may be used in a cell, providing they are connected together at the top, and do not touch the zinc cylinder nor take up too much space in the cell. There should be ½ in. clear space between any part of the carbon and the zinc, and the tops of the carbon plates should stand up quite ½ in. above the top of the cell.—G. E. B.

Shocking Coil.—H. B. J. C. (*Birmingham*).—The dimensions suitable to your purpose will be as follows: Core of iron wires, ⅝ in. in diameter by 5 in. in length, made to slide in the hollow core of the bobbin, and fitted with a brass or wood knob for drawing the core out. Bobbin of ebonite, 4½ in. long by 1½ in. in diameter. Wind on this four layers of No. 22 silk-covered wire for the primary, then fill up the bobbin with your No. 36 wire, or put on as much as you have, even if the bobbin is not full. When the conductors are connected to the two ends of the primary the shock will be quite strong enough for a child. When they are connected to the two ends of the secondary, and the core is out, the shock will be unpleasant to most people; whilst with the core in and a pint bichromate connected to the coil, the shock will be too great for a strong man to bear. But why spend your time and money on a shocking coil? It is of no use at all to anyone outside the medical profession. By using the material to construct a small spark coil, you may spend many happy hours in amusing yourself and friends.—G. E. B.

Plumbing.—WORKING PLUMBER.—Practical papers are just about to appear. Tell all your plumbing friends.—ED.

Writing on Glass.—T. W. V. (*Leicester*).—The glass tablets to which you refer—"Bovril," "Cadbury's cocoa," etc.—are not embossed in the ordinary way, but are cut out by a process of grinding termed "sand-blast." The ruby or blue film that is flashed on is simply ground out by the aid of machinery instead of burnt out by acid. If you write to the London Sand-blast Decorative Glass Works, 58A, Gray's Inn Road, and mention for trade purposes, they will probably send you a small sample and quote prices, from which you will learn the comparatively cheap prices that the most elaborate designs can be supplied for. Stencilling is of no use for acid work. With repeats for lamp such as you mention, I should draw it out on lining paper, then rub over the back with whiting, and mark over letters, leaving a white impression on the glass. This would save time spent in cutting a stencil, for stencils are really useless for good work. You must rely upon the pencil and your own smartness, and practice. Good Brunswick black is best for stopping-out. Write Messrs. Wilkinson & Sons, Attercliffe, Sheffield, for particulars of their goods for embossing.—F. P.

Mounting Lathe on Sewing-machine Stand.—G. S. B. (*Huddersfield*).—This question has been asked several times. You can, of course, do what you propose if the lathe be very small—by "very small," I mean, perhaps, of 2 in. centre, a watchmaker's lathe. I think you could very likely buy one second-hand, and no doubt you will find it easy to mount it on the table of the sewing machine. I cannot give you any more directions without seeing the sewing-machine stand. Pray do not suppose you can exert enough power to drive an ordinary lathe; you might as well try to wind a church clock with a watch-key or drive a tenpenny nail with a tack hammer. You may turn chessmen and draughts, or do small work in metal, such as parts of a model engine, etc., and small drilling up to about $\frac{3}{16}$ in., and the little lathe might prove very useful for such things as those.—F. A. M.

Lacquering Desk Corners.—ALPHA.—To relacquer your desk corners, you must first carefully clean off all the old lacquer; as you cannot get the corners off, you must take care that you do not scratch the polish of the woodwork. I should use fine glass-cloth on the end of a piece of stick. Of course, it will require patience and more time than if they could be got off, but you must not mind that. When the lacquer is all off, give a final rubbing in straight strokes to polish; finish with powdered pumice-stone, rubbing with a small cork. With regard to lacquering, as it would be awkward to heat the brass equally and without injuring the wood, you had better use a cold process lacquer. This you can procure from Palmer's, Old Street, St. Luke's. It simply requires laying on with a soft camel-hair brush. Do not take too much up at a time, or it will run, and spoil the work; do not give two coats till the first is dry and hard.—R. A.

Clock; Conjunction of Indices.—H. R. F. (*Colne*).—As your indices revolve—A twice a day, B once in thirty days, and C three times in forty days—their relative rates of speed are 2, $\frac{1}{30}$, $\frac{3}{40}$, which ratios are also represented by 240, 4, and 9, which are the numerators of corresponding fractions having 120 as a common denominator, which, being common, does not affect their relative values, and may therefore be omitted. Taking, first, the two indices B and C, it is evident C will go once round the dial and overtake B during its second course, as the speed of the former is more than twice that of the latter. If D = distance in the minute spaces of the dial passed over by index B before reaching C, then

$$D = 60 \times \frac{4\,D}{9};\quad D - \frac{4\,D}{9} = \frac{5\,D}{9} = 60$$

and D = 108 divisions. Therefore, at every 108 divisions these hands will be together; the interval of time between successive conjunctions will be found from the proportion:—

$$60 : \frac{40}{3} :: 108 : 24 \text{ days},$$

because the index C travels over the 60 minute divisions three times in forty days. The distance D′ passed by the index A before reaching the index C, is

$$D' = 60 \times \frac{9\,D'}{240} = 60 \times \frac{3\,D'}{80};\ \frac{77\,D'}{80} = 60, \text{ and } D' = \frac{4800}{77}$$

As the hand A travels 120 minute spaces per day, the intervals of time between the conjunctions between A and C will be

$$\frac{4800}{77 \times 120} = \frac{40}{77} \text{ days.}$$

To find the number of days in which the two conjunctions coincide, we must find the least common multiple of the intervals; to bring both fractions to the same denomination, 24 is multiplied by 77, making 1,848. The L. C. M. of the numerators is thus found—

$$\begin{array}{r|l} 8 & 1848,\ 40, \\ \hline & 231,\ 5, \end{array}$$

$$8 \times 231 \times 5 = 9{,}240, \text{ and } \frac{9240}{77} = 120 \text{ days.}$$

During this period the indices will make the following numbers of revolutions round the dial:—A, $120 \times 2 = 240$; B, $\frac{120}{30} = 4$; and C, $\frac{120 \times 3}{40} = 9$ revolutions. This will be the least interval between two triple conjunctions of the hands.—F. C.

Air-pump.—J. S. (*Beith*), referring to my answer in No. 166, says:—"What I want is an air-pump to be driven by a ½ h.-p. steam engine for exhausting square iron vessels, something the same as applied to the milking machines, where the resistance is much the same, as for every stroke of the air-pump the vessel becomes filled with milk." Now, that certainly is a more sensible way of putting a want before the mind. Might I say here for the good of the brotherhood, that if one has an idea to work out, and wants a little assistance, it would be far easier if the correspondent would send a sketch of his work? If it is something he wishes to keep secret until he patents his idea, and that were said in the communication, the Editor and such of his staff as the matter might be submitted to may be trusted to deal honourably; I presume everyone to whom the Editor submits questions are tried men. Now to the answer. The air-pumps described by me are altogether unsuited to J. S.'s needs; they

are laboratory instruments. The problem stands thus, to my mind: From a given vessel abstract air so that a fluid may flow into it—if on such a scale as to require a ½ h-p. engine, then I should employ an exhaust fan: this may be made of any power. In a steel converter a blast is thrown into converter of tremendous force. Some years ago, in Crewe, a party of visitors were going through the railway works, and one, pointing with his umbrella to the large pipe connected with the exhaust fan, had it forcibly wrenched from his hand by the suction, and drawn into the machinery, doing such mischief that it cost a hundred or two pounds in repairing the same—a somewhat expensive pneumatic experiment. In the absence, then, of any definite knowledge of the kind of work to be done, I should suggest a chamber attached to the iron vessel containing an exhaust fan, driven at a high speed, which would produce such a vacuum in the vessel as would permit the flow of milk or other fluid by atmospheric pressure. If this does not help J. S., then I would suggest that he send in confidence a sketch of the vessels he wants exhausting, with their position, etc., and I or someone else will, no doubt, be able to help him further.—O. B.

Magnetised Watch Parts.—J. A. (*Thirsk*).—The only thing I can advise to make a thoroughly reliable job of the watch is to take away all the parts that are magnetised and put new ones; and if the wearer has to do with electrical works, then put non-magnetic pieces. You can take the magnetism out by making red-hot: that, of course, means spoiling in this case, and the above is the only remedy.—A. B. C.

Solder.—J. A. (*Thirsk*).—Two parts pure silver, one part brass; or, two silver, one tin for quick running white solder for silver, jewellery, etc. The best flux is borax.—A. B. C.

Clocks.—One who Wishes to Know.—Britten's "Watch and Clock Makers' Handbook, Guide, and Dictionary," price 5s., published at the Horological Institute, Northampton Square, Clerkenwell, London, E.C. Also one by Mr. Glasgow, price 4s. 6d.; and another by Hasluck, about same price. Either of the above may be ordered through any bookseller.—A. B. C.

Graining.—Excelsior.—Articles appeared in Work, Nos. 55, 62, 65, 69, 72, 78, 81, 93, 127, 134, and 138.

Quarter Horse-power Engine.—J. R. B. (*Accrington*).—Articles appeared in Work, Nos. 106, 110, 121, 125, 131, 136, 141, 145, and 149.

Plumbing Papers. — T. J. (*Droitwich*). — A series of practical papers on Plumbing, etc., is in course of preparation, and in it the various queries you have put will be attended to. I shall endeavour to be very clear and explicit as heretofore; glad to find my work appreciated.—R. A.

Tin from Waste Cuttings.—A. R. (*Aberdeen*). Search back numbers and indices, and watch "Shop" column for another reply.—R. A.

Brazing.—A Reader.—Search in the back numbers. Whilst we are at all times ready to help any reader if he will state his wants definitely, it would be a waste of time and space to repeat general instructions that have only very recently appeared.—R. A.

Precious Stones.—Apprentice.—Cornelian and carnelian are but two names for the same kind of chalcedony. The first is derived from the horn-like ("cornu," a horn) appearance of its fracture. The second name, carnelian, is given to it on account of its flesh-like colour ("carnis," flesh). That is their derivation, but now, when a little more care is being taken in description, the cornelian is said to have a waxy lustre on its fractured surface, while that of a sard is dull and horn-like. Engraved gems are arranged in these three classes—viz., cameos, intaglios, and scarabs. Cameos have their design cut in relief, and stand out from the background of a different colour. Intaglios have their designs sunk into the gems. Thus an intaglio is just the reverse of a cameo. With an intaglio the chief aim is to produce an impression, therefore it is suitable for signet rings and for seals; with a cameo the gem adorns by the beauty of its appearance, and, consequently, is employed in the other articles of jewellery. A scarab combines the characteristics of both cameo and intaglio, for the back of the scarab is cut to represent a beetle in the manner of a cameo, while the face has the design sunk into it—that is, in intaglio. These definitions are quite apart from the material they are formed out of. A cameo is a cameo, whether cut out of shell or out of a piece of opal attached to its matrix—a kind of cameo, by-the-bye, which is now rather in demand—or out of onyx or sardonyx; the term cameo applies to the condition of the gem after it has been carved with the figure or figures raised above the ground. In the same way an intaglio is still an intaglio, whether it be cut in sard or crystal or glass. Therefore, either of the terms should be preceded by a descriptive word to indicate the sort of cameo or intaglio it is—for example, a shell cameo or an onyx intaglio, as the case may be. A most celebrated collection of this class of gems belongs to the Duke of Devonshire, but the British Museum is very rich in specimens, too.—H. S. G.

Printing at Home.—Worker.—A series of papers is with the printer, and will appear shortly in Work. Tell your friends.

Electro-deposition of Iron.—J. C. (*Stratford*).—Iron is sometimes deposited on the face of an electrotype of a wood engraving to protect it from wear in the press. This is termed "steel-facing the electro," because the iron thus deposited is nearly as hard as steel. The work can be done by professional electrotypers. Try Messrs. Hare & Co., Essex Street, Strand, W.C., or Messrs. Dellagana & Co., Fetter Lane, London. If you find any difficulty in getting what you require, write to S. R. Bonney, 19, Avenue Road, Lewisham, S.E., and he will endeavour to get it done for you.—G. E. B.

III.—Questions Submitted to Readers.

*** *The attention and co-operation of readers of* Work *are invited for this section of "Shop."*

Rhinoceros Tusk.—A. W. A. T. (*Plaistow*) has a rhinoceros tusk, and will thank heartily any reader, professional or amateur, to tell him of a good use to put it to.

Mail Cart.—Mail Cart writes:—"I should be obliged if some kind reader would furnish me with measurements and instructions how to make a mail cart suitable for two children."—[Much has already appeared in design and letterpress on mail carts. Consult back numbers.—Ed.]

Fret Monogram.—W. K. (*Pullocking*) writes:—"An old reader from the first would be obliged for monogram in fretwork of 'W. K.' from any fellow-readers of Work."

Furbishing Leather.—J. B. (*Dublin*) writes:—"I have a travelling bag which was originally black, but has become brown through wear, and would be obliged if any kind reader would inform me of a means for renovating same."

Sensitive Metals.—J. W. (*Old Kent Road*) writes:—"Will any reader kindly inform me of a metal, or an alloy of metals, that is most sensitive to temperature, and how to make the same?"

Emigration.—Derwent writes:—"In April last you published in Work a letter from a resident in Ottawa, Ontario, in which he draws attention to the opening existing in that city for electricians. I have some idea of going out next spring, but should like some reliable data to go on. Could you oblige me with your correspondent's name and address, or put me into other channels of information, direct or through columns of Work?"—[Perhaps the Ottawa correspondent will reply.—Ed.]

IV.—Questions Answered by Correspondents.

Stained Glass Designs.—Mathews & Smith, of 39, *Tamworth Road, West Croydon*, write to T. B. (*Moss Side*) (see No. 172, p. 251):—"We will send you coloured design sheet, containing geometrical and foliage patterns, for 3s., post free."

Fancy Articles.—R. S. Donaldson (*Netherby, Cambuslang, Glasgow*) writes:—"I do not find that Cabinet-maker's Tool's inquiry in No. 157 for 'Fancy Articles Market' has yet been replied to. I am connected with the fancy goods trade, making and selling articles myself, and should be glad to act as Cabinet-maker's Tool's agent. Some of my customers have been inquiring for smokers' cabinets and hanging bookshelves. Such articles are made in Germany, I understand, and, perhaps, a few in Birmingham. Perhaps Cabinet-maker's Tool could write me on the subject."

V.—Letters Received.

Questions have been received from the following correspondents, and answers only await space in Shop, upon which there is great pressure:—A. F. M. (*Liverpool*); E. D. (*Wandsworth*); D. M. L. (*Glasgow*); A. F. (*Ovenden*); Electro; C. B. (*Sheffield*); N. D. W. (*Steeton*); M. W. (*Stepney*); A Subscriber; P.B.H. (*Southport*); W. J. W. (*Heckmondwike*); W. H. (*Chilcers Coton*); J.M. (*Edenfield*); T. W. (*London*); C. C. (*Bathgate, N.B.*); E. R. (*Stockton-on-Tees*); Eddefra; A. F. (*Edinburgh*); E. J. (*Barnsley*); Cherry; S. M. (*Leeds*); Engineman; J. G. (*Crasshouse*); T. McC. (*Pendleton*); E. D. (*Hanley*); Horologist; A Reader of "Work"; J. W. (*Edinburgh*); Satphire; J. S. (*Torphins*); Wheeler; W. C. (*Manchester*); Beck; A. T. M. (*Streatham*); J. L. (*Aberdeen*); R. C. H. (*Nottingham*); Country Cabinet-maker; H. G. B. (*Clapham*); W. P. (*Cannock*).

"WORK" PRIZE SCHEME.

FIFTH COMPETITION.

"Domestic, Commercial, or Scientific Application of Electricity" Competition.

Continuing our scheme of Prize Competitions of a useful and practical nature, we propose to devote the present one to the subject of Electricity, in which our readers and the world at large take so keen an interest. We invite competition for the following prizes—

First Prize, £3;

Second Prize, £2;

Third Prize, £1;

for the three best suggestions of an original and practical nature, involving the application of electricity to some domestic, commercial, or scientific use. This application may be on a large or small scale, to take effect on land, sea, or in air—the main conditions being the newness and practical possibilities of the suggestion.

Conditions and Rules of the "Electricity Suggestion" Competition.

All Descriptions to bear the Work Prize Coupon, cut from one of the numbers of Work in which the Prize Scheme is announced.

Each Description to be signed with an original *nom de plume*, and to have the writer's real name and address securely attached to the manuscript in a sealed envelope.

Each Suggestion should be fully described in respect to its purpose, construction, and working, and, where possible, should be illustrated with a drawing of the article itself and its various parts, to elucidate the description.

A Suggestion not illustrated will have an equal claim in the competition, provided the description be sufficiently in detail to convey a full idea of the article suggested.

In the work of judging regard will be had to the practical nature and utility of the suggestions, and their prospective popularity.

The Prize Suggestions and Drawings, and any others, to be published, if desired by the Editor, in Work, but the copyright thereof to remain with the authors.

Copies of MSS. and Drawings to be retained by the competitors, as in no case can the return of MSS. be undertaken.

The Editor of Work will supervise the judging of the Suggestions, and the selection, or decision, as determined upon by him is to be final.

All manuscripts intended for the "Electricity Suggestion" Competition must be addressed to the Editor of Work, c/o Cassell & Co., Ld., Ludgate Hill, London, E.C. They must reach him on or before Saturday, December 17th, endorsed, "Electricity Suggestion" Competition.

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Water Motors, from 5s. each; ½ h.-p., price 20s.; list, stamp.—Walton, 9, Queen Anne St., Stoke-on-Trent.

Wanted, Vol. I. of Work.—W. Reeves, Larne.

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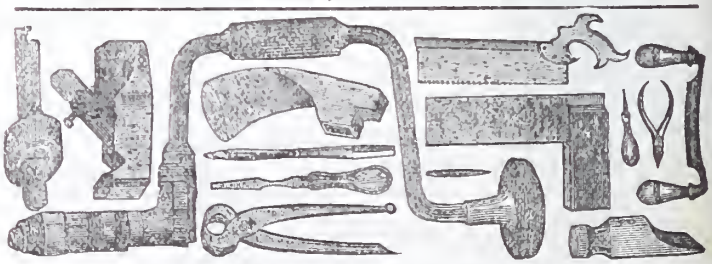

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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VOL. IV.—No. 191.] SATURDAY, NOVEMBER 12, 1892. [PRICE ONE PENNY.

WORK WORLD.

IN Chicago, out of 3,000 school-teachers, not more than 200 are men, and the remainder are women.

* *

Somnal is a new hypnotic. Its effects are far less depressing than those of chloral, and in other characteristics it has the same advantages.

* *

Edison has in store for the world some inventions that leave his past achievements out of sight, but, as they are not yet patented, he keeps the objects of them a secret.

* *

Six years ago Belgium sent only 8,000 tons of iron to India. Last year the quantity increased to 38,000 tons; and these exports are chiefly at the expense of British work.

* *

The straw-plaiting industry of England is dying out. In September the imports of plait were 606,808 lb. The greater portion came from China, where labour is cheap, and the workers extraordinarily skilful.

* *

Manufactured iron can be delivered from Belgium to London for 5s. per ton, whilst the Black Country cannot do it for less than 12s. 6d. No wonder home industries are crippled, and foreigners can beat us on our own ground.

* *

The Watkin Tower will be 150 ft. higher than the Eiffel Tower in Paris, and it is estimated that its top will be visible, in a clear day, at a distance of 100 miles. The area of country visible from its top should therefore embrace a circuit of 600 miles!

* *

Emigration to Brazil! With regard to the 1,000,000 emigrants wanted, we say—No! The tropical parts into which emigrants will be cast are unhealthy, and great risks will be run. No Brazil for Britons unless they are tired of life!

* *

Halesowen has for some time past been the home of chain-making. Now works are to be started at Coatbridge for the manufacture of cables. With all the materials at hand, it is strange this industry has not been started before.

* *

The dispute in the cotton trade is to form a subject for arbitration. The suggestion originated with the Mayor of Liverpool in a letter to the Mayor of Manchester. If operatives and masters agree to this course the lock-out may be averted.

* *

House painters and decorators—employers and employés—are to deliberate on such questions as:—The Apprenticeship System, Technical Education of Painters and Trade Classes, Registration of Painters. The Conference will take place in Painters' Hall on January 16, 17, and 18 next, and is likely to prove rather lively.

* *

Finnish Dragoons have been testing aluminium horse-shoes. Horses were shod on one fore-foot and one hind-foot with aluminium shoes, and on the other feet with ordinary iron shoes. Six months' use on a hard and stony road proved the superiority of the aluminium shoes, not one of which had gone to pieces.

* *

Glass manufacture in the Midlands is so low that one little town in France does more trade than the whole Stourbridge district, including Dudley and Birmingham. The Merchandise Marks Act cripples the English glass trade. The Board of Trade should look into this. With the exception of chimney-glasses, glass is exempt from the operations of the Act.

* *

Carrier pigeons are being used in France for conveying vaccine and other elements in tubes. One pigeon is capable of conveying, in one journey, from five to six tubes. The utility of this means of transport in times of war is obvious, and one can imagine the joy of the representatives of the Army Medical Department at the sight of a flock of these swift medicine-carriers in a besieged town.

* *

A Berne tramway is worked on the compressed air system, owing to the gradient which extends throughout the line being too stiff for horse haulage. The compressed air is contained in reservoirs in the cars. Each car carries twelve reservoirs, which are in communication with each other, and are charged with air at a pressure of 600 lb. per square inch. The speed ranges from seven and a half to nine and a half miles per hour.

* *

For thirty years attempts have been made to smelt the iron-sand of New Zealand, but without success. Now a blast furnace at Onehunga has been charged with iron-sand formed into bricks. On tapping the furnace, several tons of iron were obtained. The metal was pronounced by the workmen to be of excellent quality and workable—in short, superior to that obtained from any of the New Zealand ores. The "bricks" are made of iron-sand and clay. The yield of iron is 50 per cent. of the weight of "bricks" charged into the furnace.

* *

Important amendments have lately been made in the Patent Act of Canada. In future examiners are to be employed to make a thorough search into the applicant's title to his invention. Other material changes are: models of inventions, or specimens of compositions need only be furnished if required by the Commissioners of Patents. The duration of a patent is to be eighteen years instead of fifteen, with a fee of £12; with the option, however, of paying partial fees of £4 and £8 for the terms of six or twelve years.

* *

The steel lattice girder bridge over the Cannich Water on the Strathglass Road, which collapsed on the eve of its formal opening for traffic, though a competition job, possessed a serious error somewhere. The girders are 130 ft. span and 13 ft. deep, with a road width of 16 ft. Some rivets were sheared, and the bridge subsided on to a temporary scaffolding which, fortunately, had not been removed. The bridge was guaranteed to carry a distributed load of forty tons, but failed under a load of gravel. In ordinary practice such a bridge should be calculated to carry 104 tons—that is, one hundredweight per superficial foot, which represents the live load due to a crowd.

* *

In Western Mongolia the extremes of temperature render a brick of great durability a necessity of life. The oven in which the bricks are made is cylindrical, and furnished with a hemispherical cap, which is kept open for the first three days. The bricks, about 7,000 at a time, are baked by a fire fed with about 16,000 lb. of an annual ligneous plant (*Alhagi camelorum*). On the third day the opening is closed with felt, which is kept constantly wetted, so that the bricks, while kept at a red heat, are enclosed in a steam bath. In structure the bricks appear porous; they become sonorous and acquire great hardness. They show a striking resemblance to certain trachytes.

THE WAY FRENCH SABOTS ARE MADE.

BY WALTER LODIA.

These wooden shoes should be found very serviceable in English farm homes.

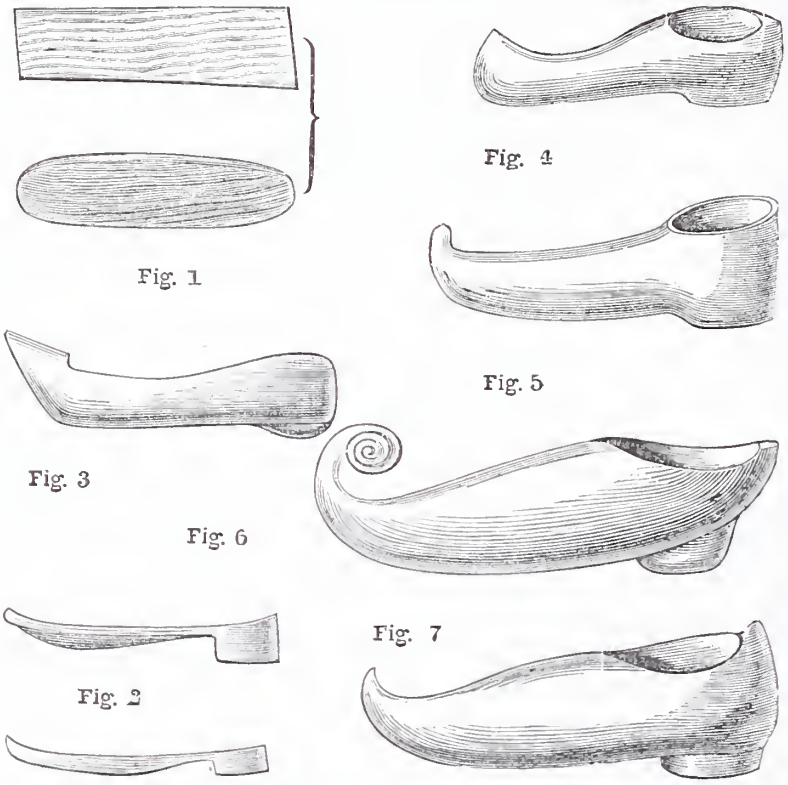
The first process towards the manufacture of the sabot has its quarters in the forests of France—chiefly in the eastern departments, such as Vosges and neighbouring provinces. There, the large supplies of walnut and beech are brought into requisition, and the devastation has for years been such, that whole forests have been fearfully thinned down; and as not much thought has been given to replanting (in spite of a law to the contrary), France has become practically a treeless country over very many thousands of square miles. The neglect to replant will, after all, bear something in time—bear bitter fruit (or rather cause bitter results), and make the French feel acutely their indolence.

Walnut and beech are the best materials, by their nature, for the sabot. Oak and other woods do not answer nearly so well. Walnut is more in favour than beech. It is transported in logs from the forest to the mill, cut into planks, and then into the requisite size blocks for the sorts and conditions of sabots to be made. These blocks are next given the crude shape of a sabot—they are, in fact, treated just like the piece of marble which is given a form of some sort by rough hands before it is taken in charge by the sculptor or his student. (Fig. 1.)

The sabot has now entered its first stage of manufacture, and the chumps of wood are supplied by the thousand to the *sabotiers* (wooden-shoe makers). Thus received by the sabotiers, the material is styled in the vernacular, *en brut* (in the rough). The second degree of manufacture begins now. This is the real commencement of the career of the sabot. Rather curious to relate, all the cutting is done to-day as it was hundreds of years ago—by hand. Machinery has been repeatedly tried as a substitute for hand-work, but without success. The attempts which have been made have ended in inferior outputs, and the loss of much money and time. (Fig. 2.)

It is the gouger—as he is called—who first takes hold of the sabot in block, and prepares to give it life (so to write). His duty it is to cut a place in the wood where the foot may be placed. Plying the gouge rapidly, he busies himself boring hole after hole right and left. The haste with which he works shows that, being paid by the piece, he makes little profit. When half through with the job, he stops to rout out the honeycombed woodwork with a chisel. Then he resumes boring, his attention now being more particularly concerned with the foot, the most difficult part, and to which the heel portion is as child's play. But "practice makes perfect," and our man soon scoops the rest of the wood out up to the toe with ease, using turned chisels specially adapted for the work. A few more finishing touches and removals of unevennesses in the interior, and the receptacle for the foot is done with, thrown aside, and the gouger is proceeding with other blocks in the same way. (Figs. 3, 4.)

As the sabot is one single piece of wood throughout, care has to be taken to avoid splitting while boring. If a flaw occurs, due to the lack of caution of the borer, he quickly knows to his cost that all his work so far on that sabot is lost, for it must be discarded, and a fresh block commenced upon. If, by an oversight, the foreman suffers the flawed sabot to pass, only the purchaser and wearer will find out the defect some time after, as the crack, however little, will enlarge and enlarge, until the article has to be thrown aside, while but at half its lasting age. Nothing will stop the flaw growing bigger.



French Sabots. Fig. 1.—The Future Sabot, as received "en brut" from the Saw Mills. Fig. 2.—Sabot Soles for Sandals. Fig. 3.—The Block taking Shape. Fig. 4.—Sabot half finished. Fig. 5.—The finished Sabot. Fig. 6.—An Ornamented Sabot. Fig. 7.—The Typical Sabot.

Now the finisher handles the democratic sabot. His work at this the third stage is simple. He has to pare down all the uneven surfaces of the exterior, and this is done with the turnable, sickle-like long blade affixed to bench, the same as in use in continental machine-finishing last factories. In the majority of cases, the heel and sole have already been very roughly marked out at the mill, and it is the finisher who also gives these parts a more defined cutting. This work done, the whole surface of the exterior is passed under a rasping and filing machine, and made quite smooth. (Fig. 5.)

The ordinary sabot is not merely a golosh or slipper. It is a regular shoe, reaching, and often overtopping the ankle. Then there are properly-made sabot boots and napoleons in great variety, with uppers of leather or waterproof canvas. Mention is made briefly of these latter elsewhere.

The fourth process in the career of the sabot in embryo is an unnecessary one, but in universal demand. The country people of France, like Spanish women who cannot do without highly-coloured designs on their fans, will have a show of ornamentation on the sabot, particularly on those intended for household wear. There may be a design of any sort—such as flowers, heads of animals, etc.—extending from toe to instep. These increase the selling value of the sabots. The worker doing the work is called the *ciseleur* (carver). He is extraordinarily apt with his chisel, and pushes it about, making designs "in a twinkling." (Fig. 6.)

The sabot is now finished, and sent out to the retail shops. Some of the fancy goods receive a coat of varnish. They sell at any price from 1½ francs to 5 francs the pair. Some are so fastidiously made and adorned that they are priced at 15 francs. The most commonplace pair will stand at least six months of the hardest outdoor work, such as scuttling about over the cobble-stones of a stable-yard; while for indoor domestic use they will seemingly "last for ever," or at least for three or four years. This is why they are so popular among the poor, despite the noisy rattle they make on the stone floors of homes in rural France. They have this great advantage over leather—their temperature is always even. They are not like leather, cold in winter and closely warm in summer. Same as cork soles, they are ever agreeable to the feet. (Fig. 7.)

Of course, the greater part of the rougher sort of sabots made are worn as overshoes. In this respect they are to the French what the more costly rubber overshoe is to the Americans. The larger class sabots are more frequently worn next the canvas slipper or light house-shoe than next the worsted sock. The smaller size goods—there are some scores of varieties—go very well with the woollen sock.

For walking purposes, extending to a few miles, the unprotected sabot is rather unfortunate, as the unyielding instep begins to tell with its pressure on that part of the foot. So the difficulty is avoided by nailing a small bit of canvas across the shoe in front of the instep, which takes the weight of the forward movement when walking, and thus all risk of pain at that part is avoided.

As an article for walking, the sabot ranks second to the Spanish vegetable-fibre shoe, the *alpargata*, and with this advantage in its favour: it is water-tight. In dry climates, the *alpargata* is the best and healthiest walking foot-gear in the world; it never causes sores or fatigue to the feet. But in wet weather it is unlucky, the hemp absorbing the moisture rapidly and saturating the entire surface. Once wetted, it is a trouble to dry them, and these fibre shoes are never themselves again. The fibrous sole becomes clogged with dirt, heated, and is liable to get as fetid as old leather. But keep them dry, and they remain the most hygienic walking shoes extant. The French colleague in wood of the *alpargata* serves for no matter what sort of weather, but it is not

so healthful (because less ventilated) and comfortable as the latter.

The sabot, as a boot, consists of thick sole and heel obtained *en brut* from the mills, and cut to required size by the sabotier. Generally, this is the work of another section of the trade: the sabotiers in chaussures (shoes) and the sabotiers in bottes (boots) are distinct enough to have a line drawn between them. The wood-boot maker also turns out napoleons. For the boots, the uppers are nailed to a groove cut entirely round the upper edge of the sole, and a thin strip of leather gutta-percha'd over hides the tack-heads. Napoleons (good for muddy weather or for crossing the snow in the mountains) are similarly treated.

A quick workman can nail down two dozen pairs of uppers per day, but to reach that speed he has to work "like a steam engine," working about eleven hours (exclusive of rest). He is paid four francs the dozen pairs, which is poor pay. The half-wood half-leather boots retail at from three francs to five francs, and the napoleons at from six francs to eight francs. They last as long as leather, if not longer, at the roughest outdoor work, are not subject to extreme changes in the temperature, and are decidedly economical. On the paved sidewalks of towns and cities the noise of the wooden soles on the stone may be completely evitated by fastening a couple of morsels of rubber or leather thereon. Then it is hard to distinguish them from leather soles.

To the professionals, S. Meynard, on the place de Petit Change, and J. Murard, rue Voltaire, Lyons, the correspondent acknowledges his indebtedness for diverse information.

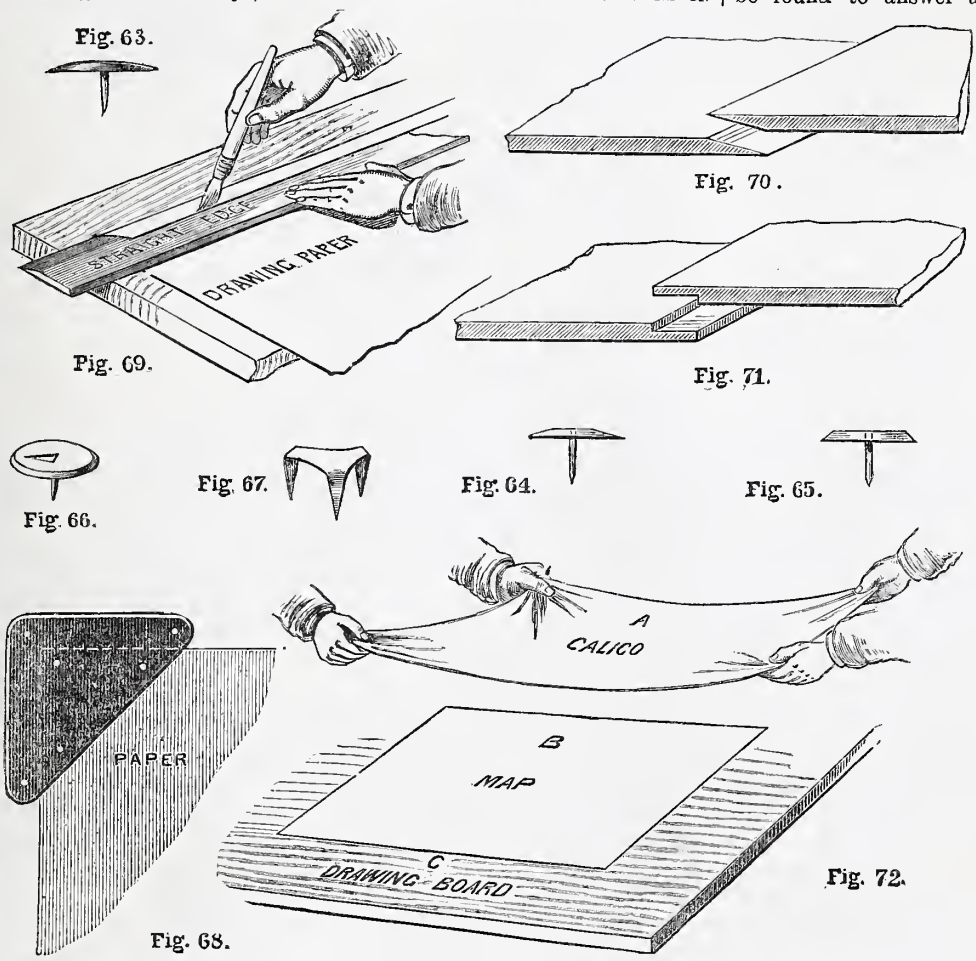
It would be little thought that the French sabot, or wooden shoe, which tourists so often see in rural Gaul, requires to be passed through from four to half a dozen different hands before it is finished and saleable. That is to write—to be more precise—that its manufacture requires that number of diverse handlings ere it is for sale at the retailers. Four of these handlings are done by workpeople who have been apprenticed to their manufacture. Surprising as it may appear to the uninitiated, no single workman can make a sabot all by himself. If some have indeed accomplished the task, it is a rarity, and quite unlooked for in average good hands.

A simple-locking article, the sabot shoe, and the cheapest and most rational footgear on the continent. The comic paper *Fun* will have afforded to Britishers from time to time the best designs extant of the sabot.

HOW TO LEARN DRAWING OFFICE WORK.

BY ARTHUR BOWES, A.M.I.C.E.

MOUNTING PAPER WITH PINS; WITH GLUE OR PASTE—JOINING UP PAPER—OVERLAPPING AND FEATHER-EDGING—MOUNTING PLANS ON CLOTH—MOUNTING TRACINGS—MOUNTING PLANS ON STRETCHERS—VARNISHING PLANS—ROLLERS FOR PLANS.



Drawing Office Work. Fig. 63.—Drawing-pin with "Dome Head." Fig. 64.—Drawing-pin, "Flat Centre, Long Bevel." Fig. 65.—Drawing-pin with "Flat Head." Fig. 66.—Steel Drawing-pin punched out of One Piece. Fig. 67.—Triangular Drawing-pin. Fig. 68.—Paper Fastener for securing Corners of Paper to Drawing-board. Fig. 69.—Gluing Edge of Paper for stretching on Drawing-board. Fig. 70.—Feather-edged Joint in Paper, magnified. Fig. 71.—"Half-lap" Joint in Paper, magnified. Fig. 72.—Method of mounting a Plan on Calico—A, Saturated with Paste; B, Map downwards with Clean Paper underneath.

Mounting Paper by means of Pins.—It is a usual, though not an invariable, custom, before commencing a mechanical drawing, to secure the paper in some way to a drawing-board, so as to keep it always flat and in the same position with relation to the edges of the board, from which right angles are set off with the T-square. The exceptions to this mode of procedure are in those cases where the draughtsman dispenses with the T-square, and uses instead a rolling parallel ruler, as described in a former chapter, weighting the corners of the paper with lead weights. In most cases it will be sufficient, in using a drawing-board, to fasten the paper with drawing-pins inserted at the corners, and, if necessary, at other points along the edges. Drawing-pins are such familiar objects to anyone likely to be interested in the subject of draughtsmanship that it almost seems superfluous to enter into discussion of their details; yet within the last few years some new varieties have been introduced which are worthy of notice. The principal point to be attended to in their choice is that the head shall be so shaped as not to interfere with the blade of the T-square passing over it; and for this reason the dome-shaped head shown in Fig. 63 will be found to answer admirably. Another good section of head is the one known as "flat centre, long bevel," shown in Fig. 64; while the "flat heads," shown in Fig. 65, are not so good as the two last mentioned. A cheap and fairly effective drawing-pin is now made by punching a tongue out of a circular steel disc, and bending it downwards to form a pin, as shown in Fig 66; while Fig. 67 shows a triangular form, in which the three corners of a thin sheet of steel are bent downwards to form three points for passing through the paper. These last-named shapes are only made in sizes too small to be really useful for practical work. In a good drawing-pin it is desirable to have the head at least $\frac{3}{4}$ in. in diameter, and it is well, also, to see that the pin is not too much tapered, or it will not have such a tight hold in the drawing-board as is necessary. In Fig. 68 is shown a recent introduction, consisting of a thin metal plate of triangular shape with six pins projecting from the under side. Four of these, when placed over the corners of the paper, fasten it very securely to the board. It is of special value in dealing with tracing-paper, which is liable to be torn when fastened with an ordinary drawing-pin.

Mounting with Glue or Paste.—If it is desired to colour any large portion of a drawing, it will be necessary to stretch and mount the paper on a drawing-board in the following manner:—First ascertain which is the correct surface of the paper for drawing on, by holding it up to the light and looking for the water-mark of the maker's name. This reads in the right direction when looked at from the drawing surface. Turning the paper with this surface downwards, the back surface is now damped over

with a sponge, which must not be wet enough to leave pools or streams of water on the paper. A margin of about 1½ in. in breadth must be left dry along each edge of the paper. When the paper has been sponged over several times, until it has absorbed the water thoroughly into its texture—a process which will take some three or four minutes—it must be laid, with the wet surface down, on the drawing-board in the position it is to be fixed in. The sponge is now done with, and can be put aside. Laying a T-square, or, preferably, a wooden straight-edge, along the top edge of the paper, about 1 in. from the edge, bend the dry edge of the paper over the straight-edge, so as to make the bottom surface accessible, and at once pass over it a brush dipped in hot glue. Turn the paper back again, and press it into close contact with the drawing-board. Remove the straight-edge to the left-hand side of the paper, and deal with that edge in precisely the same way, and afterwards proceed to fasten down the other end and bottom edge. The process is illustrated in Fig. 69. The effect of wetting the paper has been to cause it to expand, so that it actually measures, when wet, more in length and breadth than it did when dry. If now the moisture be removed from the paper, the latter will endeavour to shrink back to its former size, and as the edges are securely glued to the board, it will stretch itself very tight and flat in the endeavour. It will be seen from this that the more expeditiously the gluing-down is performed, the better, because if there should be much delay, the paper will be half dried before the operation is completed. All that is necessary to complete the mounting is to put the drawing-board away until the moisture has evaporated, when the paper will be found perfectly hard and tight. It is not advisable to leave the board standing on one edge, as the moisture runs down to the bottom, keeping one part of the paper wet longer than another. A horizontal position should be adopted. Neither is it wise to hasten the drying by placing the board before a fire, for, in all probability, one part of the paper will dry more rapidly than another, and the uneven contraction will pull the paper into wrinkles. Instead of glue, gum or paste may be used. Shoemakers' paste, which can always be obtained ready made at any cobbler's shop or grindery store, is much stronger than the ordinary paste, but shares with that material and gum the defect of taking a long time to dry. Naturally, if the edges of the paper are not secured to the board when the paper begins to shrink, they will be pulled from their support.

Joining-up Paper.—The obvious method of joining-up two sheets of drawing-paper, in order to form a larger sheet, is to glue or paste the edge of one over the edge of the other, allowing them to overlap to the extent of 1 in. or so. A straight-edge, heavily weighted, should be laid over the joint, and left there until the glue has set; otherwise, the paper will be irregularly contracted and full of ridges. A much neater joint can be made by feather-edging each sheet of paper—that is, thinning down the edges where they have to overlap—and to do this there are two methods of procedure. The first is to rub down the edges of the paper with fine glass-paper, confining the action of the glass-paper to a narrow strip along the edge by covering up the other part with a thin straight-edge or a strip of thick paper. Of course, the top surface of one sheet will require rubbing down, and the under side of the other sheet, so that when the two are overlapped, as in Fig. 70, and glued together, the thickness is not perceptibly greater than that of the remainder of the paper. The other method of joining is one which calls for some manipulative skill. It consists in stripping off half the thickness of the two edges, and forming a "half-lap" joint, as shown in Fig. 71. To do this, each sheet of paper must be cut half through with a sharp penknife, and the superfluous thickness can then, with a little dexterity, be stripped off, and the joint glued up in the usual way.

Mounting on Cloth.—In mounting drawings or printed maps, etc., on cloth, there can be no success unless care is taken to secure the expansion and contraction of both paper and cloth at the same time; and to this end, it follows that both paper and cloth should be thoroughly expanded at the time when they are cemented together. In mounting, say, a printed map composed of several sheets, the calico or holland is first pinned down on the back of a drawing-board, and the paste or glue well rubbed into the fibres of the cloth. When this has been done, it will be found that the cloth is loose and full of wrinkles from the absorption of the paste, so that it will be necessary to alter the position of the drawing-pins to stretch it as tight and flat as possible. The loose sheets of the map, having been previously damped with a wet sponge, are covered on the back surface with paste, which must be well rubbed in with a brush. One portion of the map may now be placed in position on the calico, and laid as flat as possible. As the surface of the paper will be in a softened state and easily injured, no rubbing must be resorted to without the intervention of a clean piece of paper. Laying a clean and hard-surfaced sheet of paper over each portion of the map as it is laid on the calico, pressure may be applied, either with the hand or a paper-knife, to bring the calico and paper into close contact; and when the whole has become thoroughly dry, a perfectly flat mount ought to be the result.

Another Method.—In most cases it is desired to mount a map or plan in one piece only—not in several portions, as described above; and to do this, it will be found easier to proceed in the following manner:—First cut a piece of clean paper (any kind will do) the exact size of the map to be mounted. Now, having damped the map, lay it face downwards on the top of the clean paper, the two being supported on a drawing-board or table. The calico or holland must be cut 1 in. or 2 in. larger than the map in each direction, and, after being well soaked with the paste or glue, is lowered down on the back of the map in the manner shown in Fig. 72. Drawing-pins are inserted in the edges of the calico, and it will be found easy to pull it moderately tight and free from wrinkles. When dry, the pins are taken out—the protecting piece of paper will have kept the face of the map clean—and all that remains is to cut off the superfluous edge of the calico.

Mounting Tracings.—Tracings may be mounted on drawing-paper or calico in the manner detailed above, with the precaution of not damping the tracing sufficiently to cause any colouring there may be to run. A special material, called "gummed webbing," is to be had in wide rolls, and is very useful for this purpose. It is a stout calico-mounted paper, the paper surface of which is covered with gum by the manufacturer. All that has to be done in using this material is to cut off a portion of the required size, pin it down, damp the gummed surface, and press the tracing into close contact, taking care to use a clean piece of paper over the tracing, to prevent tearing.

Mounting Plans on Stretchers.—When drawings have to be mounted on a stretcher or flat frame of wood, as in the case of architectural competition drawings or drawings which it is desired to frame for hanging on the wall, it is usual to first cover the stretcher with calico or holland. This is done by fastening the calico with small tacks to the edges of the stretcher, first securing the ends and then the middle of each side. Care must be taken, of course, to keep the calico tightly stretched. The drawing is then damped, laid face down, and the stretcher, with its calico loaded with the mounting-paste, is placed on the back of the drawing, and pressed well down with some hard substance. A paper-knife should be passed under the frame of the stretcher, to get at the extreme edges of the drawing. Strips of coloured paper, of some quiet tint, and of a width suited to the size of the drawing, are then pasted round the edges, hiding the tacks in the edge of the stretcher and overlapping the face of the drawing, so as to form a tinted mount.

Varnishing.—Ordinary drawing-paper, as used in the drawing office, is too absorbent to be varnished without being first sized. Good isinglass-size, or that made from parchment cuttings or best pale glue, may be used, and should be laid on hot with a flat camel-hair brush. Two or three coats may be necessary, as will have to be determined by experiment on a separate piece of paper. After the size is dry, one coat of varnish should be applied. A good varnish for the purpose is composed of 1 oz. of Canada balsam dissolved in 2 oz. of spirits of turpentine. Pale copal varnish or white hard spirit varnish, known as "crystal paper varnish," will also be found suitable.

Frames and Rollers.—In deciding as to whether a drawing shall be enclosed in a frame, or merely provided with rollers at top and bottom, it may be worth while to point out that the latter arrangement has the advantage so far as portability is concerned. A plan with top and bottom rollers can be rolled up into a small space for carriage or storing away, while a framed plan is not by any means a convenient article to dispose of.

DRY FEET FOR THE WINTER.

This very desirable state of things can be secured by placing a sheet of aluminium between the two leather soles of a boot. The sheet should be thin, and tempered so as not to injure the flexibility of the boot. In this manner the feet can be kept dry when walking in rain or snow, and warm in very cold weather, even if the leather sole is worn and broken.—*Revue Scientifique.*

COMPRESSED PAPER VASES.

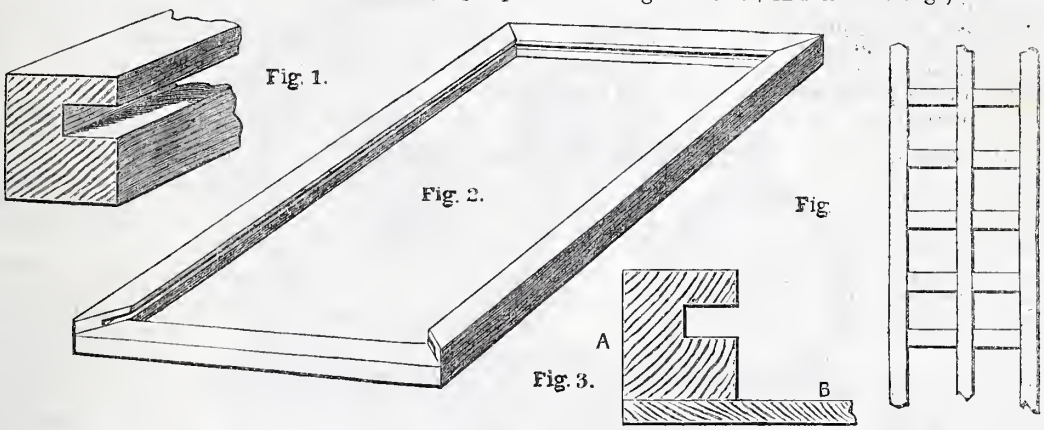
Every day some new application is found for compressed paper. Rails, wheels, casks, hulls of small boats: all these are made of paper, and now we have flower vases of the same material. They are lighter than clay flower-pots, and do not break. A suitable degree of compression gives paper the hardness of metal. These vases are also impermeable and waterproof, and consequently imputrescible. Fancy vases of greater value than the common ones are made by adding a coat of enamel and coloured artistic designs, either in relief or hollow.

HOW TO MAKE A SIMPLE COIN CASE.

BY INGENIORUM AMATOR.

This coin case is simply a shallow box of an oblong shape covered with plush. Its interior is also covered with plush, and is divided into square spaces for the reception of the coins.

To make it, prepare a long bar of wood, equal in length to that of the sides added together, and plough a groove down one side of it a little away from the middle. Fig. 1 is a section of a portion of this bar with the groove ploughed on it. Having done this, construct a frame out of the bar of the same size that you wish the case to be, the grooved side being placed inwards. Procure a piece of thin board, and nail it on to the side of the frame which is furthest from the groove, as is shown in Fig. 3, which is a section of a portion of the frame with the board nailed on it, A being a piece of the frame and B the board.



Simple Coin Case. Fig. 1.—Sectional View of Strip of Wood with Groove ploughed on it. Fig. 2.—Perspective View of Case without Lid on. Fig. 3.—Sectional View of Side Part. Fig. 4.—Manner in which Divisions are fitted in.

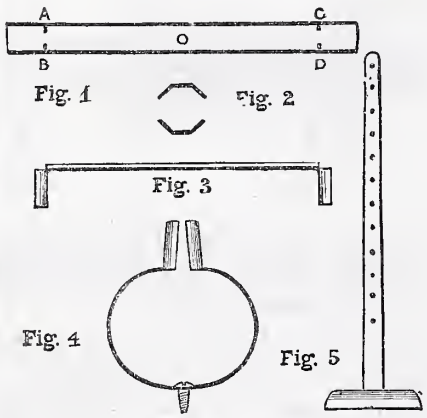
You have now constructed a shallow box with a bottom but without any lid. This latter is composed of a piece of glass, which fits into the groove and is inserted at one end, where the wood above the groove is cut away for this purpose. The appearance of the box as far as you have now advanced with its construction is represented by Fig. 2. The end on the left-hand side is that at which the piece of glass is inserted. This piece of glass is cut to fit accurately into the grooves, and a strip of wood, with mitred ends, is glued on to the end of it which rests at the left-hand end of Fig. 3, so that it comes up flush with the other sides when the piece of glass is inserted. The edges of the box should now be rounded and the whole sand-papered. It is then covered with plush. The colour of this, of course, depends upon the taste of the constructor. It is stuck on with gum, care being taken not to use too much, or it will soak through and spoil the upper surface. A piece is cut large enough to cover the bottom and sides as far as the grooves, into which the edges are fastened. Long strips are then cut out to fit the sides, and should be wide enough to extend from the groove to the underneath part and overlap about an inch. The underneath is covered with a piece of bookbinders' cloth of such a size that it leaves a margin all round. The piece of wood which was fastened on to the glass is also covered with a strip of plush, which should be wide enough to overlap the end of the box when the glass is in its place.

The only thing which remains to be done is to divide the box into squares. This is usually done by sticking thin strips of wood covered with plush on to the bottom of the box in the proper form. Several strips of wood, about ¼ in. wide and deep, are cut out with a circular saw. Some plush is then cut into strips wide enough to cover three sides of the strips of wood, and is gummed on to them. This is best done by gumming one side of each strip, laying it exactly down the centre of a strip of plush, pressing it down, and allowing it to dry. When dry the other two sides are gummed, and the plush folded over them. As soon as these are dry the edges are trimmed up with a pair of scissors.

These strips of plush-covered wood must now be gummed on to the bottom of the box in their proper positions. Fig. 4 shows the manner in which they are generally arranged. First of all, long strips are fixed from end to end at the proper distance apart. Small pieces of the right length are then cut off with a sharp chisel and fastened between them to form spaces of a size suitable for containing the coins.

SHOP CANDLESTICKS AND TALL-BOYS.

Though gas is so general, yet the tyro who has to work in out-of-the-way places in dwellings or sheds often, has to use a candle at times; its importance in going to look for a gas leakage is a very old institution, about which we hear reports unfortunately.



Tall-boys and Parts.

The worker often has to stick his candle in a bottle, in a lump of clay, or against a wall, or on to a bit of wood with a fringe of nails to hold it. A useful candlestick, that will burn the candle-end without lighting the candlestick, may be useful to some beginners, who may make one to last an age and still be serviceable if they follow the directions now given.

Make a wooden handle and base like a boy's battledore—¾ in. birch, ash, or beech serve better than deal; make the tail of the handle taper slightly, so as to fit into the holes of a "tall-boy," which will be described at last.

Next get a piece of thin 1½ in. hoop-iron as thick as a common card, 14 in. long, punch, or drill, or screw hole in the middle, then at two inches from each end of this hoop-iron make notches not more than ¼ in. in from the edge, as is shown by diagram (Fig. 1) at A, B, C, D; this may be done by a saw, shears, or a chisel. Make the ends hot, one at a time, and bend the notched part of the 2 in. inward at an angle of 45°; it does not matter about making these parts semi-circular; an end view (Fig. 2) shows how they look when finished. Again make red hot and quickly bend each end back at the 2-in. notches, to a right angle nearly, which will show as at Fig. 3. Now you may bend with the hand the iron to its final candle-holding shape, which is nearly oval, as shown by Fig. 4. Screw it into a slight recess in the wood. The iron clasp that holds the candle has its spring from the bow-part, and it may be thrown about without risk of damage to any part. With tools handy for the job, it takes twenty minutes to make. They cannot be bought at any shops.

A tall-boy is made of a piece of heavy or lead-weighted wood, into which is mortised a staff of wood 2 in. wide, ¾ in. thick, with holes 4 in. apart, large enough to receive the tail of the candlestick handle. For bench work, sometimes a stem fitted into a socket at the back of the bench has a long row of folding jointed rods, which radiate easily to any part of the bench; a similar candle-holder is on the end joint-piece. These are made in brass and iron.

Smiths often use an iron rod driven into the ground where wanted, the top end having a socket set off a little from the part struck for driving, but it has to be pulled up, or re-driven, to move it. An old iron or brass candlestick is better, with a hole in the stand part, and a clasp round the top riveted on, this clasp being a thin piece of ¾ in. metal bent round it, and a loop curled up to project from the stem so as to be vertical with the stand-hole. A ⅜ in. rod, 5 ft. high, on tripod legs, is a tall-boy, upon which the curled loop and stand-hole serve to move the candlestick up and down the rod; it holds itself any height by the nip of the curled end of metal piece. This is very durable; one made fifty years ago, and used constantly, is as firm as when first made. These cannot be bought, but are easily made in an hour.

Petroleum, it is claimed, can be rendered inexplosive and uninflammable by adding 2 lb. of copper sulphate to 40 gallons of petroleum, the whole being well stirred and left for six hours before using.

COAL-POINTED LIGHTNING CONDUCTORS.

During the last twenty years the question of lightning conductors has been constantly studied by scientists and experimenters. The point of the conducting rod should be made of a metal which preserves the property of an electric conductor in spite of all atmospheric influences. For this reason gold, silver, and platinum were employed. At the passage of electricity the point is subjected to a considerable elevation of temperature which, in the case of copper, for example, has often caused fusion. Sometimes even hard platinum has met with the same fate.

The *Elecktrotechnisher Echo* informs us that a Mr. Leder, of Berlin, had the idea of substituting retort coal for all these metals. This substance possesses several advantages; it is inoxidisable, infusible, resists all atmospheric influence and acids, etc.; consequently, it requires no repairing or attention.

Professor Weber stated that during a violent storm a continuous trail of sparks was observed at the point made of coal, whilst in the case of lightning conductors with platinum points nothing was observed. On another occasion a platinum point was melted by lightning, and the coal point remained intact in the same conditions.

The various opinions expressed on this subject by eminent scientists who have specially studied this question are not without interest. There is no objection to the use of coal, says Professor Weber, for from the point of view even of those who do not believe in the preventive influence of these points, a coal point is of equal value to the spongy point of an iron rod. Besides, in the statement of the theory of points, it is to be remarked that for identity of geometrical form the coal point is superior to metal.

Mr. Nippold says that the infusible nature of coal can be employed as sole argument. On the other hand, it possesses a resistance of conductibility greater than copper (from 10,000 to 100,000 times) and it is exposed to be burnt. Natural or artificial graphite presents the danger of mechanical destruction by lightning. In addition, he considers that the question of points is of less consequence than the general arrangement of the aërial conductors and their junction with the ground. Professor Paalzow, of Berlin, thinks that the points are of slight importance; retort coal can be applied without, however, attributing to it any particular effect.

According to the opinion of Professor Waltenhofen, of Vienna, the point of a lightning conductor should be equal from the point of view of conductibility to the rod itself. On this truism rests the introduction of copper points. As they are melted by the discharge, an attempt has been made to replace them by retort coal, without considering that it conducts electricity 1,000 times less well than iron, and 6,000 times less than copper. A blunt point is much better than a bad conducting point. The fixing of the coal on the rod is always defective. He does not advocate its use, and recommends simple galvanised iron rods with points without any addition.—*Cosmos.*

ELECTRIC TRICYCLE.

This is an invention by Mr. Fulton Gardner, of Chicago. A motor, B, of any suitable form, is supported in a case carried by the axle, A′. The armature of this motor is shown mounted on a loose sleeve on the axle, this sleeve carrying a gear which meshes with a gear, C, on the shaft, and this shaft carries another gear, *c*′, meshing with a gear, *a*′, on the axle, A′. The motor is also provided with the usual commutator, D, and brushes, D′.

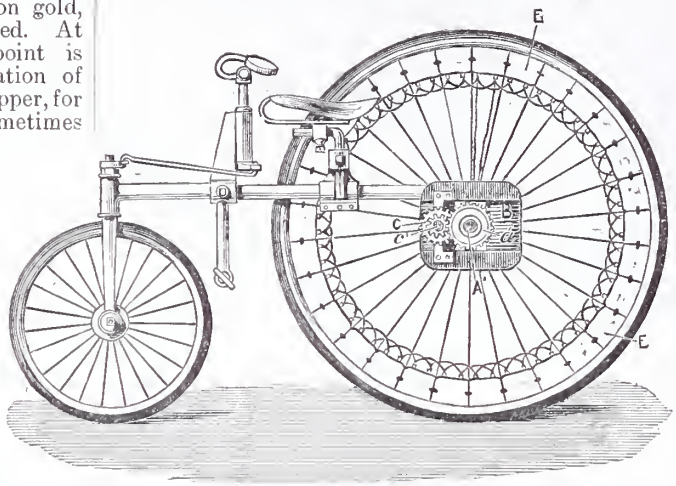


Fig. 1.—Electric Tricycle.

Around the circumference of the wheel, and preferably close to the tire thereof, as shown in Fig. 1, are placed the cells of the storage battery, E E, secured in any suitable manner to the spokes or tire. There may be any number of these cells desired.

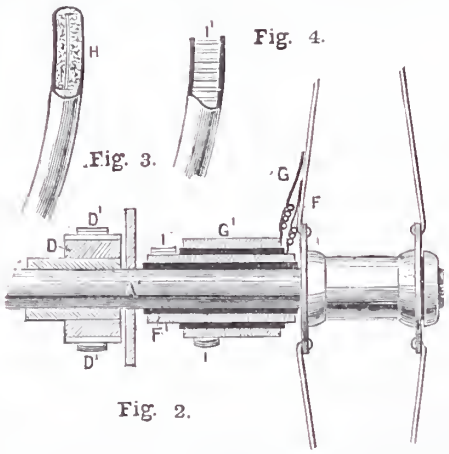


Fig. 2.—Sectional View of Axle Motor and Commutator. Fig. 3.—Tire Storage Battery Modification. Fig. 4.—Modification with Battery Plates inside the Tire.

In the drawings they are shown as extending continuously around the wheel in a single row; but it is not necessary that they should so extend, since a less number of cells may be used, or, if desired, a greater number, the number of cells depending upon the power required. These cells are connected together, as shown, and the negative poles are connected by a wire, F, with a sleeve, F′, mounted on the axle, A′, while the positive poles are connected by a wire, G, with a sleeve, G′, mounted on the same axle. These sleeves being insulated from each other and the axle, brushes, I, are used to convey the current from these sleeves to the brushes of the motor. Fig. 3 is a modification in which the tire contains the storage battery, the tire providing one metal and the core, H, the other; and in Fig. 4 another modification is shown, in which the plates, I′, of the battery are placed inside of the tire. In each of these cases there will be the same connections with the sleeves, F′ and G′.

By means of this construction the inventor is enabled to distribute the weight of the storage batteries more equally and in such a manner as to interfere as little as possible with the efficient running of the machine, while at the same time providing a simple and easily constructed device.

CARPENTRY FOR BOYS.

BY McDONALD.

Simple Shed Building—Remarks on Drawings—Methods of Framing—Methods of Covering or Boarding.

No part of carpentry is easier to deal with, as regards the using of tools, than plain shed building with undressed timber, something such as we have in this sketch. Even a bench is not absolutely necessary. The material can be cut and jointed perfectly well, and, indeed, is most frequently done so, on a pair of trestles; or, in the absence of these, on anything else that may most conveniently substitute them, as a couple of empty boxes, or such like. Of course, when the shed, or a portion of it, is to be dressed or planed, a bench of some sort is indispensable.

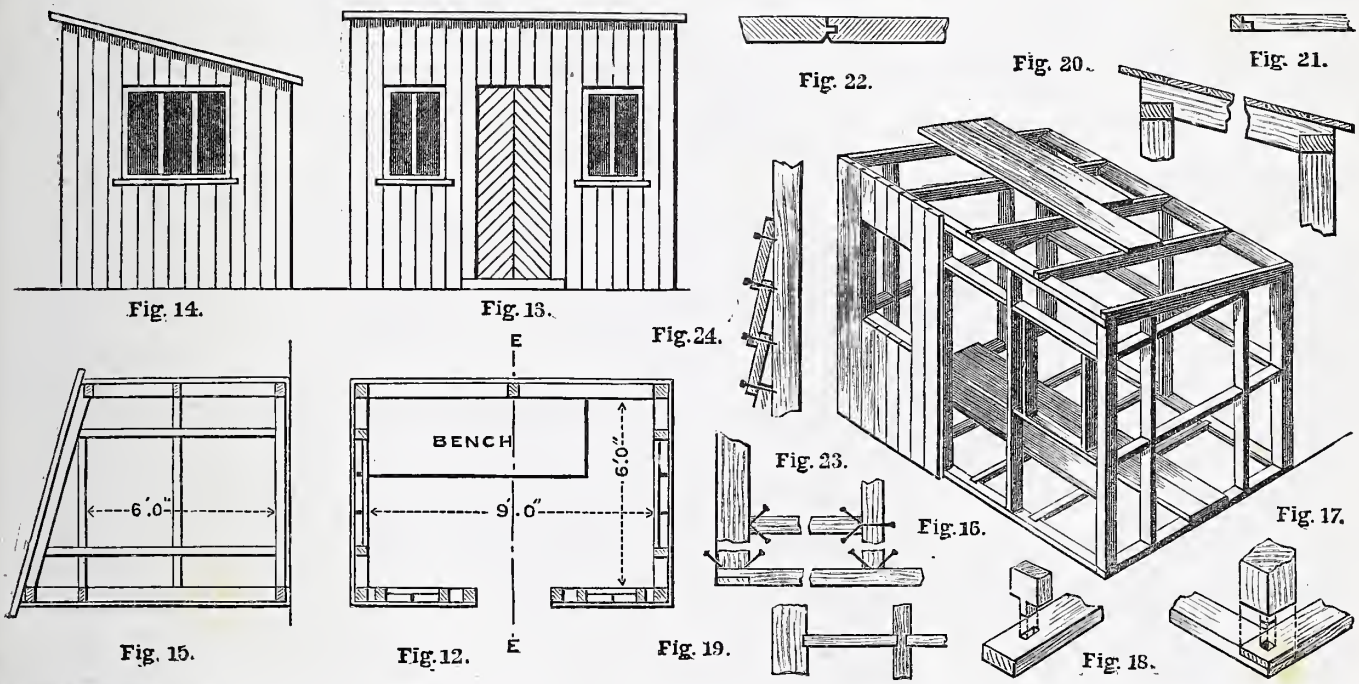
This kind of work, although coarse in the workmanship, demands considerable skill in the construction in order to make a good job. It will not do to rattle up a shed any way at all because the material is rough. The young worker will find that there are some governing principles to observe, without which the erection will be an eyesore as long as it stands: and that will not be very long unless the same are attended to. All level or horizontal timbers must be level, and all vertical or plumb timbers must be plumb. Inclined timbers should have the proper inclinations, and all straight lines must be straight. The joints and bearings should be good and thorough, and not merely resting at one corner and gaping open at another. All margins should be of parallel widths, and the nailing, wherever it is required, should be sufficiently effective, to make sure that the timbers or boards will permanently retain their positions. Attention to these matters, which, it should be observed, are general principles, will in all cases ensure satisfactory results, and the beginner will do well to bear this in mind from the outset. He will require a spirit-level, a plumb-rule and ball, as additional tools; and also a chalk line, if he has not already got one, for lining off. The uses and application of these simple things will be self-evident on inspection; but our young friend should see them in use by an experienced man to satisfy himself that he understands their full purport.

Remarks on Drawings.—The drawings in Figs. 12, 13, 14, and 15 represent a shed which we will assume is for a small workshop. Fig. 12 is the plan, or a horizontal section, taken anywhere through the windows. Its purpose is, or at any rate should be, to show the floor area, the position of bench or other fittings, the breadth and thickness of the door, and the same of the windows, the cross sections of

all vertical timbers and boarding, and the exact lengths and positions of horizontal timbers. Similarly, Fig. 15 is the converse of Fig. 12. It is an elevation, or a vertical section taken through the centre of door at E. On this the lengths of the vertical timbers, the heights of fittings, should there be any, the rake or slope of the roof, and the cross-section of horizontal timbers and boarding, are to be found. Figs. 13 and 14, being front and end elevations, give the heights and appearance of the door, windows, and boarding. Both ends are the same, and as the back is all boarded, no special elevation of it is necessary. These few observations will give our young friends an idea of drawings such as these, and their uses. They are not merely pictures, but views to measure from. In general, they are accompanied by a scale. Here the scale is not given, but it can easily be determined from any of the figured lines: as, for instance, whatever be the length of the line marked 9 ft. 0 in. on Fig. 12, its one-ninth part is a foot. Then a scale of feet constructed to that will measure the whole. Details are drawings of parts made to a large scale, or full size, so as to represent them more clearly. Details, and also principal plans, elevations, and sections, are more or less numerous, according as the object desired to be shown is very large or complicated, and so forth. The material, which may be red or white pine, will, according to the drawings, measure somewhat thus: 2 corner posts, 7 ft. 6 in. × 4 in. × 4 in.; 2 ditto, 5 ft. 10 in. × 4 in. × 4 in.; 2 door posts, 7 ft. 6 in. × 4 in. × 2 in.; 1 centre post in back, 5 ft. 10 in. × 4 in. × 2 in.; 2 end posts, 7 ft. 0 in. × 4 in. × 2 in.; 2 ditto, 6 ft. 3 in. × 4 in. × 2 in.; 6 pieces for side sills and rails, 9 ft. 8 in. × 4 in. × 2 in.; 4 end ditto, 6 ft. 8 in. × 4 in. × 2 in.; 2 end ditto, 5 ft. 6 in. × 4 in. × 2 in.; 4 filling-in pieces at sides of front windows, 3 ft. × 4 in. × 2 in.; 5 rafters, 7 ft. 0 in. × 4 in. × 2 in.; 3 sleeper joists, 6 ft. 6 in. × 2 in. × 2 in. About 24 square yards of match-boarding for sides and ends $\frac{7}{8}$ in. thick; 10 square yards sarking for roof, $\frac{5}{8}$ in. thick; 8 square yards flooring, 1 in., or $1\frac{7}{8}$ in. thick. The roof is intended to be covered with felt cloth, tarred; so ten square yards of this are required.

Methods of Framing.—In framing this, or anything of a similar construction, the top and bottom sills, or runners, are first cut to their proper lengths, and scarfed at the corners. They are then divided off for the posts according to drawings, and mortised. The posts are next shouldered and tenoned at their respective lengths, and they and the runners fixed in position. Before putting in the posts, however, the bottom sill should be levelled a few inches above the ground, on a layer of bricks or some small stones, to preserve the timber. The corners should also be squared, and temporary stays nailed across them to prevent shifting. Squaring the corners of this or any rectangular frame is best done by taking it out of twist and making its diagonal lengths equal. After the top runner is on, the posts must be accurately plumbed, and also temporarily stayed. Figs. 17 and 18 illustrate the mortising and tenoning of posts and sills. The rafters are cut as shown in Fig. 20, set off at about 18 in. from centre to centre, and nailed down on the runner. The rails are cut and checked into the posts, as at Fig. 19. The side pieces for front windows are put in the same as rails. The sleeper joists, also set off at 18 in. centres, are halved into the bottom sill. Being very light, they should be supported in the centre by placing a brick or stone underneath each. In addition to the mortising, tenoning, and checking of the joints, the whole ought to be well nailed. Another method of framing shed erections is shown at Fig. 23. In this, all mortising, tenoning, and checking for the sills, posts, and rails are dispensed with, and the joints are merely cut square and nailed diagonally, or check-nailed. The young tyro may be advised to adopt this method in his first attempt. It is easier to execute, and perfectly reliable for stationary work. Fig. 16 is a view of the framing, with part of boarding, sarking, and flooring in position.

Methods of Covering or Boarding.—The boarding used here on the sides and ends is matched, or grooved and feathered on the edges, roughly dressed on the face, and chamfered on the joints. As all these operations are commonly done by steam nowadays, our young friend can obtain the stuff from the timber-yard ready for fixing; otherwise he will require a pair of match-ploughs, and joint and plough the boards in the bench vice. Match-ploughs are sold in pairs, and to suit different thicknesses of boarding. The joint is shown at Fig. 22. The chamfering, if not run at the mill, can be done on the bench by the ordinary planes, or a plane for the purpose, called a chamfering or V-plane. Sometimes beading is used instead, which, of course, requires a bead-plane. Another method of boarding is shown at Fig. 24, in which the boards are laid in horizontal courses, and overlapping at the joints. The flooring and sarking boards are square on the edges, and merely nailed up close to one another.



Carpentry for Boys. Fig. 12.—Plan of Small Workshop. Fig. 13.—Front Elevation. Fig. 14.—End Elevation. Fig. 15.—Section at E. Fig. 16.—View of Shed Framing. Fig. 17.—Joint of Sill and Corner Post. Fig. 18.—Inside Post and Sill. Fig. 19.—Joint of Rails and Posts. Fig. 20.—Rafter. Fig. 21.—Joist and Sill. Fig. 22.—Match-boarding. Fig. 23.—Alternative Framing. Fig. 24.—Alternative Boarding.

WRINKLES.

Poisoning Protoplasm with Quinine.—Quinine has been found to destroy amœboid movement. Quinadine has five-sixths the poisoning power of quinine.

Preparing Lignite.—Macerate in carbonate of potash for several days; cut thin sections, heat them in a watch-glass until they turn yellow, drop them in cold water, and mount in glycerine.

Transparent Cement.—Take 10 drs. of gum dammar, 6 drs. of gum mastic, 6 drs. of dried Canada balsam, 2 fluid ounces of chloroform, and the same of turpentine; shake until dissolved, and filter.

Glue without Heat.—Dissolve 50 parts of barium chloride in 750 parts of cold water. Put into it 13 parts of gelatine or glue. Let it stand twelve hours. Precipitate the baryta with sodium sulphate.

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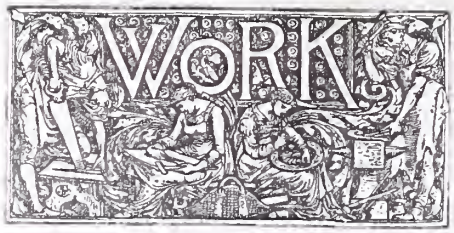

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NOTICE.

WORK correspondents are wanted in every Town.

Home-made *versus* Foreign Manures.—When the corn-growing lands of England were cut up into small farms, and the fields were tilled by ploughing them with teams of horses and oxen, an abundance of farmyard manure was produced by the working animals. Such manure is decomposed slowly, and yields its fertilising qualities to the soil gradually in small quantities as the plants can make use of them. Under the system of farming employing these manures, the land produced wheat at the rate of forty bushels per acre. Small farms have since been merged into large estates, and small fields have expanded into large ones tilled by the steam plough. This cultivator of the soil is a non-producer of manure. Its "droppings" consist of a few cinders and unproductive ashes. As plants will not thrive without food, and manure is necessary to break up the soil to prepare it for plant food, the farmer has recourse to artificial manures, such as nitrate of soda, superphosphate of lime, and similar inorganic salts. The first heavy rain on soils manured with these soluble salts washes the largest portion of them down into the drains, and leaves the ground impoverished. The effect of these manures on the crops is a mere transitory promise of fertility, and the result on the wheat crop is shown by a yield of twenty-seven bushels per acre. Under the land-holding and agricultural systems at present in vogue, the farms of England are becoming impoverished, and each year sees some hundreds of acres going out of cultivation. The land-holders and tithe collectors squeeze the farmer to get the largest share of his profits, and the farmer racks the land to get from it the last shred of fertility before his lease expires. Meanwhile, tons of good manure are annually swept and poured into our large rivers from the towns on their banks, and thousands of pounds worth lost in the sea. When will our legislators have their eyes opened to see the great national calamity which threatens us?

Railway Slaughter.—The rate at which railway servants were killed during the past year was three every two days, and the rate at which they were injured was between eight and nine per day, or for the whole year, 549 killed and 3,161 injured. These figures are from the recently issued Board of Trade returns, and are not very comforting. When we consider the classes of railway men that contribute most to these catalogues of disaster, we are forced to conclude that the perils of our railways are a good deal the result of carelessness somewhere. Accidents to trains, for instance, or rolling stock or permanent way, while a train is passing over it, may be, and no doubt are often, unavoidable; but such casualties resulted in only 12 deaths and 154 injuries among railway men. The most fatal calling on the line seems to be permanent-way men's. Of these, 136 were killed and 129 injured, the bulk whilst at work on the permanent way, and presumably, therefore, by passing trains. Such accidents can be the result of nothing but carelessness, and the neglect of the companies to provide an efficient system of notifying the approach of trains to the men engaged in repairing the line. Indeed, trains seem to be far more dangerous to people outside of them than in them; for while only 5 passengers and 12 railway servants were killed through accidents to trains, 23 passengers were killed whilst crossing the line, and, excluding permanent-way men, 188 railway servants whilst crossing or standing on the line on duty, or walking along the line home or to work. If accidents like these were eliminated, railway work would be little more perilous than other kinds of work. The companies would soon find a way of reducing their number if the Employers' Liability Act were extended to compel them to maintain a killed employee's friends who were dependent on him, provided, of course, it were shown that such employee did not meet his death through his own carelessness. It is here, of course, that the right of the public to interfere with the railway companies in the treatment of their servants comes in. By unnecessarily exposing the lives of bread-winners, they of course throw upon the community helpless widows and children—a matter that the community has a most emphatic right to protest against. The scandalously long hours that the companies work their men is another source of danger both to the public and the men themselves. It is all very well for the railways to heap up dividends for their shareholders, but it is manifestly unfair that they should do it at the expense of the community and at the peril of poor men's lives.

Turners' Company Prize Competition.—We cannot congratulate the Worshipful Company of Turners upon its twenty-third annual prize competition. Restricted to wood and pottery—which we hold to be a serious mistake—the exhibits were too few and generally too poor to be accepted as at all representative of the turners' art of this great country. Surely, considering the thousands of lathes in the hands of professional and amateur workmen throughout the three kingdoms, it ought to be possible to get together a much stronger exhibition—numerically and artistically. In view of any future competition, we should advise the Master and Wardens to offer no restrictions as to the material turned; to have classes for amateur as well as professional work; to offer prizes more worth competing for; and, above all, to make the competition better known.

DESIGN AND DECORATION OF ALL AGES.

BY M. H. C. L.

Celtic and Scandinavian.

The most original and, to the writer's mind, the most beautiful and interesting of the developments of early Christian Art was the Celtic, the character of which is so distinct and remarkable as to make it the fit subject for a separate paper. Volumes, indeed, have been written on the subject, and for those who wish to study it thoroughly Miss Stokes's "Early Christian Art in Ireland" will prove a good handbook.

It was in Ireland that Celtic Art had its birth, and reached its most perfect and complete development. The wonderful interlaced designs which were its chief feature are, however, to be found in widely separated localities. In Scotland, the Isle of Man, and certain places in the North of England, we are not surprised to find work similar to the Irish, for there also the Celts had their dwelling when the southern part of our island had become Anglo-Saxon. It might, however, puzzle us to find distinctively Celtic illuminations in the manuscripts preserved in different parts of the continent, if we did not know that monks from Ireland frequently migrated westward. One of the greatest of these missionaries, S. Colimbanus, founded monasteries at Luxeuil in France, Bobbio in Italy, and St. Gall in Switzerland; and the MSS. of all three monasteries became famous. There is sometimes a confusion in people's minds between Celtic and Anglo-Saxon Art: a

Celtic and Scandinavian Decoration. Fig. 1.—Design on Brooch, from Drogheda. Fig. 2.—Brooch: Irish Crozier. Fig. 3.—Varieties of Trumpet Pattern. Fig. 4.—Scale Pattern on Irish Bell. Fig. 5.—Illumination: S. Jerome's Bible, A.D. 840. Fig. 6.—Celtic Border: Stonework. Fig. 7.—From the Cross of Cynebalth. Fig. 8.—Celtic Interlacement. Fig. 9.—Initial, from Book of Gospels, by Maelbrigte, of Armagh. Fig. 10.—Anglo-Saxon Whalebone Casket. Figs. 11, 12.—From Crosses, Isle of Man. Fig. 13.—Manx Cross. Fig. 14.—Carving on Stone Font at Murano, N. Italy, and on Celtic Cross at Gosforth, Northumberland. Fig. 15.—From Cross at Kirk Braddon, Man. Fig. 16.—Design on Cross at Kirk Michael, and on Ninth Century Scandinavian Oliphant. Fig. 17.—On Grave at Borthkyra: Scandinavian. Fig. 18.—On Kirk Michael Cross. Fig. 19.—On Doorpost of Church at Solver, Norway (Wood Carving). Fig. 20.—From published Sheet of Norwegian Designs (Modern).

confusion likely to be maintained by the arrangement in the British Museum, where, for want of a better place to put them, the Celtic remains are placed in the Anglo-Saxon room.

The manuscripts, etc., which have illuminations of interlaced work, trumpet pattern, and like distinguishing traits of this school, must all be considered Celtic. In the seventh century the Irish monks from Iona came over to Lindisfarne, bringing with them their own caligraphy and art. Other Irish monks went to Glastonbury, and from such centres the Irish Art spread among the Anglo-Saxons.

There was no doubt, however, a pre-disposition, if one may so term it, in the Anglo-Saxon race for the adoption of this particular class of designs. In fact, the nearly allied Scandinavians—a term including not only the inhabitants of Norway and Sweden, but also of a great part of Denmark—in a very early period, and long before their adoption of Christianity, developed a style of art which, though less elaborate, less beautiful, and less finely worked out, bore a striking resemblance to the Celtic school.

The chief relics of Scandinavian Art now remaining are the fibula (brooches) and other ornaments which were buried with the old inhabitants of these countries in Pagan times. Christianity did not reach them till the eleventh century, and before this period there was frequent intercourse between Ireland and Scandinavia. It is possible, therefore, that one may have influenced the other, but we have no evidence that either was the originator; and it is probable, as Hans Hildebrand* suggests, that both may have had a common origin.

What was this origin? Probably, in both cases—at least, so it appears to the writer—some bit of interlaced work seen by chance, and waking in them a latent instinct tending to the production of mysterious and intricate designs; then a process of evolution as the one idea grew and developed in the brains and hands of an artistic people. At this day, when anything like a natural art and all tradition of the same has long died out, the Irish children, it is found, take more readily to the interlaced designs which were what their ancestors loved than to any other kind of pattern.

It has been suggested that the habit of basket weaving induced the Scandinavians to the production of interlaced designs; but basket weaving is too universal an art for this theory to be sufficient. Though certain races have especially developed this form of design, it is one that occurs here and there in all directions. In Arabian work, geometrical patterns were so fitted into and interwoven with each other as to produce patterns of the greatest intricacy. Mahomedan coins have been found among the relics from Scandinavia, but it is not likely that there was any importation of actual works of art. But Byzantine work certainly made its way into Scandinavia, and probably other products of early Christian Art. In Ireland the interlaced designs only came in with Christianity, and are referred to the similar patterns in use in Northern Italy. The design in Fig. 14 is taken from a stone font of the tenth or eleventh century, at Murano, near Venice. It is from one of the four sides of the basin, all differently decorated, the ornaments not so well spaced as in the Celtic work. The writer has come across the identical design on a monolithic cross from Gosforth, in Northumberland, cut in the seventh century.

A very early Irish design, and one which preceded Christianity, was what is known as the trumpet pattern, or divergent spiral. This pattern was peculiarly worked out in Ireland, in the older forms more prominence being given to the diverging lines, with the trumpet-like form they produced, in later days the spiral being more fully developed. For about three centuries this design disappeared from the MSS., and then came out again in stone sculpturing.

On one of the earliest of the Scandinavian relics, a bronze hatchet from Sweden, we find the divergent spiral, used, however, simply as a border, in the precise form in which it appears in the earliest Greek work, from the tombs at Mykenæ.

In Irish Art we find the trumpet pattern in a variety of forms, often with a central spiral and three other spirals diverging from it, the connecting lines being so arranged as to fit the pattern to a circle. Not infrequently the heads of animals or birds similarly arranged to fit into each other took the place of the spiral. Birds and beasts, both in their natural form and with sundry bodies divided and intertwined, were favourite motives with the Celtic artists. In Scandinavia also we find animal forms, treated in the same extraordinary fashion, prevailing from very early times. In the earlier Scandinavian designs the head is distinct, and the body can, with care, be distinguished; but as the art decayed the members of the body, and even the head itself, disappeared, though with a revival of life the same idea revived, and it is to this day a favourite *motif* in Scandinavian work. (See Fig. 20.)

The early art work of Scandinavia was often adorned with the suastika and triskele, both symbols of deities in the days of the worship of Thor. May the Celtic trumpet pattern have originated in the latter? The form in which it first appears, with the spiral undeveloped, suggests this possibility.

Besides the knot and band work, the mysterious animals and birds, and the spirals, crosses of various kinds, and rectilinear patterns, characterise the Celtic work. These designs can best be studied in the Irish illuminated manuscripts, the minute and exquisite workmanship of which passes imagination. The Book of Kells—a copy of the Four Gospels—probably written about the seventh century, is one of the most famous examples.

Sir Digby Wyatt tells us that both he and Mr. Westwood, a great authority on Irish Art, studied the pages of this manuscript for hours together, without discovering one false interlacement (*i.e.*, breaking of the rule of *one under, one over*, applicable to all interlaced work). In the space of about a quarter of an inch in one of the illuminations, by the aid of a magnifying glass, he counted one hundred and fifty-eight interlacements of a slender ribbon pattern formed of white lines, edged with black ones, upon a black ground.

Strange to say, with all the beauty of their own peculiar designs, the figure drawing of the Irish monks was barbarous and unlovely. This was, indeed, the one point where Mediæval Art was throughout least successful, the spirit of that age being in the strongest contrast with the spirit of ancient Greece. While the Greeks considered physical beauty a gift from the gods, and physical development a main object in life, mortification of the body and concealment of the human frame are principles insisted upon in the narrow, though earnest, Christianity of the middle ages.

Besides the illuminations, the metal-work of the Celtic school was celebrated. Both shrines, bookcases, and book clasps, bells, croziers, and crosses, were covered with the same elaborate system of design, produced in *repoussé* work of great delicacy and beauty.

Personal ornaments were also adorned with the same patterns. The Tara and Ardagh brooches are very beautiful specimens of this branch of Art. It is interesting to compare the animals' heads which occur on the former with those on some of the Scandinavian brooches. The form is almost identical.

One more branch of Celtic Art remains to be mentioned: the carved stones and high crosses, of which many are still standing in Ireland, Scotland, and the Isle of Man. Combined with the interlaced work, animal designs are distinctly Romanesque representations, such as the crucified Saviour, Scriptural scenes, and groups of saints. In a visit to Man, a few years ago, the writer made sketches of some of these crosses. At Kirk Michael, a little seaside village, there stands a high cross which repays study. It is evidently copyists' work, and not the production of an age of vital art. The interlaced design has organic faults, a new strand, which comes from nowhere, being occasionally added to the woven work, and an animal's body with a head at each end being introduced. Some of the designs have, however, been accurately reproduced from older ones, and the whole effect is harmonious.

Fig. 16, from this cross, is identical with the ornament on a Scandinavian Oliphant of the ninth century. The idea of an animal grasping portions of its own body is common to Norse and Celtic work.

With Christianity the early Christian Art of the rest of Europe extended to Scandinavia, but the inborn love of interlaced work still came out in their adaptations of Romanesque designs, as may be seen in the specimens of carved church doors, as given in Figs. 17 and 19.

* See "The Industrial Art of Scandinavia in the Pagan Time."—*S. Kensington Handbook.*

SCIENCE TO DATE.

Good Disinfectant.—Naphthaline is strongly recommended by a French scientist as a disinfectant, especially for animal parasites. It is non-poisonous, and may be applied alone or mixed with vaseline, or dissolved in alcohol or terebinthine. It is destructive to fleas and lice. When parasites are perceived on pet birds, the latter should be rubbed with naphthaline, and in twelve hours all traces of insects will have disappeared.

Electrolytic Copper. — According to Hampe, antimony is always present to a small extent in copper which has been prepared by electrolysis.

A New Magnetic Rock.—It is stated that at Borganasea, in Liguria, a rock has been discovered which is distinctly magnetic, though analysis shows that it only contains 7 per cent. of iron oxides, the remaining constituents being silica, alumina, magnesia, lime, and water. It is green in colour, and resembles serpentine in appearance. If true, the magnetic properties of such a rock are difficult to account for.

Magnetisation.—Bars of soft iron or cobalt become longer and more slender by magnetisation, while bars of nickel and steel become shorter and thicker. Professor Knott and Mr. Shand have lately been investigating this change of volume by magnetisation, especially with regard to iron tubes of various bores. They find that tubes possessing thin walls show the greatest dilation of internal volume in magnetic fields of low strength, but, on the contrary, thick-walled tubes have greatest internal volumes in strong fields.

"USEFUL HOUSEHOLD ARTICLE" COMPETITION.

PRIZE SUGGESTIONS.

HOT OR COLD CABINET BATH-FRAME.

By "Pater" (J. Charles King, *Burchett's Green Cottage, Maidenhead Thicket, Berks*).

I call it a bath-frame because a bath is with it; or it may be, on emergencies, a child's crib or a handy receptacle for lumber, or books and papers. But the bath, after all, is the main and essential thing in a family, of which the frame, fitted up

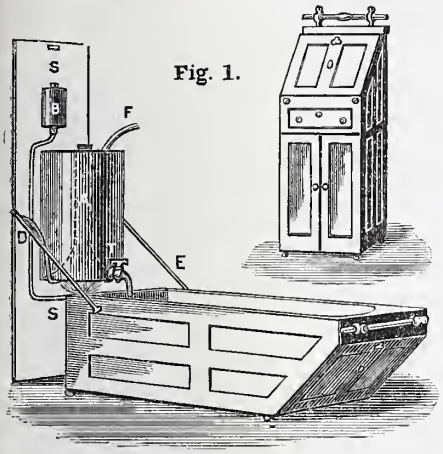


Fig. 1.—Bath Closed. Fig. 2.—Bath Open.

and panelled to user's taste, forms a neat piece of furniture, occupying but little space when closed, as shown by Fig. 1. Four and a half feet high behind, and 3½ ft. in front, 18 in. or 20 in. wide, and the same from back to front, would be convenient measurements for a sitting bath for adult, or for a child at full length. Zinc, tin, or waterproof canvas or rubber might be used for the bath.

The next essential part is the water, which, for cold baths, may be supplied by pails or a hose. The supply to be heated is shown in a boiler, A (Fig. 2), which may be cylindrical or square-shaped, fixed to the backboard, s s, by metal strap-plates, and the backboard fixed to the wall. A supply-pipe, F, from the water service, in any way easiest to accomplish, serves to fill bath, and may contain from ten to twenty gallons, or more. Only a small boiler is shown, which may be heated by a lamp under it or a gas-jet, or from a small paraffin reservoir, B, to feed the flame. It is not necessary to have a boiler full of water; a little water over a large heating surface is quickly heated, and allowed to flow into the bath as heated. A conical central chimney, shown by dotted lines at A, will explain this method of fitting. The camp-kettles fifty years ago were made with a chimney heater, and answered well to boil water quickly at picnics. To empty the bath, a syphon-pipe into pails or into a closet is one method, baling out another, but that is a detail the users must decide for themselves.

The method of closing is obvious; two stays, D, E, are jointed each by a hinge to the backboard of the bath and outside panel framing. The bath is shut up as the lid of a writing-desk. Then it has the appearance of a high desk or fancy cabinet.

Now how to make the frame. The backboard, s s, 1 in. thick, may be made up by a join of two narrow pieces if a piece of the width is not handy. The sides, bottom, ends, and top pieces of case may be solid and flat-jointed, and screwed together. Of course, panelled work is lighter and better to look at, and if an amateur can use a mortise chisel, it is not difficult. Begin at the bottom—that is, as the bath is shown at Fig. 2—then the end near the wall piece need not be framed, as it is out of sight. The narrow top piece that receives the handrail is next got out, and the sides next framed and panelled with edges of frame, beaded for neatness. The panels may be ⅜ in. thick, flush inside the bath-frame; these sides are screwed into the bottom, end, and top ledge. The sloping end is made last, and screwed into the sides and bottom, and narrow iron plates inside hold it to the ledge. It makes a strong job to rebate the joints ⅛ in. deep with a filister. Do not attempt bevel-jointing to conceal the joints; it is not so well for screwing together. Do not use glue, but red-lead and linseed oil, with any pigment to suit a dark wood; white-lead if a light-coloured wood is used. If well done, the joints cannot be easily seen, and water will not affect the joints.

The lining, if of tin or zinc, needs one who is used to soldering and bending. Waterproof canvas is easily nailed by a double fold at the top. Now a hint on using the bath for ailing children. They are mostly ill to need it, and it is cruel to put a sick child suddenly into water if it fears it. A simple plan is to lay a blanket or sheet over it to hide the water, and gradually let the cover with the child become submerged. The child is but little alarmed, and easily lifted up by the sheet or blanket out of the bath.

WINDOW SASH.

By "Improvement" (A. Beck, 2, *Carpenter Street, Horseferry Road, Westminster*).

I have sent a rough sketch of what I consider would be useful and labour-saving to everybody in window-cleaning, repairing, in case of fire, etc. It is a window sash easy to take out and replace. The sash has a groove (B, Fig. 4) cut down its sides, to within 3 in. of the bottom. A slip is made (A, Figs. 1, 4, 5) to fit in groove of sash, also to fit in channel of frame. The frame is an ordinary channel with a T moulding up the centre (B, Fig. 2) put in with three screws, heads to be flush. When the slip is in its place, it is fastened by shooting an ordinary strong cupboard bolt over the top of the slip (dotted lines, Fig. 3). To remove the window, withdraw bolt on top of sash, and the sash-weight will withdraw the slip (A, Fig. 1); ease the slips until the sash-weights bottom (both sides, of course), and you can lift your window out. In the sketch a large portion of the slip is in view, but this would not be so in application, as it would lie in the channel, and only the dowelling piece be in view when the window was removed. It would have to have a T up the centre to form a double rabbet to hold the slip in its place, otherwise, when the window is removed the slip would stand out like B (Fig. 5), and be in the way while passing pianos, mangles, or other furniture through.

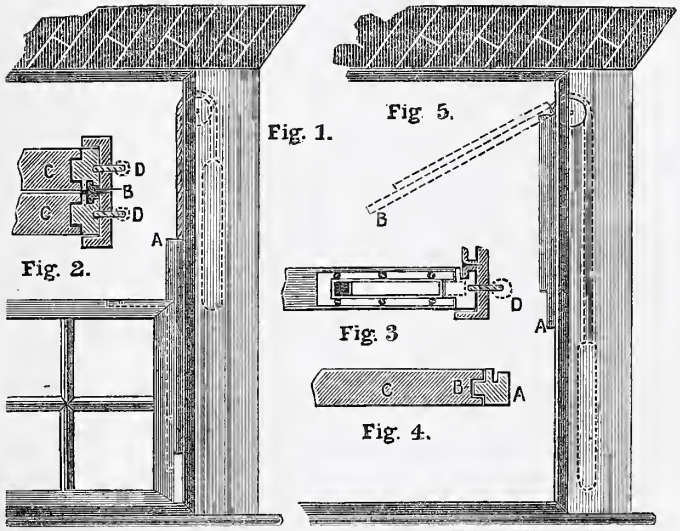


Fig. 1.—Window and Sash—A, Slip. Fig. 2.—B, T Moulding; C, Sashes; D, Sash-weights and Cords. Fig. 3.—Bolt and Slip—D, Sash-weight and Cord. Fig. 4.—A, Slip; B, Groove; C, Sash. Fig. 5.—Window Frame—A, Slip; B, Outlines of Slip.

STEP SECURER.

By "Aster" (S. M. Chapman, 11, *Simpson Street, Newcastle-on-Tyne*).

I suggest the manufacture of a new thing in steps—something more stable and secure than the style now in use. I propose to add to the usual pair of steps a couple of side supports, as

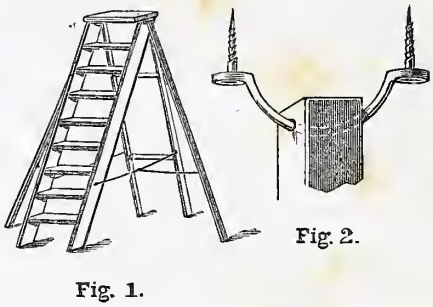


Fig. 1.—Steps extended for Use. Fig. 2.—Method of fixing Supports to Top of Steps.

shown in my drawing. The steps can still be used either with one support, if required to go close to the wall, or with both supports out when the steps are required in the middle of the room, especially for a female to mount; when put away, the side stays to be turned to the front and fastened with a button, and to close up like an ordinary tripod stand, the said supports to be the same length as the front steps.

[*** In accordance with the award published in No. 182, we present the above descriptions and illustrations of the successful suggestions in this competition. £1 will be remitted to each of the names given, as also to the remaining prize winners, whose designs will be published in our next issue (No. 192).—Ed.]

NOTES FOR WORKERS.

Professor Cornfield estimates that the mean length of life in London during the last fourteen years has increased from 34¼ to over 38¼ years.

A persevering man at Shanghai, who failed in an examination every year since he was twenty, has now, at the age of seventy-six, won a degree of considerable distinction. Here is a strong verification of the old adage, "If at first you don't succeed, try, try, try again."

After handling lead, lead salts, mercury, and other mineral poisons, wash the hands in paraffin oil and rub them dry in sawdust. This will cleanse the pores and cracks of all mineral matters. Afterwards soap the hands and well wash them in warm water.

Parchment for covering drums and banjos is now being made from wood pulp.

During a recent hailstorm in the city of Columbia, South Carolina, U.S.A., hailstones 2 in. in diameter fell with terrific force, covering the ground to a depth of 6 in., killing sheep, cattle, pigs, and poultry in large numbers, destroying vegetation, and breaking the windows in every house for miles round.

A "talking clock" has been invented by a watchmaker at the city of Geneva.

TRADE: PRESENT AND FUTURE.

**** Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

ENGINEERING TRADE.—In the Lancashire district depression prevails. Stationary engine builders are, however, fairly active, and inquiries are coming forward for locomotives and rolling stock. Orders have recently been placed with local builders for railway carriages. The reports which have lately come to hand show a considerable increase in the number of men out of employment and receiving "out" benefit from the several engineering trade unions. The returns from the Steam Engine Makers' Society show an increase of from 1½ to 5 per cent. of the members out of employment. In the Manchester district 7½ per cent. of the members of the Amalgamated Society of Engineers are out of employment.

COTTON TRADE.—Employers and operatives are adopting firmer attitudes, and it is expected that the strike will now commence. It is thought probable, however, that masters will pay the customary fine of ¼d. a spindle, and keep their mills running. Arbitration may reconcile matters.

SHIPBUILDERS' TOOLS TRADE.—The shipbuilding tool trade is stagnant, consequent on the inactivity at the shipyards.

TIMBER TRADE.—Stocks at the Surrey Commercial Docks for the past three years show as follows:

	Baltic Deals and Battens.	Canadian Deals and Battens.	Prepared Boards.	Floated Timber.
	Stds.	Stds.	Stds.	Loads.
Sept. 30th, 1890	60,963	27,056	15,616	29,120
,, 1891	45,329	20,544	17,649	29,802
,, 1892	41,348	22,979	17,505	26,540

And the deliveries from the docks for the nine months of the said years:

	Deals and Battens.	Prepared Boards.	Floated Timber.
1890	161,117 stds.	34,129 stds.	37,435 loads
1891	158,975 ,,	35,924 ,,	36,607 ,,
1892	152,402 ,,	35,376 ,,	35,756 ,,

The import to London for the respective years to September 30th was as follows:

	Sawn Standards.	Hewn Standards.
1890	330,140	157,707
1891	252,479	148,649
1892	273,532	131,732

Our Liverpool correspondent writes:—There have been several large sales of timber at the docks, which included the following: 358 logs and curls of Tabasco mahogany, 556 logs African mahogany, 136 curls St. Domingo mahogany, 207 logs Panama mahogany, 7 logs Tabasco cedar, 75 logs Cuba Sabicu, 857 planks Sequoia, 72 logs American black walnut, 80 logs American whitewood, 2,539 pieces American sugar-pine boards, 2,857 planks and boards whitewood, 359 planks satin walnut, 100 planks American oak, 47 logs pencil cedar, 11,678 pieces Kauri pine planks and boards, 900 logs Picton birch, 286 logs pine, 183 logs satin walnut, 39 logs American maple, 9,430 pieces 2nd and 3rd quality pine deals, 2,421 pieces pine sidings, 3,601 pine boards, 798 red pine deals, 894 pieces Michigan pine deals, 1,823 pieces Michigan pine sidings, 13 logs St. Domingo satinwood, 448 sundry South American furniture woods, 28 logs South American fancy wood, 14 logs and planks Bahia rosewood.

FILES TRADE.—An increase is noted, chiefly connected with the home trade.

EDGE TOOLS TRADE.—The edge tool makers of Sheffield are well employed, and skate makers are busy.

MACHINE KNIFE TRADE.—This department of trade is exceedingly slack, and firms are working shortened hours.

SHIPBUILDING TRADE.—The chief interest in the shipbuilding line at present is the coming launch of the *Royal Oak*, one of the battle-ships built by Messrs. Laird & Co. for the British Government.

BOOT AND SHOE TRADE.—London hand-sewn trade has made a move, and most houses are fairly busy for the first week of November.

RAILWAY MATERIAL TRADE.—There is a demand for railway material by English railway companies.

GOLD THREAD TRADE.—With the near approach of the pantomime season at theatres, there is generally a revival in demands for imitation gold threads, wires, purls, checks, and bullions. This season the demand for low-priced goods has not been very brisk, and the prices have been kept down to the lowest point by imports from France and Germany. There has been a slightly increased demand for Indian skein threads, but at lower rates than formerly. The home trade in real gold and silver threads and stuffs is very dull.

SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

I.—LETTERS FROM CORRESPONDENTS.

Timber Terms.—A. J. H. (*Brixton*) writes:—"In the article 'Carpentry for Boys' (see No. 183, pp. 426 and 427), the writer, in his remarks on timber, uses the terms yellow, red, pitch, and white pine. His remarks concerning these are not quite correct, as far as the London timber trade is concerned. Red pine in London is an import from Canada, the same as spruce and yellow pine. The wood he refers to is known as *yellow deal*, and comes from the Baltic. That which he calls white pine is known as white deal or spruce, the former being a softer wood than the spruce, and comes from the Baltic also. It is used for kitchen-table tops, dresser tops, shelves, and for all articles that require to be kept clean, as it is white and clean-looking after being scrubbed. Spruce is not so white, and is tougher. He then goes on to speak of flooring and 'lining.' Does he mean matchlining? Flooring can be had in ⅝ in., ⅞ in., 1 in., 1¼ in., and 1½ in.; but he only mentions 1½ in.—a size I never heard of. He further adds: 'The flooring and lining, generally machine dressed, and grooved and feathered.' This is a conglomeration of matchlining, flooring, and feather-edge boards, and is likely to get the purchaser, asking for a 'grooved and feathered lining board,' laughed at. Those of our young friends who intend making anything can refer back to my article on 'Purchasing Timber' (No. 33), and will there find all the information required for buying timber in small quantities, with prices. I frequently have readers of WORK asking for sizes in timber which are never stocked. I should advise all amateur carpenters to get another copy of No. 33, and cut out the article on 'Purchasing Timber,' and fix it up in their workshops for reference. I shall always be pleased to give readers any information they need regarding this question."—[MCDONALD writes:—"With regard to the criticism by A. J. H. on my article on 'Carpentry for Boys,' which appeared in No. 183, pp. 426 and 427, I will only say that, if the writer likes to acquaint himself with the timber trade in Scotland, he will find that my remarks in the article referred to are quite accurate, as far as this portion of the United Kingdom is concerned. His classification of ⅝ in. stuff as flooring, his advocacy of white pine in preference to good yellow pine for table and dresser tops, together with his acknowledgment of never having heard of 1½ in. flooring, are things that surprise me, and which I must leave to the judgment of your readers."]—A. J. H. adds:—"Mr. McDonald, in his reply, says, 'My remarks, as far as this portion of the United Kingdom is concerned, are quite correct.' My letter did not contradict this, as I stated that the terms were not used in London; and this Mr. McDonald does not deny. I admit that the trade terms in Scotland differ from those used in London, and, in writing, Mr. McDonald should have remembered this. He then draws attention to my remarks upon the sizes of flooring, doubting that ⅝ in. is a stock size and used, and quite certain that 1½ in. is. I repeat I have never heard of 1½ in. flooring being stocked. I forward for your inspection a catalogue of one of the sales similar to those held every week in London, and two specification lists from importers, and I very much doubt if you will find 1½ in. flooring mentioned or ⅝ in. ignored. *Re* 'white pine,' I do not 'advocate' the use of this wood; I merely mentioned that the term white pine is not used in London, but is known as white deal, and is used for certain purposes. I may add I have had a life experience in the timber trade in every branch, and have yet to learn what 'grooved and feathered lining or flooring' is. My only motive in writing to you was that many of your London readers—and I suppose they number more than the Scottish—would be in difficulties in asking for such items as mentioned by the writer of the article."—["Shop" is always open.—ED.]

The "Campania's" Rudder.—N. M. (*Sheffield*) writes:—"It was stated that the size of the *Campania's* rudder precluded the possibility of its being rolled in any mill except that of Messrs. Krupp, Essen. This is an error, as will be seen from inquiries made by Mr. C. J. Stoddart, J.P., managing director of the Parkgate Iron and Steel Works. He found that the plate in question was 21 ft. long, 11 ft. 3 in. wide, and 1½ in. in thickness. Plates of this particular size could have been readily rolled and supplied from the Parkgate works. Mr Stoddart has grounds for his belief that 'the British manufacturer is still able to hold his own in the rolling of steel plates of large size and high quality.' Should there be anything like a serious demand for large rudders, it will be met by increased enterprise on the part of English manufacturers. Mr. Stoddart has done good service to Yorkshire by demonstrating that, at all events, it will not be his fault if, in the future, our great Atlantic steamers carry rudders bearing the inscription—not over-pleasant to English eyes—'Made in Germany.'"

Newtonian Telescope.—P. K. (*Gateshead*) writes:—"I venture to reply, in answer to your correspondent, 'O. B.,' that he can obtain the above, complete in cell, from Mr. Calver Widford, Chelmsford, of all sizes, and at a very reasonable rate. He can also obtain discs of glass ready for polishing the above class of telescopes from Mr. Holmes, of Essex Road. I shall be willing to give any further information possible should your correspondent require me."—[Mr. Caplatzi, who advertises with us, could also supply.—ED.]

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Cardboard Model of York Minster.—X. (*Rotherham*).—You can buy photographic views of York Minster, but I doubt if you can obtain working drawings of it now, as there are none published. You will find the same difficulty with other cathedrals. The cost of tracings of works of this description depends upon the amount of detail you require. You might write to some architect in York as to the cost of drawings.—F. C.

Preventing Injury from Restive Horses.—F. T. R. (*Lybster, Wick, N.B.*).—From the general statement of the invention afforded us in the letter of our correspondent we are unable to inform him whether his mode of achieving the result is new or not. The principle of doing something to disengage restive horses from the vehicle has been proposed or carried out in a variety of ways during the present century, and we have had a great many simple and efficient modes of doing this submitted to us at various times. Many have been patented, but we know of none that have been adopted or patronised by the public, having only seen them fitted on or to a vehicle belonging to, or used by, the inventor. We cannot undertake to advise any particular agent to be employed, but it is evident that the first thing to be done is to make a careful search of the filed specifications to see how far the idea has been anticipated; otherwise, it is very certain that something already known will be described or claimed, and this would at once vitiate any patent that might be obtained. The fees on patents have been reduced since the end of September. Respecting the institution, if he will refer to WORK, No. 175, p. 296, Vol. IV., and No. 181, p. 445, Vol. IV., he will there see what results are likely to attend the course of going to other than established firms.—C. E.

Cabinet Making.—R. S. (*West Croydon*).—The time of apprenticeship varies from three to five years. The trade in London is more divided up into sections or departments than it is, generally speaking, in the country. The chances are that if you get bound to a large city firm you will be put at work in one department only, and thus get into a groove, and probably remain there. In a good all-round firm you have more chances of learning, and, if you keep your eyes open and trust in yourself, you ought to succeed. Go to a school of art in the winter evenings; every workman ought to learn drawing.—F. J.

Tailoring and Cutting.—S. W. (*Ashton-under-Lyne*).—Several series of papers are running through this volume. Directly room presents itself, the Tailoring series will be commenced.—ED.

Fretwork Tools.—J. C. (*Egremont*).—It is a difficult matter to know what you call a complete set of tools, as it depends entirely upon how much cash you are prepared to spend. It is possible to do much simple work with a hand frame and a bradawl or drill only; but if you are going in for good work, a treadle machine is the best, and these can be bought from 12s. 6d. to £5 5s. or more. A good cheap machine is the "New Rogers," at 16s., but, if you can afford it, get one in which the saw has a vertical stroke, as it is easier to do good work with such a one. I should advise you to use the "Star" saw-blades. The following small articles will go to make up a useful list: Archimedean drill and bits, small iron plane, shooting-board, transfer paper, two or three bradawls of different sizes, small screwdriver and hammer, one or two hand-screws, files of different shapes, glue pot and brush, glass-paper. I cannot recommend anywhere better than Harger Bros., Settle, Yorkshire, for both designs and tools, as they are cheap and good. Their catalogue can be had for 6d. If you wish for any further information, write again, and state your wants more explicitly. I shall then be able to understand better how to advise you.—CHOPSTICK.

Red Oil for Mahogany.—A CONSTANT READER.—Red oil is made by steeping ¼ lb. alkanet root—obtainable at most druggists' and drysaltery stores for 1½d.—in 1 pint of raw linseed oil. Allow the work to stand overnight when wiped over with it. Fill in with "filling" coloured to match by adding a little rose pink or Venetian red. You can bring out the work still richer in colour if, when polishing, you use coloured polish, which is made by adding a few drops of red stain. The latter is made by dissolving ⅛ oz. Bismarck brown (cost, 3d.) in ½ pint methylated spirits. We are pleased to learn that WORK has been so useful to you, but it is against our rule to send replies by post, as you suggest.—LIFEBOAT.

Removing Ink Stains from Imitation Ivory.—E. W. N. (*Shrewsbury*).—Try the effect of wiping over with 1 oz. oxalic acid dissolved in ½ pint of hot water. Give repeated applications, taking care

to keep it from the French-polished part of the desk, unless this is also intended to be repolished. Should this be of no avail, rub the surface with fine glass-paper till all marks are removed, then repolish with putty powder and oil, applied with felt or cloth; finish with dry powder and chamois leather. I need hardly remind you that the work would be much simplified, and finished in a more satisfactory manner, if the tablets could be removed from the desk.—LIFEBOAT.

Watch and Clock Cleaning and Repairing.—ONE IN A FIX has lost a jewel-hole from the plate of his watch, and wants to know how to replace it. His best plan will be to go to Clerkenwell, and at a watch material shop procure a jewel-hole to fit the pivot and recess in plate, and put it in. With a steel point carefully open the setting of the jewel (if it is not already open) and place the new hole in, flat side towards the wheel. It is almost unnecessary to say that the hole goes in from the *under* side of the plate. See that it lies flat, then with the steel point carefully close in the circular setting again by a burnishing motion—round and round—till the hole is securely held. If the hole has come out through the setting being insufficient to hold it, it must go to a "watch jeweller"—a man whose business it is to make and set watch jewels—who will form a fresh setting. There are many watch jewellers to be found in Clerkenwell by inquiry at a material shop.—G.

Black and Brown Harness Composition.—G. L. (*Willington*).—For brown harness composition: Melt with gentle heat and mix—Boiled oil, 16 parts; yellow wax, 2 parts; Burgundy pitch, 1 part; turpentine, 2 parts; resin, 1 part. To be well stirred while melting. Clean the harness with soft soap, and have it quite dry before you brush on the compo. If it does not dry quickly enough for your purpose, add about 2 oz. sugar of lead to the mixture. If the leather has lost colour, add a little orange, ebrome yellow, or yellow ochre to suit your taste. If it has become chafed and worn in parts, smooth with pumice-stone dry, then wet, and sleek-smooth with a little weak glue-water. When quite dry mix with gold-size any dry colour to match, and paint it over the bare places before you apply the compo. Black composition for harness: Cleanse the leather with turpentine. Mix treacle, 8 parts; drop lamp-black, 1 part; sweet oil, 1 part; gum Arabic, 1 part dissolved; isinglass, 1 part dissolved, in 32 parts of water. Heat it to mix perfectly; a little ox-gall may be added. Let it be slightly warm when applied. Apply as little as may be required with a bit of sponge, as excess of compo. is not likely to produce good results. Black dubbing, similar to blacking, to be well rubbed in and brush-polished: Ground drop-black, 2 lb.; treacle, 2 lb.; sweet oil, 1 lb.; oil of vitriol, ¾ lb. Dilute with stale beer or weak gum and water when it is used, if too thick. If you want it as a paste blacking, mix ground ivory black, 2 parts; sweet oil, 1 part; treacle, 3 parts; oil of vitriol, 2 parts. This tends to make the leather harsh by the excess of vitriol. It must not be forgotten that neither of these dressings, which are only intended to protect the surface of leather, nourish it like oil or tallow, which should be used without stint, especially inside the straps and at all bends and buckle-holes, using plenty of friction in brushing it in. To ensure the grease or oil entering the leather, wash well with warm water with a little soft soap in it, and before it is dry rub in the oil or grease forcibly; it will enter the pores of the leather as the damp dries out, and make it supple. It almost seems like restoring again to the animal skin its natural lubricant-grease. Linseed oil should not be used, as it burns the leather. Boiled oil is too soapy and gummy. Paraffin is good for harsh, dry leather as a preparatory dressing for grease or oil to follow. Hard suet is the best grease. Neats-foot oil—if it can be got—olive oil, and castor oil are the best oils to use for harness leather.—J. C. K.

Sleigh Bells.—T. B. (*London, W.*).—For these, and fittings of best quality, apply to J. Barlow & Co., Sedley Place, Bond Street, Oxford Street, W.—J. C. K.

Chemical Apparatus.—C. H. (*Ipswich*).—We are always pleased that our efforts are appreciated. Watch the articles carefully, and you will find one devoted to a spirit blowpipe very suitable for your purpose; there are none suitable on the market. It has been suggested before that a spirit blowpipe was a *desideratum*, and so I have been experimenting, with the result that I shall be able to describe one I have brought out, which, though not as good as a gas blowpipe, will be quite sufficient for all ordinary work. In the meantime, you may bend glass tubes in the spirit lamp, for which see my article, p. 167, No. 167, Vol. IV.; but the tube must be moved backwards and forwards and round, so that at least 3 in. of it shall be equally heated, otherwise the bend will be too acute. Take care not to bend the tube until it is quite hot enough, and bend gently, keeping in the flame all the time.—H. B. S.

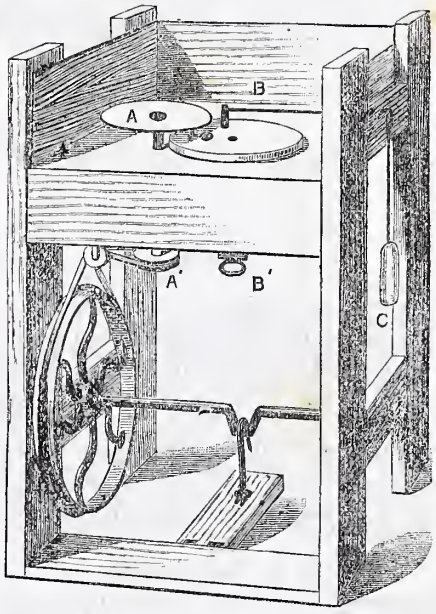
Glass Blowing.—J. H., JUNR. (*Gateshead*).—No papers treating specially of glass blowing have appeared in WORK, but a series on Chemical Apparatus was commenced in No. 189, Vol. IV., which contains a description of simple glass blowing and working; if that is not what you want, write again. The term glass blowing is rather vague, as it ranges from working glass tubes to making window glass. Faraday's "Chemical Manipulation" is a good book for working on a small scale. No doubt the Editor would be prepared to treat of Glass Blowing by a good man.—H. B. S.

Zincographers' Plates and Presses.—PAT.—You may obtain zinc plates, planished, polished, and grained, and also all kinds of presses, from Messrs. B. Winstone & Sons, 100 and 101, Shoe Lane, London, E.C. Write for their price list, and kindly name this paper.—N. M.

Egg Holder.—J. G. (*Kilmarnock*).—It would be waste of time and money to take out a provisional protection for either of the articles mentioned in your letter, there are so many already in the market, some better and some worse than those described by you.—E. D.

Sanitary Engineer.—F. J. (*No Address*).—Write to the Offices of the Sanitary Institute, Parkes Museum, 74A, Margaret Street, London, W., where you can obtain all particulars of above; but—add your address.—E. D.

Machine for Cutting Pebbles.—AGATE.—I send you a rough sketch of a small machine for cutting and polishing pebbles, but I can hardly give you any idea of the cost to make, as I do not know any firm who supply castings. As you will notice, they are rather peculiar, working in a different direction to a lathe, the band being deflected by two small wheels immediately over the driving-wheel, passing round a pulley, A′ in the figure, and driving the cutting-wheel, A, which is made of soft iron, the edge of which is dressed with diamond dust, and lubricated with oil or turpentine. The pebble is embedded in the hollow of the other wheel, B, by



Machine for Cutting Pebbles.

cement, and is raised or lowered, to regulate the size of the piece cut, by a screw underneath, E, a constant pressure against the cutting-wheel being kept up by the weight, C. The cutting-wheel is made to take off, so that polishing-wheels can be mounted upon the same spindle. A zinc tray goes underneath and all round at the back. Should you only wish to do a few, you might manage without a machine. You do not ask for directions for polishing, so I presume you are familiar with that; if not, read the reply to LAPI upon "Cutting and Polishing Pebbles," and if that does not cover your wants, write again, and I shall be pleased to answer.—W. E. D., JR.

Boot and Shoe Making.—T. O. (*Collyhurst*).—Articles appeared in WORK, Nos. 165, 168, 173, 176, 182, and 187.

Phonograph.—E. W. (*Hull*).—From your letter you seem to have carried out faithfully the instructions given in the article for making the above, and now, when you work it, you can only get a grating sound. The sample of ferrotype which you send is all right, but the tinfoil might be a little better; there is too much lead in it. But I do not think that that is the fault. All you require is careful adjustment of the needle if, as you say, every other point has been carefully attended to. The adjustment of the needle requires much patience and many experiments, but, when once set properly, it will be all right. See to this, and report again, but do not send stamped envelopes, as I cannot answer otherwise than through this column.—W. D.

Phonograph.—A. J. R. (*Byfleet*).—I am sorry that I cannot tell you where you can get the shaft and needle of the above to buy, but I should think that a good mechanic could easily make them for you from the instructions in WORK. The price I could not tell, but you might not be far out if you set it down as 15s. Designs for steam ships and steam engines I cannot give you.—W. D.

Rocking Horse.—T. P. (*Warsaw*).—It is true that I anticipated being in a position to be able to provide a paper dealing with the above, but I am afraid that, after all, I shall be compelled to relinquish my intentions. I have been attempting to gain full information—and it appears to be no easy matter to make rocking horses—but have not succeeded proportionately to my expectations. Therefore, rather than supply a paper of doubtful utility, I prefer, at the hazard of being regarded as a breaker of promise, to leave such to hands and minds possessing, or able to possess, additional details to the scanty ones I have knowledge of. I am really sorry for being compelled to back out of responsibility, but I feel that, if I cannot be complete, my decision is the best course to adopt.—J. S.

Painting and Graining.—YOUNG PAINTER.—I could advise you more usefully if I knew more about your work and wants. As to a book on "painting and graining," there are scores of them. You leave me to guess the greater part of your question. Brodie & Middleton, Long Acre, London, publish a cheap little manual, price 2s., useful to amateurs and apprentices, who, as is often the case, have no proper tuition given them. Crosby Lockwood & Co. publish some useful books. George Field's "Grammar of Colouring," price 3s., is one of the most useful elementary works the earnest student can possess. WORK, Vol. I., contains a simple but reliable series of papers on plain painting, distempering, etc., which many journeymen house painters might read to their advantage. Vol. II. contains a series of lessons on "Graining," equal to anything you can buy elsewhere at the price of the book.—DECORATOR.

Enamelling.—S. H. (*Cardiff*).—I have written the gentleman from whom I received the information respecting enamelling boilers, but he is unable to give me the address of the firm. Will make inquiry, the result of which I will communicate as soon as I receive it. In the meantime, you might, perhaps, obtain some information on the subject from Messrs. Clarke, Shakespeare Foundry, Wolverhampton, who are makers of enamel goods.—M.

Stereoscopic Camera.—J. V. M. (*Pendleton*).—To answer J. V. M.'s queries in full would occupy the whole of one of these numbers of WORK, so it will be impossible to do more than give a slight sketch in "Shop." To begin with, stereoscopic cameras, of all cameras, require accurate adjustment, and if J. V. M. has had no experience in photography, he is not very likely to succeed in making one of them. The materials used are precisely the same as for other cameras. An expanding partition is always used in this camera, so that two entirely distinct negatives may be made on one plate. The size of camera best suited for this work is one of 8 in. by 5 in. The trimming can then be more artistically managed than with smaller instruments. The distance between the lenses must be adjustable, 3½ in. being the shortest. The rule is, the more distant the object, the wider the separation of the lenses required. Any camera that will take a picture 7 in. long can be adapted for stereoscopic work, but this length allows no margin whatever in the width of the picture. Many prefer a whole-plate camera, divided centrally, to any other, as stereo pictures may be any height, but must not exceed 3½ in. in width. Six inches is a good length of focus for the lenses. On p. 361, No. 23, of WORK will be found diagrams and instructions for making a whole-plate camera, which, with a little modification, will be sufficient for another sized camera. There are no books we are aware of that treat specially on stereoscopic work.—D.

Drilling Machine.—DRILLER will find sketches of drilling machines such as he requires in the trade catalogues of the Britannia Co. and of Churchill Co., Cross Street, Finsbury, the well-known importers of American tools. There are very good ones to be had from America, in which the drill is depressed by the foot or by a hand lever acting against a weight, which tends to hold it up. All back-lash is taken up by this means, so that you can feel the drill at work, and, when it gets through, it does not drop and get broken.—F. A. M.

Gold Lettering.—AMATEUR BOOKBINDER.—To prepare cloth for lettering is a very simple affair, the only thing necessary being to coat it with glaire—which is white of egg beaten up to a thick froth, and allowed to settle again. Give the cloth one coat only with a sponge, taking care that no bubbles or froth are allowed to dry on. A very little glaire only should be used. In fact, some cloths can be lettered without any preparation whatever. In the case of leather, before coating with glaire, wash the entire surface with paste-water, and, when dry, give *two* coats of glaire, allowing the first to dry before applying the second. Different leathers require slightly different treatment, but, as you have not specified any leather, the above general instructions may help you. See back numbers of WORK for much on this subject. Marcus Ward & Co., London and Belfast, publish copybooks on Illuminated Writing. See them. So do Blackie & Son, Glasgow and Dublin.—G. C.

Model Horizontal Engine.—D. G. (*No Address*).—Such drawings as you ask for are not to be bought, but an intelligent workman could advise you in this matter. Diagrams for school and lecture purposes are sold in most large towns, but these would be of no use in matters of detail.—F.C.

Machine Construction and Drawing.—AJAX.—This subject shall be taken up as soon as a competent writer presents himself.

Small Electric Lamps.—F. H. (*Sheffield*).—Electric lamps of one and two candle-power can be

obtained from all dealers in electrical sundries. Portable electric lamps are made and sold by Messrs. Cathcart, Peto & Radford, Hatton Garden, and Mr. James Pitkin, Red Lion Street, E.C. I cannot say who the makers are of the lamps in use by the London Omnibus Company.—G. E. B.

Electric Launch.—W. J. W. (*Wolverhampton*).—Space cannot be spared in "Shop" for a description of an electro-motor suitable for driving a pleasure-boat to carry from four to six persons. Such a motor cannot be conveniently driven by a bichromate or any other primary battery, since a large number of very large cells would be needed to furnish current to the motor, and these would prove an intolerable nuisance to the owner and the occupants of the boat.—G. E. B.

Electric Indicator.—P. J. M. (*Bristol*).—Of course, you will understand that the terms "cheap" and "easy" are comparative terms, having a different value to two or more persons. Would you think 1s. too much to pay for the parts of an indicator? If not, you may get from King, Mendham & Co., Bristol, their K.M.B. self-adjusting pendulum movement indicator parts for this sum, and the parts can be easily put together by any ordinary bell fitter. I know of nothing else so cheap and easy. Others are mentioned in their illustrated price list and guide, price 6d.—G. E. B.

Lamp for Boiler.—J. W. C. (*Polegate*).—If you send all full particulars through "Shop," THOROUGH and other readers will be benefited.

Wood Worms.—ANXIOUS.—You need not fear that the worms are still in the wood, as they either die or leave it when the sap goes out; at any rate, there are very few alive by the time the timber gets in the hands of the user. A dock clerk, who handles American oak every day, tells me he has never seen a live worm in this wood. I also presume that, as you are going to use the wood for furniture, it is thoroughly dry, and the most you will find in the holes is the old shells.—A. J. H.

Mackintosh.—ENQUIRER (*Crewe*).—Under the circumstances related, there is no mode of overcoming or rectifying the evil complained of. All that can be done is to provide a fresh one and carefully keep it from encountering the conditions which have acted so prejudicially on the former. Things of this kind will not bear contact with, or exposure to, the substances mentioned without injury of some kind arising either to the colour or to the substance of which they are composed. We do not know any means which could be adopted to obtain what is desired or that would not produce a worse evil than that desired to be rectified.—C. E.

Brass Plates.—R. E. M. (*Sunderland*).—Before I can give you any advice on the subject of lacquering coloured waxed plates, I must know under what conditions you require the lacquering applied. I may as well tell you that no lacquer that I am acquainted with will protect the polish of brass when exposed to the weather, and, according to my own observations, as lacquering is done nowadays, very little use inside. Perhaps what you want is a highly-polished surface to your plates, erroneously termed "lacquering." If this is so, you must "finish" the plate on a revolving soft buff, using prepared lime as a polishing medium. This with a nice bright wax is all you need, taking particular care that the plate does not get hot while polishing. There is, or was, a company in Sheffield who, for a small charge, deposited a thin film upon silver articles which protected the article from tarnishing and discoloration most effectually; perhaps this process is being done in London.—N. M.

Stage Draperies.—NOVICE.—You will find "Stage Draperies: Their Painting and Manipulation" treated in No. 181, p. 309, Vol. IV. Theatrical Limelight Apparatus and other Appliances used for Producing different Effects, Transformation Scenery, etc., articles will be produced shortly. I am pleased to know that former articles are so much appreciated.—W. C.

Piano Iron Frame.—PIANO.—Your piano frame must not lie on the bracings, but must be supported on the wrest-plank, bent side screws being put through the flanges, where there are holes made for that purpose. The soundboard rests on slips of wood, and is suspended between the bracings and the iron frame. If your iron frame rests on the soundboard, you will have no tone in your piano. If you refer to the first volume of WORK, you will see how the soundboard is made and attached; the method of fitting soundboard for iron frame piano is exactly the same, except that bridges are thicker, so that the strings clear the iron frame. You will possibly have to make your long bridge in two sections, so as to clear the iron bars and contract the pins on this bridge, so that the strings clear the sides of the bars.—T. E.

Organette.—E. H. (*Bethnal Green*).—We think our correspondent might obtain the information he asks from any large paper and cardboard manufacturers: say, Messrs. Spicer & Son, 50, Upper Thames Street, E.C.—G.

Woven Wire for Mattress Frame.—BUCKEYE.—Write to Mr. John Turner, Sheffield Wire Works, New Surrey Street, Sheffield, sending him a diagram of the mesh required, size of sheet, and gauge of wire you wish the woven piece to be made. Also send full particulars of the manner in which you propose to stretch the same, so that he may be able to provide for the extra strain in that direction.—N. M.

III.—QUESTIONS SUBMITTED TO READERS.

**** The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

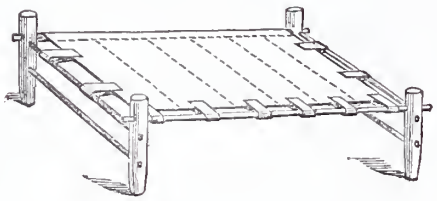
Lawn Arrangement.—CAM writes:—"Could any gardening reader give me designs for laying out a piece of lawn (70 yds. by 30 yds.) in a geometrical pattern, with beds, walks, and turf?"

"Z. F." Monogram.—CONSTANT READER writes:—"Will any kind reader of WORK give me a monogram of 'Z. F.' to be cut in ivory for box top inlay, and say, also, where I can get the ivory for same?"

Punt.—C. R. (*Acton, W.*) will be obliged for working diagrams of a rowing punt.

IV.—QUESTION ANSWERED BY A CORRESPONDENT.

Camp Cot.—V. D. (*Portsdown Road*) writes:—"Here is a further description of the bedstead—*vide* 'Camp Cot'—F. K. (*Staveley*) (No. 167, p. 174); first part of description was in No. 178, p. 350: The holes in the legs for the top rails of the ends should be made as close to the holes for the long side poles as possible, so that the leather or canvas bottom may be, when strapped, as near as possible the same level at the ends as at the sides. All 'removables' to have tapering ends, all of which, and the respective holes they fit, are to be marked to correspond each with each. I cannot describe the best way to make fixtures of the four end rails to the legs, and am not at all sure that they *must* be, though probably better as such. To keep the pillow on, a narrow



Camp Cot.

strip of board, for instance, with a hook at each end to slip into screw-eyes in the legs. The buckles on short straps to be sewn underneath, and the corresponding straps on the top. I suggest that the bottom might be made of leather, this being strong, and can be kept clean and supple with soft soap or saddlers' composition. Also, that an economical way to get it made might be to buy two or three sheepskins properly cured (minus the wool), and give them to a humble worker in leather to cut out and fit, etc., as high (saddlers') finish seems unnecessary. I enclose a few 'helps' for the artist. If you intend to sit on bedstead, have the side poles strong accordingly. I could tell you of a way to fix very good and portable mosquito curtains to it."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—H. L. (*Norwich*); R. A. DE P. (*South Kensington*); E. R. (*Everton*); C. C. (*Sheffield*); A. J. H. (*London, N.*); P. J. W. (*Liverpool*); W. T. T. (*Sunderland*); A. G. (*St. Albans*); J. C. (*St. Helens*); M. D. (*Blackburn*); J. H. (*Holyhead*); C. W. W. (*Southsea*); A. H. B. (*Canonbury*); G. M. K. (*Hull*); A. A. S. (*Ipswich*); A. H. (*Manchester*); GAMMA; J. E. L. (*Bandon*); T. B. (*Failsworth*); H. C. (*Dorchester*); E. C. (*Smeeth*); W. M. (*Garsington*); H. F. (*Liverpool*); W. J. W. (*New Kent Road*); JUMBO; G. M. (*Hendon, Sunderland*); G. H. (*Patricroft*); A YOUNG ENGINEER; T. E. (*Crectown, N.B.*); J. W. T. (*Huntingdon*); SIGN; A READER; A. R. (*Scorrier*); AMATEUR; C. H. B. (*Blackpool*); J. B. (*Norden*); T. T. B. (*Bristol*); W. H. (*Bristol*); ANXIOUS; EGROGE; F. H. K. (*Brighton*); MODELMAKER; K. L. Y. (*Lincoln*); M. P. (*Glasgow*); LAURÆRNEST; F. J. K. (*Tufnell Park*); W. H. T. (*London, E.C.*); SAMUEL; OUT OF KNOW; ENGINEER; WIRE; T. & W. (*Manchester*); W. C. M. (*Norwood*); A READER FROM No. 1; MANCHESTER AND STOCKPORT CHEMICAL CO. (*Stockport*); BUNKER; H. H. (*Sheffield*); WALTHAMSTOW; HARRY; COLLECTOR; A CONSTANT SUBSCRIBER; R. C. (*Dublin*); R. T. T. (*Frome*).

"WORK" PRIZE SCHEME.

FIFTH COMPETITION.

"Domestic, Commercial, or Scientific Application of Electricity" Competition.

CONTINUING our scheme of Prize Competitions of a useful and practical nature, we propose to devote the present one to the subject of Electricity, in which our readers and the world at large take so keen an interest. We invite competition for the following prizes—

First Prize, £3;

Second Prize, £2;

Third Prize, £1;

for the three best suggestions of an original and practical nature, involving the application of electricity to some domestic, commercial, or scientific use. This application may be on a large or small scale, to take effect on land, sea, or in air—the main conditions being the newness and practical possibilities of the suggestion.

CONDITIONS AND RULES OF THE "ELECTRICITY SUGGESTION" COMPETITION.

ALL Descriptions to bear the WORK Prize Coupon, cut from one of the numbers of WORK in which the Prize Scheme is announced.

Each Description to be signed with an original *nom de plume*, and to have the writer's real name and address securely attached to the manuscript in a sealed envelope.

Each Suggestion should be fully described in respect to its purpose, construction, and working, and, where possible, should be illustrated with a drawing of the article itself and its various parts, to elucidate the description.

A Suggestion not illustrated will have an equal claim in the competition, provided the description be sufficiently in detail to convey a full idea of the article suggested.

In the work of judging regard will be had to the practical nature and utility of the suggestions, and their prospective popularity.

The Prize Suggestions and Drawings, and any others, to be published, if desired by the Editor, in WORK, but the copyright thereof to remain with the authors.

Copies of MSS. and Drawings to be retained by the competitors, as in no case can the return of MSS. be undertaken.

The Editor of WORK will supervise the judging of the Suggestions, and the selection, or decision, as determined upon by him is to be final.

All manuscripts intended for the "Electricity Suggestion" Competition must be addressed to the Editor of WORK, c/o Cassell & Co., Ld., Ludgate Hill, London, E.C. They must reach him on or before Saturday, December 17th, endorsed, "Electricity Suggestion" Competition.

SALE AND EXCHANGE.

Victor Supply Co., Grimsby, sell Mail-cart Wheels and Parts. [7 R

The Capitaine Oil Engine.—Economic, reliable, safe; for all driving purposes.—LEOP TOLCH, 38, Byrom Street, Liverpool. [9 R

Joiner's Tool List, post free, from BOOTH BROTHERS, Dublin. [12 R

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100 Fretwork Designs (new), 100 Carving, 100 Repoussé, 30 Fret Brackets, 35 Photo Frames, 100 Sign-writers' Stencils (all full size), 300 Turning, 400 Small Stencils. Each packet, 1s.; post free. All fretwork requisites, machines, wood, etc. Catalogue, with 540 Illustrations, 3d.—F. COULTHARD, Darlington Street, Bath. [3 S

Caplatzi's Scientific Hire and Exchange Stores.—Established 1860. The largest and cheapest for amateurs and professionals. Goods warranted. Advice free.

Catalogues—General, Electrical, Telescope, Microscope, Spectroscope, Photographic. Lantern, Chemical, Lathe, Model Machinery, Miscellaneous, 2d. each.—CAPLATZI, Chenies Street, Bedford Square. [8 R

Fretwork.—New set original designs, entirely unlike any other. Post free, 2s. 8d.—KNIGHT'S Library, Ventnor.

Fretwork Competition.—11 Prizes in Cash, and a Silver Medal to be given for best articles of Fretwork. Entry form and particulars, one stamp. List of miniatures, with 500 Illustrations, free for six stamps.—TULLOCH, Red House, Millfield, Sunderland.

Turning Designs, accurately drawn, 1st and 2nd Series, 1s. 7d. each, post free.—WALKER, Newton Road, Ipswich.

Cycle Making for Amateurs.—Humber models, Crypto models; working drawings, 6d. each. Price lists of materials and accessories, 1d.—A. CRAIG, Engineer, Trevelyan Road, Tooting.

Architectural.—Gwilt's "Encyclopædia," Tarn's "Science of Building," "Students' Guide to Measuring" Perfectly new. Half price.—KEYS, Triangle, Bournemouth.

Photographic Requisites.—Remains of dealer's stock at half cost. List, one stamp.—KEYS, Triangle, Bournemouth.

WORK.—Wanted, Vols I., II., III., not bound preferred. State lowest price to R. F. PEINIGER, Blois, France.

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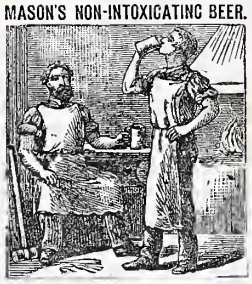

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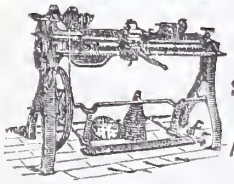

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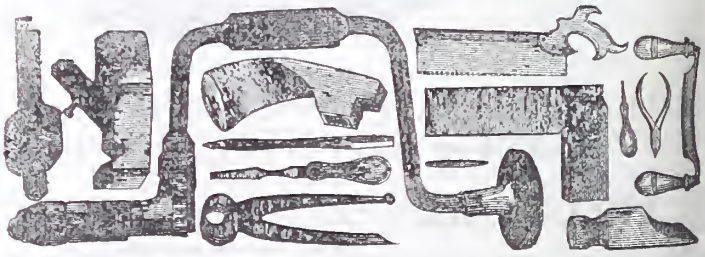

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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VOL. IV.—No. 192.] SATURDAY, NOVEMBER 19, 1892. [PRICE ONE PENNY.

WORK WORLD.

JAPAN has twelve electric light stations supplying electricity for light and power.

* *

The total output of gold from the mines of the world for last year was 6,033,000 oz.

* *

The Yorkshire Miners' Association Council propose a general week's holiday at Christmas for all miners.

* *

The hours of work for women in French factories is henceforth limited to eleven hours a day.

* *

The Durham miners have voted against a legal compulsory eight hours' day, only 12,684 voting for eight hours, whilst 28,217 voted against it.

* *

A new use for paper pulp has been discovered in Germany. By a special process the pulp is compressed in moulds, and hardened to form artificial teeth.

* *

Earl Russell has commenced business as a general contracting electrical engineer. He has had considerable experience in electrical work whilst acting as business manager to a firm of electrical engineers.

* *

A new American reaping, thrashing, and bagging machine has been tried on most of the big farms in North Dacota with great success. Each machine will harvest over sixty acres of corn in one day.

* *

A new process of tanning by electricity is used on the skins of stray dogs in Paris. The skins are transformed into leather in a much shorter time by electricity than by the old-time tanning methods.

* *

The cost of the biggest firework display the world has yet seen, which took place recently at the inauguration of the exhibition buildings, Chicago, was £6,000. Over a million people witnessed the display, which was provided by a London firm.

* *

Workmen of a large Tyne shipyard recently requested to work three-quarter time in order that all the operatives might be employed, firmly resolved that 25 per cent. of them should be paid off so that the other 75 per cent. would be employed on full time.

Persons using an electric search-light cannot discover the approach of a boat painted dead black if the sea is calm. Calm water does not reflect the rays of an electric light, but appears almost black, and the black boat is lost in the surrounding blackness.

* *

The straw-plaiting industry of England is carried on principally in the counties of Bucks, Beds, and Herts, and gives employment to from 4,000 to 5,000 men, and about 500,000 women and children. As this is a home industry, the employment is but partial. * *

American and Austrian newspaper proprietors are employing electro-motors for driving their printing machinery, and report complete success. The Vienna *Fremdenblatt* is printed by power derived through an electro-motor from the mains of the electric light company.

* *

At Aspen, Colorado, U.S.A., the electric light is maintained by water-power. The electric light company have recently erected plant to furnish power for mining operations in the district. The dynamos are to be driven by five 250-h.-p. Pelton water-wheels, worked by a 356 ft. head of water brought through 30 in. pipes.

* *

A German chemist has discovered that silver can be separated from copper and bismuth in a nitrate solution of these metals, and mercury in the mercurous state from copper, bismuth, and arsenic, dissolved in weak nitric acid, by electrolysis, using a weak current of electricity at a pressure of only 1·35 volts.

* *

In a Japanese invention, to enable members of the House of Representatives to vote without leaving their places, an electrical button is pressed by the voting member, and a corresponding ball is discharged into a receptacle behind the President's chair. After the balls have been counted they are electrically returned to a storage chamber, ready for the next division.

* *

A boat of novel construction has been recently built at Glasgow. Two thin sheets of Siemens-Martin steel were pressed to the exact shape and size required, and riveted together with a bulb steel between them, forming the stem, keel, and stern-post. The gunwale, streaths, and bottom bars are fitted in the usual manner, and a strong hook and ring-bolt is fixed at each end for mooring purposes. * *

The diminution in lighting power of an electric incandescent lamp is partly due to the deposit of a carbon film on the interior of the bulb. This "age coating" is most pronounced in the early life of the lamp, and is greatest in lamps of high initial efficiency. The loss in transparency of the bulb, after a run of from 800 to 900 hours, varies from 15 to 20 per cent., being greatest in the most efficient lamps.

* *

A new alloy, resembling gold, remains unaltered even in colour after prolonged exposure to air, containing ammoniacal or acid vapours. It consists of 100 parts copper to 6 of antimony. When first mixed, the alloy would cool with a porous structure, but this is prevented by a flux of charcoal, magnesium, and calcspar put in the crucible; it can be cast, rolled, hammered, and soldered like gold, and is of greater solidity.

* *

If the bottles used in this country alone were made at home, it would find work for 20,000 people. From three to five thousand gross of bottles are said to be imported every week to the detriment of the English manufacturers and artisans. These bottles, by some curious oversight in the Merchandise Marks Act, are not compelled to be marked with their place of origin, and it is hard to distinguish whether they are English or foreign. It is time this was altered.

* *

The Balubans, in Central Africa, have a good local reputation as iron-workers. They find bog-iron ore on, or very little under, the surface of the ground. Their smelting furnaces are of clay, 6 ft. to 10 ft. high, conical in shape, and 40 in. to 60 in. diameter at the base. The ore is tipped in at the top, and charcoal fed in through basin-like side openings, which also receive a continuous air-blast; the iron and slag are removed from the bottom of the furnace every eight or twelve hours, according to the heat attained. The bellows supplying the blast consist of a block of wood about 20 in. long, hollowed out, and fitted with a funnel head of clay. At the lower end are two openings, over which skins are stretched. Motion is imparted through two small rods.

CHEMICAL APPARATUS: HOW TO MAKE AND USE IT.

BY H. B. STOCKS.

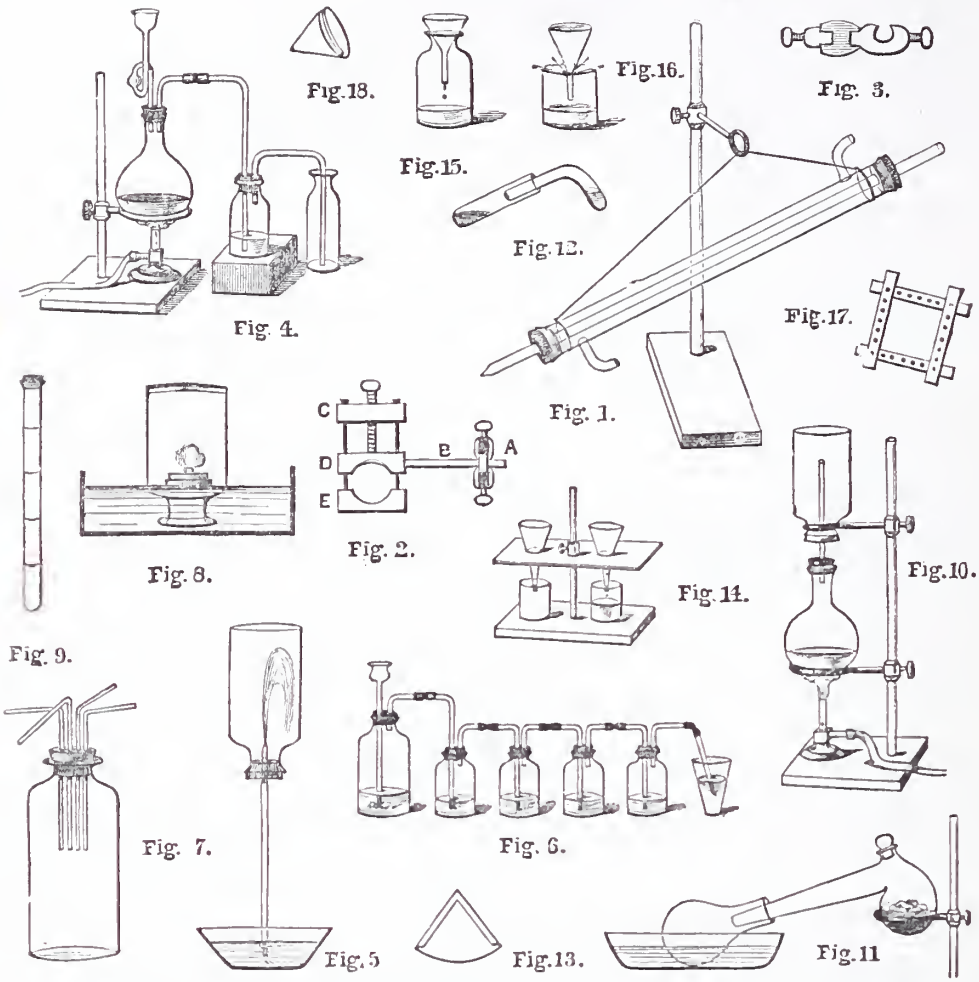
Support for Condenser—Clamp and Boss—Apparatus for Chlorine, etc.—Apparatus for showing Solubility of Gases—Method of showing Action of Sulphuretted Hydrogen upon Metallic Solutions—Apparatus for Sulphuric Acid, Nitrogen, Ammonia, Nitric Acid—Tube Retort and Receiver—Filtration—Methods—Filter-paper—Filter-cutters—Filter-stands—Funnels.

For supporting a condenser a special stand is not really necessary. It may be supported from a retort-stand by means of a copper wire or stout string, and may then be inclined in any direction (Fig. 1), or a clamp and boss may be attached to the retort-stand. These will be found very useful, not only for holding a condenser, but for retorts, flasks, etc.

The two articles above named are seen at Fig. 2, A being the boss and B the clamp. The boss will have to be cast in brass, and it has two thumb-screws and two slots at right angles to one another—one to grip the retort-stand, and the other to grip the rod of the clamp. A boss may be bought for about 1s. 6d.

The clamp may be made by anyone. The three portions, C, D, E, are made of hard wood, 3 in. × 2 in. × 1 in., two of them being slotted out to grip the article intended to be held.

Procure a 4 in. screw, and file off the head; make a hole for it in D, and screw it in firmly, taking care not to split the wood. Procure also a screw for window fastening, about 2½ in. long, and a little thick copper wire. Place C, D, E together, and bore two holes one on each side of the slot, clear of the screw, right through the three pieces; also in the centre of A bore a hole for the thumb-screw, and let in the brass plate which accompanies it. Make the two holes in D a little larger, so that it will easily slip upon the copper wire. Push a piece of copper wire through all the holes, and flatten it at top and bottom, after leaving about 1½ in. for the clamp to move. Turning the screw will then draw E towards D, thus gripping the object. A small piece of sheet brass let into D under the point of the screw will lessen the wear at that place.



Chemical Apparatus. Fig. 1.—Condenser supported by String. Fig. 2.—Clamp and Boss. Fig. 3.—Boss. Fig. 4.—Apparatus for Chlorine, etc. Fig. 5.—Apparatus for showing Solubility of Gases. Fig. 6.—Apparatus for showing Action of Sulphuretted Hydrogen upon Solutions. Fig. 7.—Apparatus for Sulphuric Acid. Fig. 8.—Apparatus for Nitrogen. Fig. 9.—Tube for showing Composition of Air. Fig. 10.—Apparatus for Ammonia. Fig. 11.—Apparatus for Nitric Acid. Fig. 12.—Tube Retort and Receiver. Fig. 13.—Filter-cutter. Figs. 14, 15, 16.—Supports for Funnels. Fig. 17.—Wood Frame for Filtration. Fig. 18.—Filter-paper ready for Funnel.

Chlorine and hydrochloric acid may be made in the apparatus, which is seen at Fig. 4, and consists of a 20 oz. flask (costing 9d.), a safety funnel (costing 5d.), bent tube, and the wash-bottle from the hydrogen apparatus. The safety funnel is intended to prevent any of the gas entering the room; and the preparation of these gases would be much better carried out in the open air, as chlorine especially is dangerous when inhaled. The collection of the gases is somewhat different to those I have described. As they are so soluble in water they are collected by displacement; being heavier than air, they displace the air in the jar, and after a short time the glass plate may be placed over the jar. Take care to grease the mouths of the jars and the glass plates, to prevent leakage.

To show the solubility of hydrochloric acid in water, procure a large white glass bottle, a cork to fit, and a piece of glass tubing 2 ft. long. Draw the tube out to a point in the manner already described, bore a hole in the cork, and push the tube through, so that the point is just out of the cork. Fill the bottle with the dried gas, and for this purpose place a little strong sulphuric acid in the wash-bottle instead of water. When the jar is full of the gas, insert the cork, with the point of the tube inside the bottle; place a little plug on the open end of the tube (a short piece of rubber tube with a piece of glass rod in one end is suitable); suspend the bottle over a basin containing water coloured with a little blue litmus solution, into which the tube dips. Now take off the plug and shake the bottle a little. A fine fountain will play inside the bottle, owing to the vacuum produced by the gas dissolving, and the litmus will change to red, showing the acid nature of the gas.

The same apparatus will do to show the solubility of ammonia gas. The litmus in the basin, being coloured red, will change to blue in the bottle, showing the alkaline nature of the gas.

The preparation of sulphuretted hydrogen should also be carried out in the open air, as its odour is not very pleasant, to say the least of it. The apparatus used is the same as that for hydrogen, or, for small quantities, the tube apparatus I have described. It is soluble in water, and therefore must be collected by displacement, in the same manner as chlorine.

The chief interest of sulphuretted hydrogen is its value as a test. As with many metallic solutions, it gives precipitates of various colours. To show this to the best advantage, fit up a number of small wash-bottles, similar to the one described, and connect them together by means of rubber tube—the first one to the gas generator and the last one to a glass of water.

Into the wash-bottles put solutions of (1) tartar emetic (antimony potassium tartrate), (2) lead acetate (sugar of lead), (3) stannous chloride (tin-salts), (4) zinc sulphate, made alkaline with ammonia; pass the gas, and notice the colours. Sulphurous acid is made in the same apparatus as chlorine, and collected in the same manner. Sulphuric acid is made on the large scale by bringing together sulphurous acid, nitric acid, and water in large leaden chambers. Now this process of manufacture may be imitated on a small scale, in a similar manner to that used some time ago, when the acid was 5s. or 6s. per pound. It is now only 2d. or 3d. per pound.

In place of the leaden chamber, we will have a half-gallon wide-mouthed bottle. A large cork is required, bored with four holes, each containing a bent glass tube. Connect one of these to the sulphurous acid apparatus, one to a flask containing nitre and sulphuric acid, and heated so as to give off nitric acid,

and one to a flask containing water; the fourth tube is left open for air. If, now, sulphurous acid and nitric acid are allowed to pass into the bottle, the "chamber" crystals are seen; and on boiling the water in the flask these are dissolved, red fumes of nitric oxide are formed, and the liquid at the bottom of the bottle is dilute sulphuric acid, which may be shown by its redding litmus sol and by giving a white precipitate with barium chloride.

Nitrogen is usually prepared from air which consists of four-fifths of this element and one-fifth of oxygen. As phosphorus burns readily in oxygen, we may take the whole of the latter element away, leaving the nitrogen.

The apparatus is very simple, and consists of a bung or flat cork, on which is placed a small porcelain capsule or the lid of a porcelain crucible. This is floated upon the water in the pneumatic trough; a bit of phosphorus, dried by pressing (not rubbing) between blotting-paper, is dropped upon the capsule, set fire to, and a wide-mouthed jar placed over it in the trough. After the fumes have subsided, the residual gas is nitrogen.

To show the composition of the air, a tube, 18 in. long and ½ in. in diameter, is sealed at one end, as for a test-tube. It is then divided into five equal portions by rubber bands on the outside, and a good cork fitted to the open end. A small piece of phosphorus is dried, and placed about 2 in. from the open end of the tube. The cork is tightly inserted, and the phosphorus slightly warmed, and as soon as melted, shaken down to the bottom of the tube. It will take fire in its course, and when the flame has disappeared, place the corked end of the tube into water, withdraw the cork, and pour water on the tube to cool it. Again insert the cork under the water, so as to keep in the tube the water which has risen; then notice the height of the water in the tube. It will be at the first elastic band, showing that one-fifth of the air has disappeared. This one-fifth, as before stated, is oxygen.

Ammonia may be prepared in the apparatus shown at Fig. 10, which consists of the flask used for oxygen, a tube, and gas-jar. It will be noticed that ammonia is collected by displacement, being very soluble in water. Being also lighter than air, it displaces the air downwards in an inverted gas-jar.

Nitric acid is prepared in the apparatus shown at Fig. 11, and consists of a 10 oz. retort (costing 7d.) and a flask (that used for oxygen will do), the flask being kept cool by water in a basin. The nitric acid distils over from the materials in the retort, and is received in the flask, which is called the receiver.

When it is required to distil very small quantities of nitric acid or any other liquid, the tube retort and receiver (Fig. 12), made of hard glass tube ¾ in. in diameter, may be used. These may be made by anyone who has exercised himself in glass-blowing, in a similar manner to that I have described in former papers.

Having now gone over a little of the ground required by those studying elementary chemistry, and described the apparatus used in preparing, collecting, and testing gases, etc., I intend giving a few examples of apparatus which are in general use for many purposes in chemical laboratories.

Everyone knows what a filter is. It is usually a very unwieldy article, intended to filter and purify water, which it rarely does. Chemists never use these filters. If a coarse filtration is all that is necessary, a piece of cotton is spread upon a wood frame (Fig. 17), and held there by a number of pins fastened into the wood. The frame is supported over a dish, which catches the liquid.

The general method of filtration is by means of a funnel containing a filter-paper. Filter-paper is very similar in appearance to fine blotting-paper, and for qualitative work white blotting-paper will do quite as well. Filter-papers are cut to a circular shape, and for this purpose filter-cutters will be required. These are merely pieces of tin-plate cut to a triangle, with a rounded base, and having the sides turned up about ⅛ in. The filter-paper to be cut is folded twice and placed in the cutter, and, by means of scissors, the ends projecting beyond the tin-plate are cut off. The filter is then taken out, opened in the manner shown at Fig. 18, and placed in the funnel, which should be larger than the filter-paper—never *vice versâ*. Convenient-sized cutters will be 1½ in., 2 in., and 3 in., giving filter-papers double that diameter. The funnels required for these papers will be 2½ in., 3 in., and 4 in. in diameter, costing 2½d., 3d., and 4d. respectively.

A filter-stand is very useful (Fig. 14). It is made in wood, the base being 10 in. × 4 in., and the rod 12 in. high and about ½ in. in diameter. The sliding portion may be 3 in. wide, also 10 in. long. At each side a hole is bored, 2 in. in diameter, and in the centre a hole about 1 in. in diameter. Into this hole a cork is glued, and a hole is bored in the centre of the cork, and enlarged by means of the rat-tail file until it will just push on the rod. The sliding portion may then be adjusted at any height on the rod, and will take two funnels.

These stands are not absolutely necessary, as the funnel may be supported in the mouth of a bottle or over a beaker by means of a wire triangle.

METALLIC AND GLASS PIPES.

Metallic pipes made of iron, cast iron, lead, etc., all have the disadvantage of rapidly oxidising, and consequently contaminating the water or liquids more or less. This is a demonstrated fact for which no genuine remedy has yet been found. In spite of this, we are compelled to employ them in all cases where glass is not sufficiently resisting—that is to say, for water-pipes, syphons, etc.

But is it not possible to make glass capable of supporting interior and exterior pressures such as those to which such conduits are subjected? Two Belgian engineers posed this problem and solved it in the following manner:—

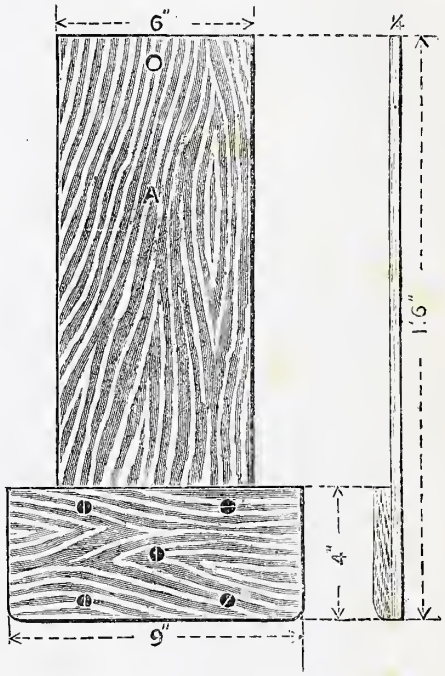
They cover the glass pipe with another made of metal, and between the two they pour special cement, which perfectly unites the pipe and covering, and at the same time protects the glass, and consequently the liquid running through, against the variations of temperature.

The method of manufacture is applied not only to straight pipes, but to every form of conduit used in trade. The ends of the pipes are wormed or fitted with flanges, so that they can be joined hermetically without expensive solder as with lead pipes.

Thanks to their lightness, and the non-conductibility of glass for electricity, the employment of these pipes is also presented to the electric industry; uncovered cables can then be used without fear of danger.—*Les Inventions Nouvelles.*

LEDGER-REST.

Amongst the very many thousands of readers of Work, there are doubtless many that have at least occasionally to enter various matters in large books or ledgers. To such as these I have no need to mention the difficulty experienced in writing as the bottom of the page is approached. Various expedients are employed to support the hand, such as placing the left hand or a large book under the hand holding the pen. These, at the best, are only to be regarded as makeshifts, and therefore will be used no longer than is necessary. The simple contrivance here



Ledger-rest, Front and Sectional Views.

placed at the service of readers may readily be constructed by the merest novice in the use of wood-working tools. It is formed of two pieces of wood screwed together at right angles as shown in sketch. The piece A may be about 18 in. long, 6 in. wide, and ¼ in. thick. The other should be, say, 9 in. long, 4 in wide, and ½ in. thick. The two pieces should be planed smooth, and screwed together with five ½ in. screws as seen. It may be made of any kind of wood, mahogany being preferred, as it can then be French polished, which will keep it clean, and by keeping the air away prevent it warping. In use, the thin blade is passed between the leaves of the ledger, the other piece thus forming the required support for the hand.—[This contrivance has been known to us for years. Nevertheless, being useful, insertion is willingly given to it.—Ed.]

Graphite, as a lubricant, is strongly recommended. To cool hot bearings, put it on as thick as it will mix with oil.

Steam Traps, situated in any exposed position, should have a drain-cock, so that they can run dry when not in use. If left full, or nearly full, of water, a frost expanding the water will burst them.

BENT IRON WORK, AND HOW TO DO IT.

BY J. H.

LANTERNS.

LANTERNS — THE SUSPENSION BRACKET — ORNAMENTAL STARS—BALL—SUSPENSION CHAINS—THE LANTERN.

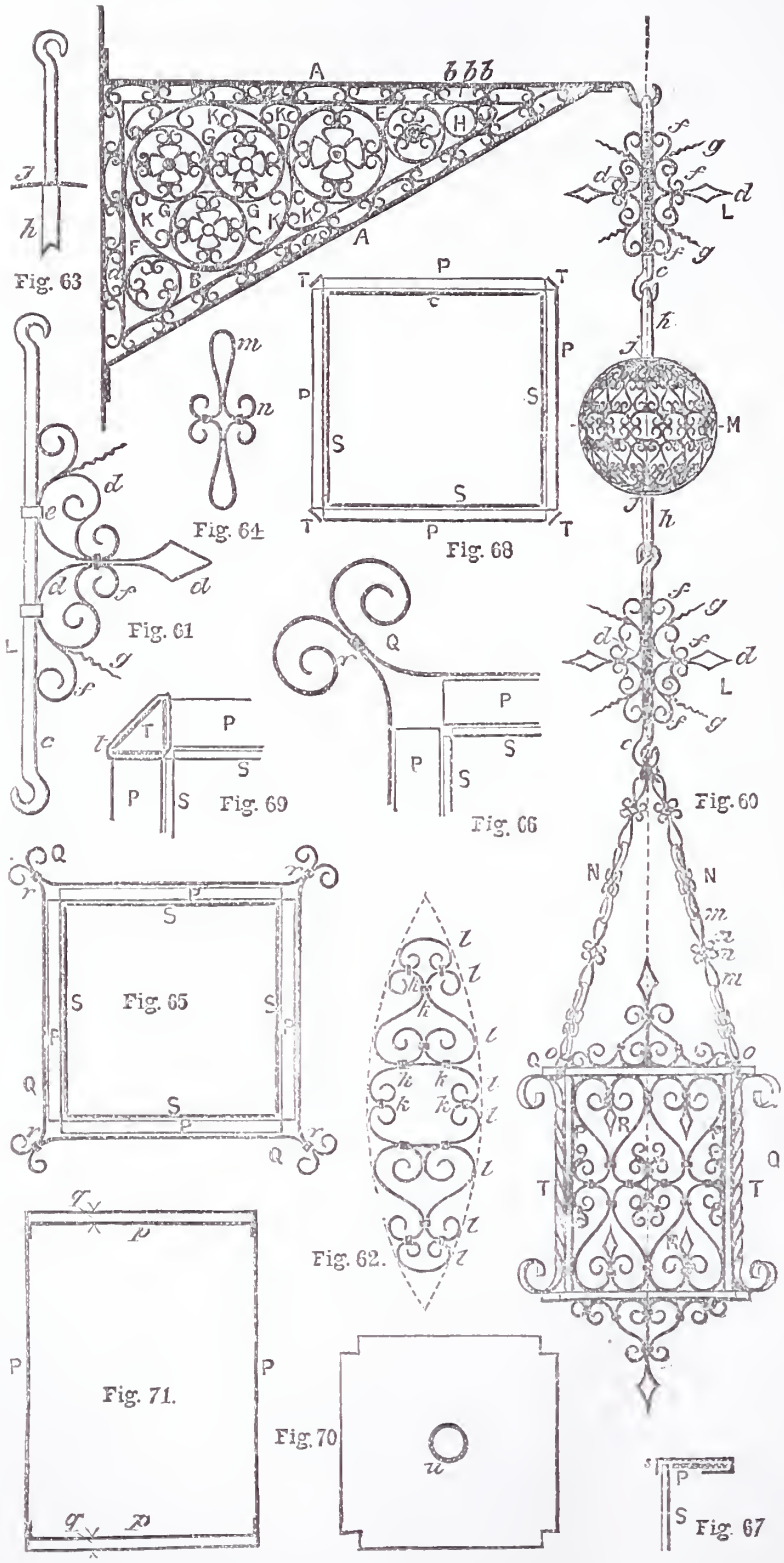
Lanterns.—Lanterns are articles that can be very prettily constructed in bent iron. They admit of many and varied designs, and their mode of suspension is generally made the vehicle of much ornamentation. In Fig. 60 I show a lantern with ornamental chains and attachments suspended from a bracket, formed mainly of scrolls and rosettes. Suppose we begin with the latter.

The Suspension Bracket.—There are two main frames, A and B, made by bending strips of iron of $\frac{1}{2}$ in. × $\frac{1}{16}$ in., or $\frac{3}{8}$ in. × $\frac{1}{16}$ in. section, into the triangular form shown in the figure. The joints may be made by lapping, or by scarfing and riveting, as already described in the description of the screen. The two frames are united with the double curves, *a*. These should be clipped at three points, *b*, *b*, *b*, to the frames. They need not be united to each other. Caution and care are requisite, as in the screen before described, to have these outer framings straight and free from winding. Then there are two large circles, C and D. These should be of the same heavy section as A and B, because a good deal of work has to be fastened to them, and they tie B together. They will be curved to lines struck on a board, or to wooden discs turned of the correct diameter. The end joints should be scarfed, and riveted or brazed. The circles should be riveted to B and to each other. The smaller circles, E, F, G, H, J, are made of the ordinary thin strips $\frac{3}{8}$ in. wide, and their ends may be united with soft solder. They need only be soft soldered to the other circles, or to B, or even fastened with the common clips. The centres of D and G are occupied with floral ornaments, fastened with double curves of bent iron to their respective circles. The flowers are cut from sheet copper, and hollowed out on a pitch block with a round-faced punch, and riveted in pairs *back to back*. The curves are clipped to their circumscribing circles and soldered to the edges of the flowers. Sundry curves, K, fill in open spaces, and serve by means of clips to render the union of the circles with the frames more complete.

Ornamental Stars.—Instead of suspending the lantern from a single long chain, the practice sometimes is to interpose several ornaments between it and the supporting bracket. In the figure there are two star-like designs, L, L, and a ball, M. The stars are easily made; the ball is rather difficult. For the stars, a central bar of iron, *c*, $\frac{3}{16}$ in., or, at the most, in. square, is used to carry the scroll-work. A hook is formed at each end of the bar by tapering down and turning round, according to the method described in p. 437, Fig. 44. Upon each bar there are four sets of scroll-work, identical in design and size. A single set is shown enlarged in Fig. 61. There is a main double curve, *d*, with a finial, one on each flat of the bar, *c*. These are united to the bar and to each other with clips at *e*, or with solder. The minor curves, *f*, are fastened to this with common clips. At *g* tendrils are brought out. These are made of the thin iron bent backwards and forwards with the round-nosed pliers. They are placed between their curves, *d* and *f*, and the clips are made to encircle the three thicknesses.

Ball.—The ball, M, is rather troublesome. It is made of several built-up pieces, which in general outline are like the surfaces of a segmented orange (Fig. 62). We proceed as follows:—First, prepare the centre-bar, *h* (Fig. 60), with hooks at each end, just as in the case of the stars, or large links, L. At the positions, *j*, *j*, on the bar corresponding with the diameter of the ball, thin circular discs are fastened. These discs are best secured by filing shallow shoulders on the bar for the discs to abut against, and securing them either with solder or with spelter (Fig. 63). The spherical curvature which is imparted to the discs will be the same as that of the ball. Now prepare a number of curves, as in Fig. 62, which represents one of the segments, of which there are fourteen, curved and united, required to complete the ball. These curves are united to each other with clips, as shown at *k*, and to their fellows on each side at *l*. The difficulty lies in imparting the spherical form to each of these segmental members and to the complete ball. Each of the members can be bent separately upon a templet ball of wood. Then during the process of union each to each, use may be made of the same templet to secure uniformity in the horizontal—or shall we say equatorial?—curves, and so on, until we have two separate hemispheres, each containing seven segmental members, and each bent by gentle pressure of the hand to the spherical form of the templet ball. These hemispheres will easily be united to each other with clips, so completing the ball.

Suspension Chains.—The suspension chains, N, for the lamp are made of bent iron. Two links are shown enlarged in Fig. 64. The links are made to engage each



Bent Iron Work. Fig. 60.—Suspension Lantern. Fig. 61.—Portion of Star. Fig. 62.—Segmental Portion of Ball. Fig. 63.—"Polar" Disc of Ball. Fig. 64.—View of Link for Suspension Chain. Fig. 65.—Plan of Frames and Horizontals. Fig. 66.—Enlarged View of Corner. Fig. 67.—Method of securing Glass to Frames. Fig. 68.—Plan of framing Glass, and Twisted Corners. Fig. 69.—Fastening of Corner. Fig. 70.—Bottom of Lantern.

with its fellow at *m*, before the scrolls, *n*, are secured to each other with clips. The rings, *o*, also are inserted before the adjacent curves are secured.

The Lantern.—The lantern, O, is made in one way out of several possible. I want, therefore, to make this the vehicle for remarks applicable to other types. In the figure the lantern is four-sided. It might, however, be triangular. It is glazed all over the sides, within the bent iron. It might be glazed with oblong slips, or with circular discs only. There is no door. It might be made with a hinged door. The chains come down to the top of the lantern, but the corners of the lantern frame could be carried up in neat curves to meet the chains. Instead of the way shown of putting the frame together, another way might be adopted.

As regards this particular example, first: There are four frames, made of $\frac{3}{4}$ in. iron (Figs. 60, 65, and 69). This may be the ordinary thin strips; but it is better to take a bit of $\frac{1}{8}$ in. square rod, heat it, and hammer it down until it is $\frac{1}{16}$ in. thick and $\frac{1}{4}$ in. wide. This will then make quite a substantial framing that can be manipulated with perfect freedom, without risk of distortion. Inside each frame, at top and bottom, and at a distance of $\frac{3}{8}$ in. along, a strip of thin iron, *p*, is fastened by turning down, and soldering in the ends. These receive the clips that attach the scroll-work at top and bottom, and the $\frac{3}{8}$ in. width is covered over by the strips, Q, that bind the frames, O, together.

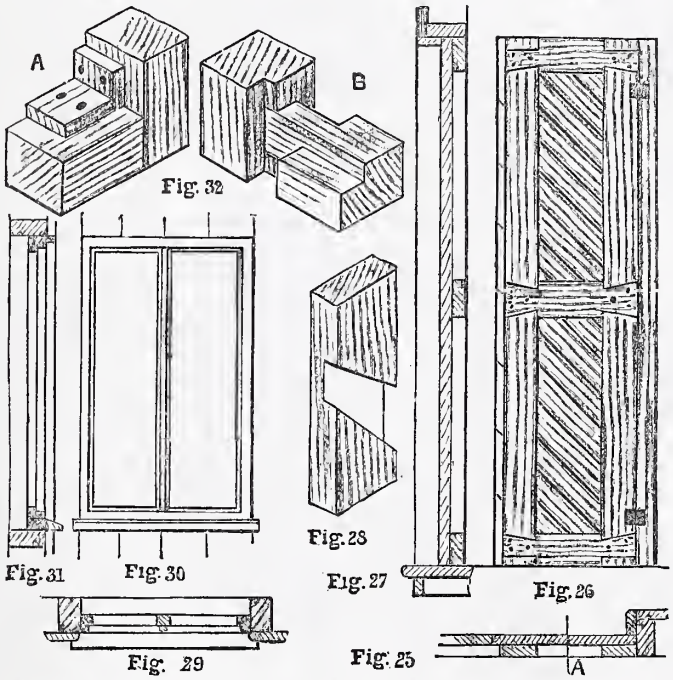
The frames are filled in with scroll-work, R. The main scrolls are fastened with clips to the frames at their points of mutual contact, and to each other also. The minor scrolls are united to the others with clips. These frames can be united to each other in several ways. In this example the horizontal strips, Q (see also the enlarged view, Figs. 65 and 66), act as binders, embracing the frames, being themselves held at the corners with clips, *r*. It will also prevent movement of the parts if a little solder is run between the faces at P. The horizontal strips must be secured to the frames with clips or with fine wire—the former looks more in keeping with the rest of the work.

Some finish is required at the corners formed by the meeting of the frames. That shown in Fig. 60 will look very well. It is simply a double-ended scroll, T, of $\frac{1}{4}$ in. iron, with its shaft twisted with the pliers. In Figs. 68 and 69 the scroll, T, is shown in the section of the thin iron near top and bottom, where it is clipped to P, P, with clips, *t* (Fig. 69). A little ornamentation at top and bottom completes the lantern framing. The scrolls at top and bottom are in harmony with those in the panels. They are fastened with clips similarly to the others.

Within the lantern frames oblong plates of coloured glass, S, are placed. They are secured with clips, as seen in Fig. 67, the ends, *s*, being turned down carefully after the insertion of the glass slips. Four clips—two at top and two at bottom—are sufficient to hold the glass securely.

In Figs. 65 and 66 the relative positions of these several parts are clearly seen, the outer frames, P, the horizontal binders, Q, and the glass, S. These parts are, of course, in contact, though in the figure they are shown separated a little. I have shown them like this in order to make the division between the separate parts quite clear.

I have not yet said anything about the bottom of the lantern. This should properly be cut to fit within the frames, P; in Fig. 70 the plan view of the bottom is shown. It rests on the inside of the bottom bars of the frames. It may be made of thin iron, brass, tin, zinc, or copper. No fastening is necessary, only it must be inserted previous to the fastening together of the frames with the top and bottom horizontals, Q. Upon it may be soldered a candle socket, *u*, or a small oil lamp be stood upon it. This completes the lantern. I will show an alternative method in my next and concluding paper.



Carpentry for Boys. Fig. 25.—Half Plan of Door. Fig. 26.—Back Half Elevation. Fig. 27.—Section at A. Fig. 28.—Joint of Rails and Stiles. Fig. 29.—Plan of Sash. Fig. 30.—Elevation. Fig. 31.—Section. Fig. 32.—A, B, Joints of Corner.

CARPENTRY FOR BOYS.

BY McDONALD.

CONSTRUCTION OF SHED DOOR—CONSTRUCTION OF WINDOWS — REMARKS ON OTHER CONSTRUCTIONS.

REFERRING to the sketches, it will be seen that the construction for our shed door is very simple, but quite substantial. It is in two leaves, or halves, one of which only is shown, the other being just the same. The back frame is made out of $3\frac{1}{2}$ in. × $1\frac{1}{4}$ in. stuff, dovetail-halved at the joints, and the boarding $\frac{7}{8}$ in. or so thick, laid diagonally, and nailed on the face. Dovetail-halving is not a difficult joint to make. The rails are gauged, shouldered, and cut out, as shown for square halving. They are then tapered or dovetailed, as at Fig. 26, laid on the stiles in position, and marked. The stiles are cut out, as in Fig. 28, to receive them. The frame is screwed together, and if necessary, flushed off on both sides by the jack-plane and trying-plane, after which the boarding is nailed on. The door is kept flush at the central joint when closed, by allowing the boarding to project $\frac{3}{4}$ in. or so over one leaf, and keeping it a corresponding distance back on the other. It is hung with strong back-fold hinges, flush with inside of door-post, and a piece of boarding, made flush with outer face of shed and chamfered, is nailed round on the posts and lintel to stop it. It will require a lock and a couple of slip bolts; but the fixing of these, especially the former, need not be detailed here, as our youth should get some assistance from a practical man with them. In fitting the door, care must be taken to give sufficient clearance all round.

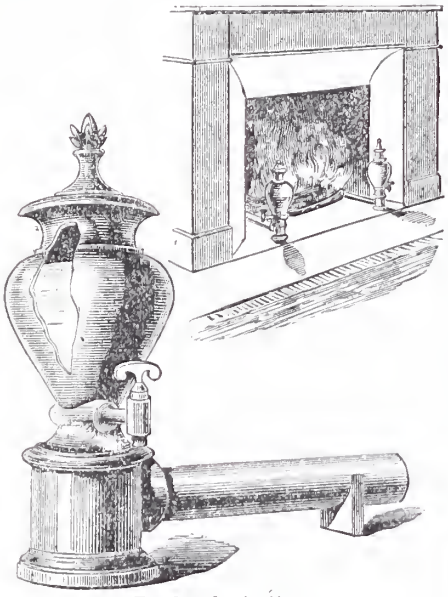
Construction of Windows.—The windows, or rather the sashes, should be constructed, as at B (Fig. 32), with mortise and tenon joints, and the glass rebate or check taken out of the solid timber. This would necessitate the procuring of a back check—an expensive tool—with which the young worker can well enough dispense at this stage. Accordingly, the alternative construction in the same figure is given. This consists of a frame mortised and tenoned together, of sufficient dimensions to fill a window space, and pieces to form the glass check nailed on. The stuff for the frame may be 2 in. × $1\frac{1}{2}$ in., and that for the fillets $1\frac{1}{2}$ in. × $\frac{1}{2}$ in. or so; all to be dressed, squared, and gauged. The bars or divisions for the glass must be treated in the same manner. It should be noticed at B that when a mortise is at the end of a piece the tenon is rebated, so as not to come through the end. All mortised and tenoned frames, whenever practicable, ought to be cramped up, and pinned or wedged if the tenons go through. If pinned, these should go through the centres of the tenons; if wedged, allowance must be made in the backs of the mortises for wedge-grips. In inside work mortises and tenons should be glued; in exposed or outside work white-leaded. It will be observed from Fig. 31 that there is a small sill under each sash projecting, and weathered to take away the rain-water. There are also narrow stops nailed round the sides and lintels, finished flush with outside of shed boarding and chamfered similar to those for the door.

Remarks on other Constructions. — The youthful worker will now begin to perceive that there are many ways of doing work, all of which are employed as circumstances demand. Thus our sashes might have been checked or halved at the joints, and the door might have been mortised and tenoned. In fact, this is how they would have been made had it not been for the purpose of showing variety of construction. Also the bench and trestles could be fixed together by one or other of these methods, instead of being nailed only. But these are matters of judgment and discretion. Our young friend, when he gets a little more familiar with the craft, will see which method answers best for a certain job, and so on. We will only say here that for movable or portable work mortising and tenoning are best; for stationary work or fixtures, checking, halving, or even nailing only, is sufficiently substantial. Taste also plays a part. The joints should be hidden as much as possible. For instance, had it not been for the reason already stated, our door should have the

board nailed on the side of the frame exposed to view, instead of as it is. But, whatever the method of construction may be, the worker should endeavour to make a sound and pleasing job of it; for anything worth doing at all is worth doing well.

TEA-KETTLE ANDIRON.

The apparatus represented herewith is, in America, replacing with advantage the tea-kettles that are usually placed before the fire in order that hot water may always be at one's disposal. This andiron is entirely hollow, so that it may be filled with water.



Tea-kettle Andiron.

A cock placed at the side permits of drawing off the water in measure as it is needed.

If it is desired to convert the apparatus into a hot-water bath, it is only necessary to remove the cover and to immerse in the boiling water the vessel containing the liquid to be heated. It is very easy to give the apparatus an artistic form that will permit of its being utilised in any fireplace.

HOW TO MAKE AND WORK THE SPECTROSCOPE.

BY CHARLES A. PARKER.

Supporting Stand of Spectroscope—Selection of Wood—Triangular Base of Stand—Table Top—Supporting Arms for Telescopes—Table for Prism—Supporting Pillar—Fitting Stand Together—Supporting Collars for Telescope Tubes—Clamping Plate and Nut for Movable Arm—Black Enamel for Stand—Polishing the Brasswork—Dead Black for Interior of Tubes—Lacquering the Brasswork.

We now come to the stand on which the collimator and telescope are supported. In the more expensive instruments this generally forms an important part of the apparatus, being one on which a considerable amount of care and ingenuity are usually expended. The stand illustrated in the accompanying diagrams, while being simple and easy to make, will be found to possess perfect rigidity combined with a good appearance. The most suitable wood to employ for the supporting pillar, the table top, and the triangular base, will be well-seasoned yellow pine for the former, and Honduras mahogany—sometimes called baywood—for the latter, each kind being straight grained and free from knots or shakes. With reference to the baywood, the pale description should be selected, as this is easy to work and not liable to warp or shrink. It should, however, be of a uniform colour, and not streaked with two different shades of red, the same remarks applying equally to the yellow pine. Beech or pine is unsuitable for our purpose, as this wood is liable to warp out of shape. If it is obtainable, nothing could be better than a leaf from a disused table or similar piece of furniture for the table top and the base, as a board of this description will sure to be thoroughly well seasoned, and will, moreover, require little or no preparation. Before proceeding further, make a full-size paper plan of the triangular base shown in Fig. 24. To do this with accuracy, first draw on a sheet of paper of suitable dimensions an exact triangle, the outside size of the base, which is 14 in., and then bring three lines to the centre, one from each angle, after which a 4 in. circle should be struck out from the centre with another smaller circle $1\frac{3}{4}$ in. in diameter at the apex of each of the angles. A line is now drawn at an equal distance from the central line on either side to join the outer and inner circles, tapering from 1 in. at the end to 2 in. in the middle, and finally a 1 in. circle is drawn exactly in the centre of the plan in order to indicate the position of the hole to receive the projecting pin of the supporting pillar.

Having selected a suitable board, which should be $\frac{3}{4}$ in. thick, proceed to carefully dress up the surfaces as true as possible, and, when quite ready, paste or gum the paper pattern on the best side of the wood, and afterwards saw the board to the exact outline by means of a fret or a bow saw, great care being taken not to splinter or otherwise damage the wood during the process of sawing. When the wood has been cut to the form of the pattern, the various sawn edges may be carefully smoothed by suitable paring tools, and then finished off by means of glass-paper, which should be glued on to a piece of cork or wood in order to preserve the edges of the wood.

For the table top we shall require a piece of $\frac{1}{2}$ in. mahogany, which should be dressed up with the same amount of care as before; but this time we shall not require any paper plans, as it is of much more simple construction than the base. With a pair of compasses strike out an 8 in. circle on the surface of the wood to indicate the diameter of the table, and then, without removing the compass leg from the centre, strike out the quarter of a circle $\frac{1}{8}$ in. inside the other, and then another at $\frac{1}{4}$ in. from the previous line in order to mark the position for the slot of the clamping screw, after which a final circle, 1 in. in diameter, is marked in the centre, as will be understood by reference to Fig. 25. Now, by means of a fret-saw, cut the wood to the form of the outer circle, and then cut the inner slot, and lastly remove the 1 in. circle in the centre, afterwards smoothing the sawn edges in the usual manner.

This done, we shall now be ready for the two supporting arms of the brass tubes, which are sawn from a piece of $\frac{3}{8}$ in. wood to the form of Figs. 26 and 27, the measurements being 6 in. by 2 in., and 8 in. by 2 in., with one end of each rounded off carefully, and a 1 in. hole at the end of the 8 in. arm. We must also prepare a 2 in. circular disc of wood of the same thickness to form the table for the prism, as shown in Fig. 28, after which a couple of shaped supporting arms should be sawn to the plan of Fig. 29, the length being $5\frac{1}{4}$ in. and the width 1 in., which is gradually shaped off to $\frac{1}{2}$ in. at the end, a piece of the wood from the straight-edge, measuring $2\frac{1}{2}$ in. by $\frac{1}{2}$ in., being removed to allow for the thickness of the table top.

The supporting pillar is now turned in a lathe according to the section shown in Fig. 30, the length being 12 in., with a pin 1 in. in diameter at the top, and a similar one 2 in. in diameter at the bottom. The base of the pillar may measure 4 in. in diameter, tapering to 3 in. at the top. As soon as this pillar has been finished, three knobs or supporting feet for the triangular base should be turned in a lathe to the form of Fig. 30, and then secured to the under side of each leg of the base. These feet should measure 2 in. in diameter, and may be turned from a piece of mahogany to $\frac{3}{4}$ in. thick.

Everything being ready, the stand may now be put together in the following manner. Having first affixed the three feet to the under side of the triangular legs of the base, proceed to fit the lower pin of the central pillar into the opening in the middle of the base, gluing, and afterwards securing it in position by means of three 2 in. screws driven in from the under side of the base into the broad part of the pillar, the wood being previously countersunk to take the heads of the screws. Now affix the table top to the upper end of the pillar in a like manner, and then slip the larger arm in position with the hole in the rounded end of the latter, put over the projecting pin of the pillar, after which the small supporting table for the prism is glued on to the top of the projecting pin previously accurately levelled to receive it. Screws or nails should not be driven through the table, otherwise they will spoil its appearance, and it must be so arranged as to come down quite close on to the movable arm, only just sufficient freedom being allowed to the latter. It will be found a good plan to glue a small curved strip of chamois leather to the under side of the movable arm in the position indicated by the dotted lines in Fig. 27, as this will enable it to be slid smoothly over the surface of the table. Another piece of leather cut to the form of a ring may also be glued to the under side of the prism table, which will enable the arm to move with greater ease and freedom. The other arm is now screwed to the table from the under side on the opposite side to the slot, as will be seen by referring back to Fig. 3, after which the two shaped supports are glued to the underneath of each of the arms, thus completing the stand.

We are now ready for the four collars which are attached to the wooden arms for the purpose of supporting the tubes. For each of these file up a moderately stout plate of brass to measure 1 in. by $\frac{3}{8}$ in., drilling a hole in the centre and one on either side; then cut off a $\frac{7}{8}$ in. length of $\frac{1}{4}$ in. brass rod, and having first filed a slight shoulder at either end, rivet this into the central hole of the plate just prepared, after which a $\frac{1}{2}$ in. ring of brass tubing, $1\frac{3}{4}$ in. in diameter, is trued up in a lathe and provided with a couple of holes exactly opposite to each other, being afterwards riveted to the other end of the stem of the plate, thus completing the collar, as shown in plan and section in Fig. 32. A small brass screw, with a nut to fit, is now soldered over the hole in the top of the ring, and a narrow strip of chamois leather must be glued round the inside in order to form a soft bed on which the tube

may rest, after which the four collars may be attached to the two wooden arms of the stands by means of short spherical-headed brass screws.

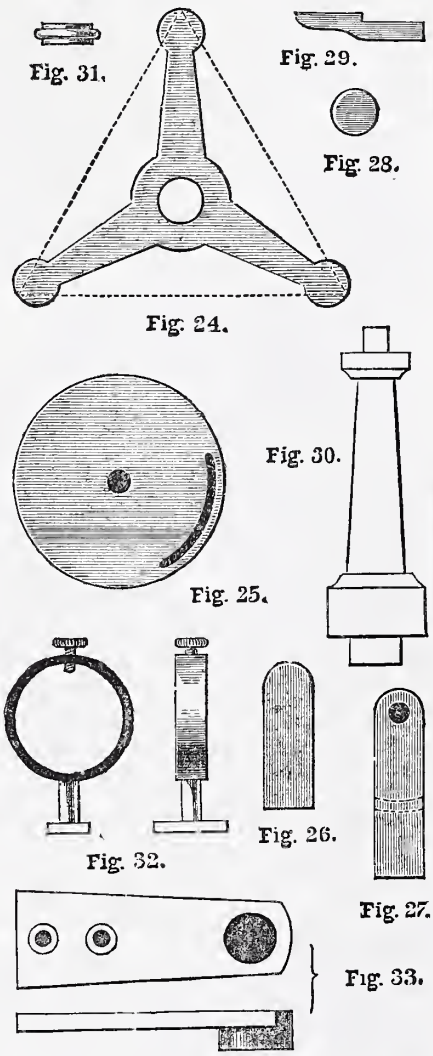
We must now prepare the clamping-plate and screw by which the adjustment of the movable arm is effected. For the plate, file up a piece of stout brass plate to the form of Fig. 33 until quite square and true to measure 1½ in. by ½ in., afterwards drilling three holes in the position shown in the cut. Now procure a clamping-screw and nut, which may be the same size and form to the regulating screw of the collimator. Solder the nut to the under side of the plate just made, and then screw this to the movable arm with the nut in position just over the slot in the table top, so that the clamping-screw can be passed through the latter and screwed into the clamping plate.

When completed, the stand may either be French polished or varnished, according to the taste or ability of the maker. In any case it will be found advisable to have the table top and the supporting arms carefully French polished, but the central pillar and the triangular base may, with advantage, be enamelled by "Palmer's black enamel varnish," which is a quick-drying spirit enamel. It is sold by Messrs. Palmer & Co., 78, Old Street, St. Luke's, London. A sixpenny bottle would be ample for the present work.

It will now be time to polish and lacquer all the brasswork, including the tubes, the collimator hood, the two clamping-screws, the clamping-plate, and the supporting collars of the two tubes. The brasswork should first be gone over with Oakey's emery paper in the following degrees of fineness—No. 1, F, FF, and O, after which a brilliant lustre is brought up by the use of crocus powder or one or other of the many excellent polishing pastes at present sold. The writer can personally recommend "the Universal metal polishing pomade," which will soon bring the surface up to a burnish-like brilliancy. It is sold in small tins at 1d. each, and can be had from ironmongers and oilmen, and some cyclists' emporiums. In polishing the work, the strokes should always be taken lengthwise, and it will be necessary to be particular and keep all the polishing materials distinct from one another.

When the polishing process is complete, the interior of all the tubes will require to be painted with a dead black varnish applied by means of a flat camel-hair brush. The dead black can be readily prepared by mixing ivory black with a small quantity of spirit varnish or French polish, and afterwards diluting it with methylated spirit until it dries with a good dull black surface, the exact proportion of spirit and black being ascertained by trial on waste pieces of wood. An excess of varnish will cause it to dry with a glossy surface, which may be remedied by the addition of a few drops of methylated spirit.

The various pieces of brasswork should be lacquered as soon as possible after having been polished, as they will soon lose their brilliancy by exposure to the air. It is also necessary to guard against handling the freshly polished surfaces, otherwise unsightly marks will appear on the surface of the metal. It is safest to handle the freshly polished work by means of pieces of wood. When ready to lacquer, about three-pennyworth—usually an ounce—of golden lacquer should be poured into a small pot or cup, across the top of which a string has been stretched for the purpose of wiping off any excess of lacquer from the brush. Now heat the article to be lacquered to about the temperature of boiling water, or until just too hot for the hand to bear, and then lightly draw a flat camel-hair brush—previously dipped in the lacquer—rapidly, and yet not hurriedly, lengthwise across the freshly polished surface of the work, care being taken not to stop once, otherwise an ugly mark will result. If the brush is laid on with a slightly curved motion at the beginning of the stroke, it will be possible to avoid the lacquer running over the sharp edges, and



Spectroscope. Fig. 24.—Plan of Base of Stand. Fig. 25.—Plan of Table. Figs. 26, 27, 28, and 29.—Plans of Table, Supporting Arms, Prism Table, and Shaped Supports for Arms. Fig. 30.—Supporting Pillar of Stand. Fig. 31.—Foot for Stand. Fig. 32.—Front and Side Elevation of Supporting Collar. Fig. 33.—Plan and Section of Clamping-plate.

it should always be taken over the surface in one uniformly steady sweep, and then raised the instant it reaches the opposite edge. Practice alone can make perfect, but it is, nevertheless, satisfactory to remember that a spoiled coat of lacquer can be removed by boiling the work in a lye composed of pearlash and water.

Smokers can mend their pipes with a paste made of plaster-of-Paris and water, and used immediately, as it hardens very quickly. But the best cement for the purpose is by dissolving ordinary glue with a little acetic acid.

TRADE: PRESENT AND FUTURE.

*** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

Iron and Steel Trades. — The improvement recently noted in the Sheffield iron and steel industries is still shown. There is a good demand for railway wheels, tires, springs, and axles. There is, however, much hesitation on the part of customers, who still appear to be waiting for a fall in coal. This is not to be counted on, as until there are no signs of trouble in the coal trade, the market will not settle down. Hematites and Bessemer are unaltered in prices. Crucible steel is in small request, but file material and shear steel for cutlery shows a slight improvement. The first consignment of American pig iron, of 200 tons, for England, has been despatched from the "other side" for Liverpool. An *ad valorem* duty of fifty per centum would effectively stop this new business departure. Our Manchester correspondent writes:—The Lancashire steel trade remains in a very depressed state, and exceedingly low prices are quoted for orders of fairly large weight. Prices for best steel boiler plates range from £6 15s. to £6 17s. 6d. The volume of business being done in both raw and manufactured material is quite insignificant. In the latter branch, increasing competition by the German and Belgian makers renders orders for shipment difficult to obtain. Prices generally remain unchanged.

Boot and Shoe Trade.—In Liverpool a fair amount of business is being done in the retail trade, but wholesale houses are in want of orders.

Plate, Cutlery, and Scissors Trades.—The silver plate and electro trades are not fully employed. The cutlery trade shows a slight improvement. There is a better feeling in the scissors trade. Messrs. Parkin & Sons, who have the Sheffield agency for Messrs. John Waine & Sons' new method of making scissors, are busy.

Flannel Trade.—This holds its own very well.

Chemical Trade.—The price of bleaching powder has now fallen to its former value of £7 10s. per ton; owing to the cholera scare, large quantities of this commodity have been shipped to American and Continental ports. Caustic soda, 74 per cent. is sold at £11 5s.; 70 per cent., £10 5s.; 60 per cent., £9 2s. 6d., f.o.b. Recovered sulphur is steady and in fair request at £4 12s. 6d. Chlorate of potash, scarce, at 7½d. per lb. Chlorate of soda, 8½d. per lb. There is no improvement in the price of sulphate of copper, £14 15s. to £15 per ton being the figure. White arsenic is firm at £12 10s.

Cotton Trade.—Our Rochdale and district correspondent writes:—The crisis has come to a head, and though the members of the Masters' Federation in this town have decided, without a single exception, to continue to run their mills and pay the fine (½d. a spindle, or £5,000 per week) for doing so, this is not the case in the surrounding district, and ere this is in print there will be from 50,000 to 60,000 operatives out on strike, the whole of whom will be drawing pay from the several societies. The proposal to decide the matter by arbitration, as proposed by the Mayors of Liverpool and Manchester, and agreed to by the Masters' Federation, was curtly rejected by the operatives, the letters sent being couched in most insulting language; so that if the working class suffer by the strike, it is their own, or rather their advisers', fault.

Shipbuilding Trade.—Messrs. Laird & Co., of Birkenhead, have at the present time on the stocks three vessels for the Royal Navy, three vessels of war—two being powerful ironclads—for foreign Powers, and a despatch boat for the Indian Government. The Liverpool freight rates remain about the same, most business, at present, being between Black Sea and Baltic ports.

Armourplates and Warship Material Trade.—In a speech of Lord Brassey at the "Banquet of the North," some passages occurred which will be interesting to armourplate manufacturers and others. He remarked: "Assuming the expenditure on naval construction will be maintained for the present, we may expect to find, in the forthcoming programme, ships of more moderate dimensions than those of the Hamilton programme, which included eight ships of no less than 14,159 tons. The larger vessels have their merits, but we have two ships building, of the *Barfleur* type, which combine the excellent qualities of speed, coal-carrying, armament, and armour within the limit of 10,500 tons. While adding to our strength in battle-ships, we must not neglect to supply an adequate number of cruisers, and the sea-going torpedo catchers and torpedo vessels."

NOTICE TO READERS.

Next week's Work (No. 193) will contain, among other illustrated papers, the following:—

Plumbers' Papers—Wiped Joint Making.
Light for Lanternists.
Stained Glass Window Making.
How to Make a Snow Sledge.
Roadways and Horseshoes.
Childrens' Walking Appliances.
Japanese Domino Game.
Seam Iron for Tailors and Sempstresses.
Electricity Influence on Watches.
Glue for Glass and Porcelain.

*** The Editor makes this intimation in the hope that readers, having friends interested in any of these subjects, will bring the same to their notice.

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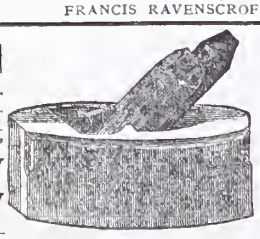
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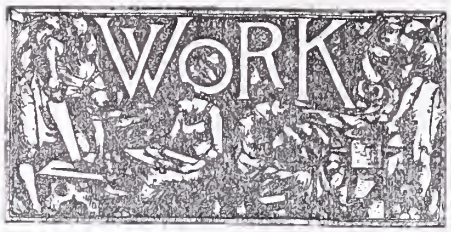

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*** Advertisements should reach the Office fourteen days in advance of the date of issue.

*** All letters suggesting Articles, Designs, and MS. communications for insertion in this Journal will be welcomed, and should be addressed to the Editor of Work, Cassell and Company, Limited, London, E.C.

NOTICE.
WORK correspondents are wanted in every Town.

Emigration to Brazil.—A contract has been signed between the Brazilian Government and a private company for the introduction of 1,000,000 emigrants from Europe and the colonial possessions of Spain and Portugal into Brazil. Under these circumstances, it is advisable to give a word of warning to such of our workers as might be tempted to try their fortune in South America. Under clause 10 of the contract, immigrants are to be taken to Pernambuco, Pahia, and Victoria, all three places being on the tropical part of the Brazilian coast. The climate in most, if not all, parts of the country is wholly unsuited to British emigrants, and the population, language, laws, habits, and modes of life and work are all alike strange to labourers from Great Britain and Ireland. However great may be the natural resources of Brazil, experience has abundantly proved that the country is wholly unsuited to the British workman; it is therefore sincerely to be hoped that our artisans will not be tempted by offers of free or assisted passages or grants of land to go out to that country.

Winter Distress.—There is little doubt that we are verging upon a winter when the pinch of poverty will be more than usually felt by those most concerned—so depressed already are many branches of trade upon which the working classes depend. Before the misery arising out of bad trade, depressed industries, and strikes is actually upon us, it behoves parish authorities and others responsible for the employment of labour generally to look ahead and prejudge, as far as possible, the probable danger looming in the near future in the cry of the unemployed, and to prepare for it. Distress arising from lowness of wages and no work is chiefly present in large towns and labour centres. Here local bodies might do much to ward off not a little of the immediate distress when it presents itself, provided they were forewarned and forearmed. As a rule, however, the reverse is the case. Vestries, local boards, and councils ought to face the question ere the troublous times set in. They would be doing some real good for those who, it is all but certain, will be requiring work this winter; and in addition be affording temporary satisfaction to peaceable citizens and shopkeepers, who are naturally concerned at the gloomy possibilities which threaten, and which every winter seem to intensify, from the great unemployed community. By planning out work ahead, the authorities might appreciably diminish much of the misery which is the portion of the lower classes during British winters, especially in towns. Streets, open spaces, roads, and the pavements could be sensibly improved and rendered safer by methodical cleaning during the winter, and this with little more cost to the ratepayers. Further, by arrangements with householders, much work such as window-cleaning, boots, messages, etc., might be found for poor people whose antecedents could be guaranteed by parish and police authorities. Much more might and ought to be done for the poor during our stern winters; much which so far has never been attempted is possible to ameliorate the distress of winter among the poor, and to stop the "We've-got-no-work-to-do" cry, only those in power must look forward and see where work will be needed. The call for energy and action in this winter distress question is sure to arise again this year, and those whose duty it is to cope with these social questions should now be preparing for the increasing rumblings from the comparatively dormant unemployed element, by providing against the lessening opportunities that the trade of this country provides for the hands and brains of its teeming working thousands.

Costers.—This question is one of great importance to the artisan population, inasmuch as it is from that population that the coster draws his customers. The reason is obvious—the coster's prices being always beneath the shopkeeper's; and where incomes are so slender that every penny has to be weighed before it is spent, this is a most important consideration. Of course, the shopkeeper will tell you that the coster has no rent to pay as he himself has, and that it is thus a very simple matter for the coster to undersell him. This is doubtful; still, as we are looking at this question from an entirely working-class point of view, we shall grant the shopkeeper's argument. "You have rent to pay," says the working-man's wife to the greengrocer; "and that is why you charge three ha'pence a pound for the same potatoes as Bill, the coster, serves me with at a penny. That extra ha'penny is for your rent? Now, why should I have to pay your rent? I have my own rent to pay, and that is as much as I and my husband can afford. If shopkeepers choose to take high-rented shops, why should we working-men and women have to pay it for them? We can't get a rise in our wages whenever we choose to move to a higher-rented house, or whenever our landlord raises our rent." That would be a very fair argument in the mouth of a working-man's wife, and one that the shopkeeper would have as much difficulty in answering as the authorities seem to have in clearing the costers from our streets. The fact is, the coster is as necessary as any other form of competition, and instead of driving him away, the authorities should seek rather to regulate him.

HOW TO MAKE AN EFFICIENT BATTERY FOR ELECTRICAL PURPOSES.

BY G. E. NEWLAND-SMITH.

INTRODUCTION—VARIOUS BATTERIES—DANIELL'S BATTERY—SMEE'S CELL—GROVE'S BATTERY—BUNSEN'S BATTERY—BICHROMATE BATTERY—LECLANCHÉ'S CELL—AMALGAMATING ZINCS—MATERIALS—SUPPORTING BEAMS AND PLATES—STAND AND JARS—LIFTING ARRANGEMENTS—CONNECTING-UP—OHM'S LAW—THE SOLUTION FOR CHARGING BATTERY—CONCLUSION.

JUDGING from the numerous queries in various scientific papers, it appears that a knowledge as to how to construct a battery suitable for the all-round purposes of the general experimenter in the science of electricity would be most welcome and useful to many. I therefore propose to describe how to make a four-cell chromic acid battery in a polished wood tray, and with a lifting arrangement for raising the plates when the battery is not in use.

The battery, when made, will be most useful for all kinds of electrical experiments—such as lighting small lamps, working coils, motors, electro-magnets, decomposing water, firing fuses, etc.; and anyone who carefully carries out my instructions will have the satisfaction of knowing that he possesses a really good and scientific piece of apparatus, and not a mere toy.

The battery will not cost more than 5s. or 6s. to make, although it would cost about a guinea to buy; also, it is one of those pieces of apparatus—unlike most—which is as good when home-made as it is when bought at a shop.

Before commencing the description of the battery itself, it would be as well to describe briefly some of the most general forms of battery now in use.

Daniell's Battery consists of a copper cylinder for the *negative* element, inside which is a cell of porous earthenware. A zinc rod inside the porous cell forms the *positive* element. Terminals are attached to the copper and zinc for convenience in connecting-up. No containing cell is necessary for this battery, the copper cylinder, being closed at one end, forming one. The outside cell is charged with a saturated solution of sulphate of copper, and the porous cell with dilute sulphuric acid. This cell is remarkably constant, and is used for electro-plating on a small scale.

Smee's Cell.—This cell consists of a plate of platinised silver for the *negative* element, and two plates of zinc for the *positive* element. These plates are suspended by a wood bar in an earthenware cell, which contains dilute sulphuric acid as the excitant. This battery is fairly constant, only requires one exciting fluid, and is easily managed. It is not, however, suitable for the general experimenter.

Grove's Battery has for its elements platinum for *negative* and zinc for *positive*. The outer cell is charged with sulphuric acid diluted with water, in which is the zinc. The porous cell containing the plate of platinum is filled with nitric acid 3 parts, and sulphuric acid 1 part. The zinc is usually in the form of a U, by which means the zinc plate is brought opposite each side of the platinum plate.

Bunsen's Battery.—The elements of this battery are zinc for the *positive* and carbon for the *negative* element. A porous cell is required, in which the exciting fluids and general arrangements are similar to that of Grove's.

Bichromate Battery.—Since this is the battery we are going to manufacture, nothing will be said of it here, except that it is the best battery for general use.

Leclanché's Cell is the one used for electric bells and telephones. It is admirably suited for such work, as it will give out a current at intervals—such as is used in making an electric bell ring or speaking through a tele-

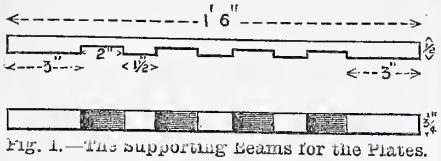


Fig. 1.—The Supporting Beams for the Plates.

phone—for several years without attention; but it is not suitable for general electrical experiments, on account of its high internal resistance, and consequently low current, besides its inability to give a *continuous* current. There are two cells employed for this battery. The outer one (of glass) contains a zinc rod, and is charged with a solution of sal-ammoniac; the inner (of porous

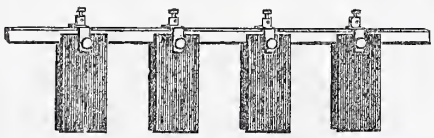


Fig. 2.—Supporting Beams with Plates fitted and clamped.

earthenware) contains a carbon plate, and is filled up with a mixture of peroxide of manganese and broken gas carbon.

The zinc plates of the bichromate (or chromic acid), Smee's, and Bunsen's battery, etc., should be *amalgamated* with mercury previous to use, and will require re-amalgamating from time to time. The process is effected as follows: Place the plates (pre-

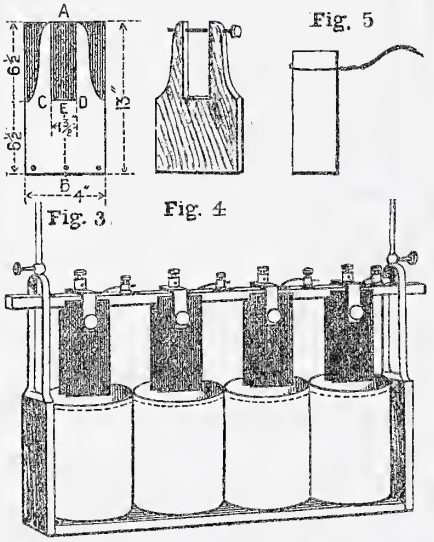


Fig. 3.—Plan of End Standard before cutting. Fig. 4.—Simple Method of suspending the Plates when out of the Solution. Fig. 5.—Zinc Plate with Wire attached ready for connecting-up. Fig. 6.—The Battery Complete.

viously well cleaned) in a shallow dish, containing sulphuric acid 1 part, water 20 parts; pour upon the zincs a globule or two of mercury, and rub it over them with an old tooth-brush until they present a silvered appearance. They are then ready for use.

The above are the most general forms of galvanic battery. There are also many other cells that have been invented and used, but in most cases have not been a success for useful work—except, perhaps, the E.S. dry cell, which is very good indeed for small plating, coil, and bell working.

Cells which are charged with one solution, and have no porous pot, are termed *single-fluid cells*, and cells with two solutions (and porous cells generally) are termed *double-fluid cells*. The double-fluid cells are more constant than the single-fluid, but are not so powerful.

Having given these preliminary details, I will commence on the battery which we are to manufacture.

Materials.—*8 carbon plates, 6 in. by 2 in. by ¼ in. thick; *4 zinc plates, 6 in. by 2 in. by ⅛ in. thick; some ½ in. planed deal board; *4 brass clamps; *3 small binding-screws; *1 large binding-screw; copper wire; ⅛ in. brass rod, and steel wood screws.

All the above marked thus (*) are to be obtained at an electrical shop. Carbons can be got as cheap as 2s. a dozen, although many shops would ask 6d. each; zincs can be got for 2d. or 3d. each; clamps, 6d.; small binding-screws, 2d. each; large one, 6d.

While on the subject of prices, I will give the amateur electrician a hint—never deal with one shop only, unless you have unlimited cash. The reason is, that one shop can supply carbons twice as cheap as another, while the other's price for wire is as cheap again as the first's. Now to proceed.

Take two strips of wood, 18 in. long, ¾ in. wide, and ½ in. thick, nicely planed and sand-papered. In each strip, on the ¾ in. side, cut four 2 in. slots. These slots are to be ¼ in. deep and 1½ in. from each other, leaving 3 in. of wood at each end (see Fig. 1). The slots are for the carbon plates to fit into. Now place the supports, as the strips will now be called, back to back, with the slots outwards, and fit a carbon plate into each slot on both sides, a pair of carbons being opposite one another. Between each pair of carbons, and clipped in place by the two flat sides of the strips, is to be placed a zinc plate. There are now four sets of two carbons and one zinc, arranged sandwich-fashion, with the zinc in the middle. On the top of each set screw a brass clamp, to keep the whole together (Fig. 2).

The wood strips serve to keep the plates from contact; which has to be done, or else the battery would *short circuit*, and not work. The clamps, which are made with terminals or binding-screws on their upper surfaces, form a connection with the carbon plates. They should therefore be screwed up tight, taking care that the plates do not touch. They should be about ⅛ in. to ¼ in. apart at the ends, and, of course, about ¼ in. at the top.

We will now put the supporting beams and plates aside, and turn our attention to the stand. To this end, we take a piece of deal 3 ft. 6 in. long by 4 in. wide, nicely planed and sand-papered, and from it cut two pieces 13 in. long. This leaves us a piece 16 in. long for the base of the stand, the two 13 in. pieces being for the standards at each end. Take one of these latter pieces, and rule a line lengthways down the middle (Fig. 3). From one end mark off along this line (A B) 6½ in., as shown in the figure, and at right angles to the line draw a line 1⅜ in. long (C D), equidistant from each side of point E (6½ in. from A).

Rule lines from each end of C D to top of standard. To make it look ornamental, draw curves as shown, and then cut away all the shaded parts of Fig. 3, leaving a flat standard with a 1⅜ in. slot cut 6½ in. down the middle of the top half, which is

cut into an ornamental shape, as shown. Do the same with the other 13 in. strip, and make them exactly alike.

Now take the 16 in. piece, and screw these two standards to each end (upright), using three 2 in. steel screws at each end, as shown at Fig. 3, the standards being perfectly perpendicular to the base. This part of the stand is now finished, and may be stained and polished as desired, a walnut stain being very suitable.

Procure now four stoneware cells or jars, 6 in. high by 3 in. or 3½ in. in diameter. Put these next one another on the base of the stand. Now place the supports and plates—which latter go into the jars—into their places, the end of the beams resting in the slots of the standards, up and down which they are to slide. When the battery is working, the plates, of course, dip into the jars, which are full of solution; but when it is not being used, the plates are lifted out by means of the supporting beams, and allowed to drain into the jars.

Some arrangement must therefore be made for suspending, raising, and lowering the plates. I shall describe two methods of effecting this; one a simple, easily constructed way, and the other a trifle more complicated. The simplest way is effected as follows:—Drill a hole through the standards, ½ in. from the top, as Fig. 4. Drill a corresponding hole through the supports where they slide up and down, opposite these holes. A stout pin is now made of a piece of ⅛ in. steel knitting-needle about 3 in. long. A blob of solder or lead is cast on one end, to serve as a head. Make two such pins—one for each end—and put them through the holes in the standards and supports, which will suspend the plates when out of solution.

The second, and more finished, method is to take two pieces of ⅛ in. brass rod 8 in. long, and make an eye at one end of each like a skewer, and put a screw-thread on it all the way down. Make also a pair of small brass nuts to fit the rod, suitably tapped. It will be convenient to have a projection of brass rod in the side of the nuts, for convenience in turning them in screwing up. Now screw two pieces of brass, ½ in. wide, over and across the top of the standard at each end, with a hole drilled through the centre of it. Through this hole passes the brass rod, the eye being underneath, and hooking on to a small hook on the top of the supports immediately underneath it. On the top end of the rod is screwed the nut, with its projection. The same arrangement is fitted to both standards. Then, by turning the nuts above the brass strips attached to the standards, the supports and plate are screwed up to any required height. This method has, as will be seen, many advantages over the first method described.

The battery is now finished all except the connections, which may be proceeded with as follows:—

Take out all the zinc plates, and file a nick on each edge ½ in. from one end. Now take a piece of copper wire—preferably tinned—and remove the covering (if insulated) from one end for about 5 in., and put it round the zinc which is being operated upon, and twist it up tightly in the nicks, leaving about 2½ in. of covered wire for connecting-up. Be sure and twist the wire up tight, so as to ensure good contact (Fig. 5).

When all the zincs have been thus wired, they can be put back in their places, the wires coming up between the supports. Now put a small binding-screw on the front support, equidistant between each set of the plates, and between the last set and the right-hand standard put in a large size binding-screw. To this connect the wire coming from the zinc of the last cell, thus forming the zinc terminal of the four-cell battery. To each small screw connect the wire from the zinc of the cell before it, each one forming the zinc terminal of that cell, the screw-clamp being the carbon terminal of each set. Each cell has now its own connecting-screws from the carbon and zinc (positive and negative) elements.

The method of connecting the cells together entirely depends on what use the battery is to be put to. You can connect the cells *in series* or *in parallel*. To connect *in series* means connecting the zinc of one cell to the carbon of the next, and so on throughout the entire series. Batteries for electric lighting are thus connected. When the cells are connected in series, the E.M.F. (or electro-motive force) is equal to that of the four cells multiplied together; but the current is only equal to that produced by one cell.

To connect *in parallel* is to connect all the carbons to one wire, forming one carbon pole of battery, and all the zincs to another wire, forming one zinc pole. When the cells are connected in parallel, the E.M.F. is equal to that of one cell, but the current is equal to that of four cells.

This is easily explained on considering Ohm's law, which is: $C = \frac{E}{R}$, where C = current in *ampères*; E = electro-motive force in *volts*; and R = resistance opposed to the current in the circuit in *ohms*.

When the carbons are all connected together, and the zincs also, as in parallel, the resistance is only equal to one-fourth that of one cell, for this reason:—When the cells are thus connected, the four cells become, as it were, the *same as one large cell*, with plates four times as large as our one cell. Well, just in the same way that people in a crowd find it easier to get along if the road is wide, so does the electricity find it easier to get along a large-surfaced plate than a small one; and in pushing along the small plate, which offers resistance and makes heat, some of the current is lost in this way.

From this it will be seen that the manner of connecting-up your cells entirely depends upon what work they are required to do. If the battery is required to have a high E.M.F. and low current, connect in series. When, on the contrary, a high current and low E.M.F. is required (such as for working coils, electro-magnets, and motors), connect-up in parallel.

All those who are interested in electricity should study Ohm's law from the text-books, and thus they will see how to connect-up for any desired effect. Having finished this digression, I will return to the battery.

The battery is now finished, and the possessor may rely upon it to do any work that a four-cell battery of this description can be expected to do. If the battery is wanted occasionally to be easily carried about, handles of brass or nickel can be put on the side of each standard, and a strip of wood put across each side of the jars, and let in at each end to the side edge of the standards, about halfway up, to keep cells in place.

To charge the battery, make up a solution in the following proportions: Chromic acid, 3 oz.; water, 1 pint; sulphuric acid, 3 fluid oz. Dissolve the chromic acid in warm water, and slowly add the sulphuric acid, *gradually in a fine stream*. Let the solution cool, and it is ready for use. The amount required for the four cells will be about five to six pints. Fill the cells about three-quarters full. The solution will run about three hours, either at intervals or continuously. When you wish to work any piece of apparatus, connect up to the battery with insulated wire, lower the plates into the solution, and there you are!

I will finish by giving, in Fig. 6, a sketch of the complete battery, so that you will see what to make it like. When you have made it, you will have a really good and useful battery.

TAKING CASTS.

To take casts from carvings, wet some stout blotting-paper and a sheet of thin paper, say bank-post. Then damp the bank-post, and paste one or two sheets of the wet blotting-paper upon it, and then lay the paper, which must be damp enough to be soft. Now place the paper (the bank-post side) upon the carving you want a cast from, and hammer the paper into the carved surface with a hard brush (about as hard as a hard shoe-brush), driving the paper into all the interstices of the carving; and when this is done, paste a piece of brown paper on, and hammer again, and then remove the paper, and soak the face with oil, melted paraffin, or grease, when the mould is ready for casting. Then get some plaster-of-Paris, and mix it with some water to the consistency of thick paste, and place it on the mould, taking care that it goes carefully into the depression in the mould; and when it is dry, you will have a *fac-simile* of the carving.

GREENHOUSE HEATING.

In order to determine whether steam or hot water were the best for heating greenhouses, a series of experiments have been made at the Agricultural Experiment Station in connection with the Cornell University (New York City, U.S.A.), in which the following conclusions were arrived at: 1. The temperature of steam pipes average higher than those of hot-water pipes throughout the entire circuit for the entire period of test. 2. The higher the inside temperature in steam pipes the less is the proportionate warming power of the pipes at a given point. The heat is distributed over a greater length of pipe, and, as steam is ordinarily carried at a higher temperature than hot water, it has a distinct advantage for heating long runs. 3. When no pressure is indicated by the steam-gauge, the difference between the temperatures of the riser and the return is greater with steam than with hot water. 4. Under pressure the difference is less with steam than with hot water. 5. There is less loss of heat in the steam risers than in the hot-water risers, and this means that more heat in the steam system is carried to the farther end of the house and more is spent in the returns as bottom heat. 6. This relation is more uniform in the steam risers than in the hot-water risers, giving much more even results with steam than with hot water. 7. When the fires are operative the fluctuation in the temperature of the risers at any given point is much greater with hot water than with steam. 8. An increase in steam pressure raises the temperature in the entire circuit, but the temperature does not rise uniformly with the pressure. 9. The first application of the pressure increases the temperature of the returns much more than that of the risers. 10. Steam

is better than hot water for long and crooked circuits. 11. Pressure is of greater utility in increasing the rapidity of circulation of steam and in forcing it through long circuits and over obstacles. 12. Unfavourable conditions can be more readily overcome with steam than with hot water. 13. Hot water consumed more coal than steam, and was at the same time less efficient. This result would probably be modified in a shorter and straighter circuit with greater fall. 14. Under the conditions here present steam is more economical than hot water and more satisfactory in every way, and this result is not modified to any extent by the style of heater used.—*The Surveyor.*

"USEFUL HOUSEHOLD ARTICLE" COMPETITION.

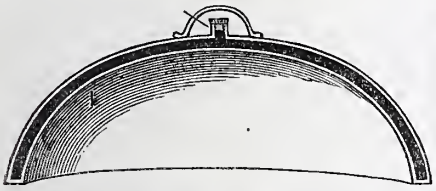
PRIZE SUGGESTIONS.

HOT-WATER DISH COVER.

By "Forkless" (Mervyn W. R. Bunbury, 15, *St. Mary's Terrace, Paddington, W.*).

A much needed invention is a hot-water dish cover.

The advantage of this cover is that it keeps the vapour of the food from condensing on the cover and bringing down on to the food any dirt there might be on the inside of the cover. It



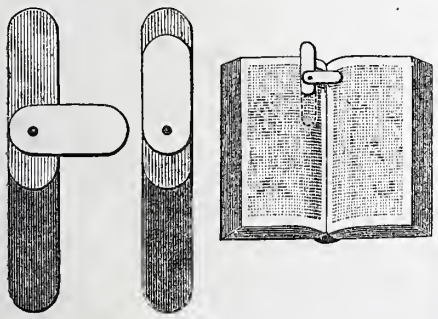
Hot-water Dish Cover.

also keeps the food from drying up. This suggestion is specially applicable for working men's homes, where ovens and such like facilities do not exist. Often a dinner has to be cut off and kept warm until some late comer has arrived, and in instances such as these the hot-water dish cover would prove of real service.

IMPROVED BOOKMARKER.

By "Bookmarker" (Sydney C. Smith, *Balliol House, Toynbee Hall, Commercial Street, E.*).

This bookmarker is designed to hold a book open whilst reading, so as to leave both hands free, also to avoid the spoiling of new books by breaking the binding in order to make them



Improved Bookmarker.

keep open. The back piece is sharpened for use as a paper knife. This article would be specially useful for reading at meals, or when smoking. The projecting arm might be made to close up over the other portion so as to make the bookmarker less bulky when the book is closed.

CLOTHES-HORSE.

By "Dhobia" (Harry T. Baker, 14, *Southgate Road, Kingsland, N.*).

I have examined every household article in my possession—perhaps I ought to say in my wife's possession—with a view to find some means of improvement; and after thinking upon everything, from the chimney-cowl to the doormat, and from the sugar-tongs to the coal-scuttle, I have decided upon the clothes-horse as an article requiring improvement as much as, if not more than, any other household article or domestic appliance. The ordinary clothes-horse, standing about 5 ft. high, and having three folds, has not more than 20 ft. of hanging accommodation. Now, I thought if the hanging accommodation could be doubled without increasing the size of the horse, it would be a decided improvement. I have worked upon that idea, and the result is a clothes-horse that will fold into a smaller compass than the ordinary clothes-horse, and yet when in use will give a hanging accommodation of 136 ft. If that is not enough, still more may be gained at the rate of 48 ft. for every foot added to its height; but I think 136 ft. enough for any ordinary household.

Fig. 1 shows the article when not in use. The first thing to be made is the frame. Get two pieces of $\frac{1}{2}$ in. iron gas barrel, each about 3 ft. 9 in. in length, having a thread at each end extending about 2 in. up, with two back nuts on each end. These are the uprights. The top, bottom, and middle rails come next. These may be made of deal or any other wood, about 1 in. by $1\frac{1}{2}$ in., and 2 ft. 4 in. in length. With a centre-bit bore a hole through at each end just large enough to admit the $\frac{1}{2}$ in. iron barrel, taking care to have a clear 2 ft. 1 in. between the holes. Having taken one back nut off each upright, slip the bottom rail on the uprights, put the other back nuts on, and screw up tight. The dark lines at A, B, C (Fig. 1) show top, bottom, and middle rails. Two legs will be required. If iron barrel has been used for the uprights, you cannot do better than use iron barrel for the legs. For each leg procure one $\frac{3}{4}$ in. T-piece with $\frac{1}{2}$ in. outlet, two 5 in. lengths of $\frac{3}{4}$ in. iron barrel, and two $\frac{3}{4}$ in. bends. Screw one of the 5 in. lengths into each end of the T-piece, and one bend on each end, and you have a strong leg (D, Fig. 1). Having made the two legs, screw them on the uprights below the bottom rail, their direction forming a right angle with the bottom rail. This is the position they will be in when the horse is in use. When the horse is not in use a quarter turn will bring them into the same direction as the bottom rail, as shown in Fig. 1, when the horse may be hung on the wall or stood close against the wall, taking up but little room. Measuring from the top of the bottom rail to the top of the upright, we have about 43 in. Allowing $2\frac{1}{2}$ in. for the thickness of the middle and top rails and back nuts, we have $40\frac{1}{2}$ in.—we will call it 40 in.—for swing rails.

Cut thirty-four rails of the same size as the bottom rail, and bore holes at each end the same as the bottom rail. Then cut them in two, as shown by dotted lines in Figs. 2 or 3, and we shall have sixty-eight 2 ft. swing rails. Having taken both back nuts off the top of each upright, place seventeen rails in such a manner as to allow each pair to fold in close, as shown in Figs. 2 and 3. Then place 6 in. of wooden washers on each upright; then the middle rail. Then place another seventeen swing rails on each upright, as before. Put one back nut on each upright, then the top rail, then the other back nut, and screw up tight, and you have the clothes-horse complete. By placing the 6 in. of wooden washers between the top half and the bottom half of the swing rails, we shall have 2 ft. space between each of the top swing rails and the corresponding swing rail of the bottom half. The top of the bottom fast rail and the bottom of the top fast rail should be countersunk, to let the back nuts in.

When the horse is in use, with all rails open, there being sixty-eight 2 ft. rails, it will give hanging accommodation equal to 136 ft. of clothes-line. When closed, with the legs turned in the same direction as the bottom rail, it will hang on a nail, with no part of it extending 2 in. from the wall.

When required for use, give the legs a quarter turn and stand it on the floor. It would be best to begin loading at the bottom of the top half. Swing the bottom pair of rails out to the front, hang the clothes on, and swing them round until their two ends meet behind. Pull out the next pair above, load them, and swing them back to within a few inches of the first pair. Continue in that manner until the top half are loaded; the ends of the top pair should meet in front, the points of the rails of each upright forming a spiral, the two spirals meeting in front at the top, and behind at the bottom. Having loaded the upper half of the swing rails, begin with the bottom pair of all; load and swing them back until they meet behind, and continue as before; and when the whole are loaded, the top pair of rails of the top half will be 2 ft. above the top pair of the bottom half, and so on. By those means you will have 136 ft. of hanging accommodation, with a free passage of air between each article, and the whole will be within a compass of 6 ft. wide, 4 ft. deep, and less than 5 ft. high.

On the same principle, it might be made with one upright standing on four spider legs; the upright to be of any height, and the arms, when in use, forming one continual spiral from top to bottom.

A very handy article may be made on the same principle to be fastened to the wall. Fig. 4 shows the article with half the rails in use, and the other half against the wall. Three or four pegs might be fastened to any one of those rails, which, when the article is not used as a clothes-hanger, would do for hat pegs, and when wanted for hanging clothes upon, such articles as stockings or socks could be hung upon those pegs.

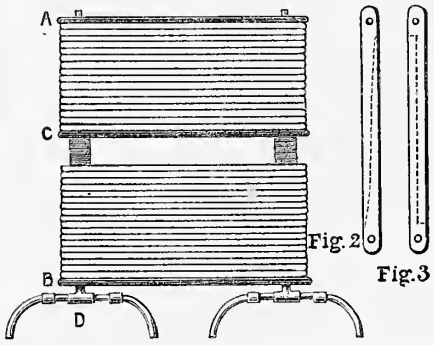


Fig. 1

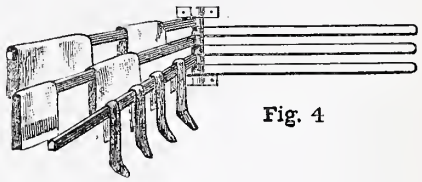


Fig. 4

Compactum Clothes-horse and Parts.

Many different forms of clothes-horse might be made on this principle, and any amateur could make them. All the tools required are a saw, a brace and centre-bit, a plane, and a wrench or spanner for tightening the back nuts.

This will certainly be considered a useful article by the ladies; and if ladies have aught to do with judging, a clothes-horse will get a place for once.

[*** £1 will be sent for each of the above prize suggestions; also, as opportunity offers, selections from the large number of designs which were sent in for this competition will be published in Work.]

Harrington bronze is composed of 55·73 per cent. copper, 42·67 zinc, 0·97 tin, and 0·68 lead, and has, after rolling, a tensile strength of 75,000 lbs. per square inch, and an elongation of 20 per cent. on a 2 in. section.

SHOP:

A Corner for Those who Want to Talk It.

*** *In consequence of the great pressure upon the "Shop" columns of* Work, *contributors are requested to be brief and concise in all future questions and replies.*

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of Work *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given.*

I.—Letters from Correspondents.

Sewage in Large Towns.—Chopstick writes:—"In regard to the necessity of providing a method of dealing with the sewage of large towns otherwise than by turning it into the rivers or canals, it may be of interest to some to know how it is dealt with in Rochdale; the method is, I believe, unique, as well as the manner of collecting. In the first place, every owner of property has to provide two tubs for each closet. These are about the size of a paraffin cask cut in two, but, for the sake of uniformity, they are supplied by the Corporation at the cost of 10s. 6d. each. One of these tubs is in use at the closet while the other is at the sanitary works, they being collected at certain periods by men in the employ of the sanitary department, who take away the full tubs in a long enclosed van, which is fitted with doors along the sides for convenience in loading. These men are also provided with lids for the tubs to keep in the smell, and, of course, on taking away the full tub, an empty one is left in its place. On arrival at the sanitary works, the tubs are emptied into a drying chamber, which revolves in contact with a heated chamber, and during the process the contents are turned over and over until the whole is formed into a dry powder, resembling guano, which is readily bought by farmers as manure. All the fumes are ejected into the air through a very high chimney, and anyone passing the works would scarcely know what process was carried on there, unless told. I believe the above method of dealing with sewage, etc., to be a very good one, but the manner of collecting I do not care for, as I think it could be managed better by means of water-closets, the water being drained off by means of gratings on arrival at the works. This would save the enormous expense of the men, horses, and vans, and would also render the system applicable to many towns without much expense; while it cannot be denied that it is decidedly unpleasant to meet one of the loaded vans in the streets. I shall be pleased to hear the opinions of some of our sanitary readers on the subject."

Soldiers' and Sailors' Handicraft Education.—Cam writes:—"I am much interested in the question you have started about teaching soldiers some trade which may be of use to them when their colour service expires. In most regiments workshops already exist, but only three or four men are employed in them."

Employment for Women.—N. M. (*Sheffield*) writes:—"It is bitterly complained from time to time that the labour market for women is sadly overstocked, and that competition daily becomes keener. This is so in some departments of labour; but one has only to take up a daily newspaper and scan the column of mistresses wanting servants, to see that at least one avenue is still left open for women. But domestic employment is not popular, as not being sufficiently 'genteel;' and it is in the ranks of those competitors for genteel employment that the greatest suffering is experienced. In America, where woman is nothing if not progressive, some persons have managed to strike out for themselves most original occupations. What is to prevent a woman from being an engraver, a chaser, an engine-turner, or an etcher?—all light trades, but requiring an artistic temperament and an artistic training—*i.e.*, an apprenticeship; for none can hope to acquire proficiency in these arts without giving time or money. Very good wages may be earned at these trades—except, perhaps, engine-turning, which is rather under a cloud; but employment is still to be had by competent female hands in the Coventry watch-making districts. As regards ornamental engraving, there are many light articles which might fairly be left to the delicate hands of women to enrich. The jewellery trade, in particular, offers a large field for the further employment of females; but they must be content to work in manufactories, and submit to a rather strict discipline in the matter of punctuality of attendance at work. And with chasing—which, by the way, is more nearly connected with the silver and electro-plated trades (tea and coffee services, etc.)—there is already a school for females established in Sheffield, where, for a moderate fee, a young person may be thoroughly trained, and where, if sufficient talent were shown, she would have no difficulty in obtaining work, which she would be able to execute at her own home. As a matter of fact, all these trades depend in a great measure on fashion, which is the one great drawback; but still, when trade is good plenty of work may be found. A preliminary essential to ornamental engraving and chasing is found in a preparatory education at a school of art, where she would learn to use her pencil deftly and quickly. This latter fact alone would be a sufficient inducement to a master to give the girl the preference over her less gifted sister applicants for a situation, as he could immediately employ her; and although she might feel rather awkward when called upon to trace a design upon a teapot, would very soon feel as much at home as though engaged in sketching with a pencil on a smooth sheet of paper pinned down to a drawing-board; and probably her employers, under the circumstances, would waive the apprenticeship, and give her a few shillings per week, together with instructions in his art. I have endeavoured to show that there are still occupations left for women. Let Englishwomen take a lesson from their sisters in America, and try to get rid of that bugbear, 'genteel employment,' all honest work being honourable; and if at first the labour should prove irksome, rest assured that, after the first plunge, all will become easier, and things will work more smoothly day by day. I have great sympathy with a delicately nurtured lady who, from any cause, finds herself compelled to seek a livelihood in a sphere quite outside that in which she has been reared, but venture to advise that a common-sense view of the situation in which she finds herself be at once taken, feeling sure that such a course will be productive of beneficial results."

Draught Excluder.—J. W. B. (*Huddersfield*) writes:—"This is the simplest way of making an excluder for both wind and rain at the bottom of doors, viz.: Take a piece of wood about 4 in. wide by 1 in. thick, and shaped as A, it being the length

Draught Excluder Pieces.

of outside, and fasten it on stepping flag; and then get another about 2 in. square and length of door, and formed as at B. Fasten this on door so that it will just fit on the other, as at C. It will be found to answer admirably. This has been tested, and I am using it myself."

II.—Questions Answered by Editor and Staff.

Lens Grinding.—S. B. (*Upton Park*) asks for "information as to the way lenses are ground ready for use," and "are there any books pertaining to the same?" Full information as to the method adopted, to be of much service, would require more space than "Shop" could supply. S. B. has not said whether the lens is for telescope or what. Two templets—one concave, the other convex—must be made, of a radius equal to the focal length of the lens. If of small size, they may be made of brass; if large, they are generally made of plate glass. The edges are ground together with emery, so as to be perfectly spherical. Two tools are now made of cast iron, concave and convex. These must be turned until they are as true as possible with the templets. When this is done, they must be ground together until they are both perfectly spherical. The disc of glass is now cemented to a bed; emery moistened with water is placed on the glass, and the tool is worked on it with a circular and swinging stroke. At the same time the worker gradually moves around the disc, and also keeps turning the tool around. From time to time the tool must be tried and ground with its own fellow to maintain a perfectly spherical curve. When every part is ground, and the disc presents a perfect form as tried by the templet, all the scratches are removed by finer emery, these by finer still, until, with a lens, no scratches can be seen, but there is simply a uniform granulated surface presented. A disc of wood must now be made of nearly the same curve, and covered with pitch or other adhesive substance. Whilst in a sticky and plastic condition, a piece of cloth is placed on it, and is worked with the iron tool until it becomes its exact counterpart. When hard, putty powder must be used wet, which will produce the necessary polish. This, in brief, is the method employed for grinding. When completed, it is centred—that is, it is ground on its edge into a circular form. When done, the lens may be said to be completed. With reference to the second question, I am not aware that any book has been published on the subject; there is, however, considerable information on lens grinding obtainable from articles that have appeared from time to time in magazines devoted to art and science. If S. B. has the opportunity, and will look up the *English Mechanic* for the last twenty years, he will find a great deal of valuable information on the subject. From the nature of the questions, my answers are, of necessity, vague; but if S. B. can state just exactly his needs, I have no doubt he will get the information required.—O. B.

Engineer.—T. B. (*Stourbridge*).—Inquiries have been made for the address of the inventor from engineers in Glasgow and elsewhere, but, so far, without success. When the address is found, it will be given in this column.—M.

Hand-power Saw Bench.—An Old Hand.—If you will read my article again, you will see that there is quite sufficient room for feeding purposes without coming into collision with the fly-wheel, and the cog-wheels are quite out of the way. In the case of tenon cutting it is usual, on benches of this kind, to use as small a saw as possible, and run the timber over the saw end up. This could easily be done from end of bench, if the latter is made 6 ft. long, as I recommended; but if made longer—say, 8 ft., as drawn—then it can be done from the side. I am perfectly aware that tenon cutting is done with a large saw on a steam-driven machine, but, of course, that would be impossible on a hand machine. If the fly-wheels were placed all on one side of bench, it would necessitate longer spindles, and the whole affair would also have a tendency to topple over, besides wearing the bearings unequally and causing friction, more or less: all of which would add to the labour of turning. As to the belt having to be very tight, it is not so in practice, the wood wheels causing it to bite more than iron ones. I do not mean to say that it would not be better with longer bearings, but we cannot have everything our own way on a small bench the same as we could on a large one. As to your so-called *complicated* arrangements for driving saw causing an undue amount of friction, and thus adding to the labour of turning the wheel, you will find that this is much more than overcome by the additional power given out by fly-wheel; and you must know that a small saw requires to be driven fast to cut easily; and did you ever see a *hand* bench, that was driven in the ordinary way, in which the saw would not be better if it was given more speed? I am sure I did not. We now come to your last question, as to why mill owners do not, or have not, adopted the same plan. My answer is: In benches where the saw is driven by steam, the fly-wheel is on the engine, so that none is required on the bench; and I know of one maker of hand benches who has adopted a very similar plan for increasing speed of saw. I hope I have answered your questions in a satisfactory manner, and I would ask you to bear in mind that, for those who can afford steam, I do not recommend hand labour; but those who cannot have one should surely make use of the other to the best advantage possible. I am thinking that you and I have had a few arguments before in the "Shop" columns, though, if so, you have adopted another *nom de plume*. Is this so? and if so, why?—Chopstick.

How to Bind Books.—J. B. (*Dalton-in-Furness*).—I do not know anything about the paper you mention. I get Work every week, but sometimes I have not an opportunity to read it through, and the paper must have escaped my notice. However, I do not think "gum tragacanth" would make a good paste. You will find flour paste suitable for all purposes for which paste is used, and it is very easily made. You can buy it at a shoemaker's furnishing shop. The colouring for edges may be any dry colour, to be obtained of either chemists or painters. For red edges, dry vermilion is the best. Grind it on a stone slab in water, and mix with a little white of egg to make it stick to the edge. Use a sponge, and apply very carefully, taking care that the colour does not run or form pools at the ends of the book.—G. C.—[The paint mentioned is an American speciality.—Ed.]

Work Index.—Axle can find out the number in which any article in Work appears as follows: Divide the number of page given in index by 16 (being the number of pages in each weekly number) and add 1 for the fraction; to this add 52 for each completed volume, and the total is the number required. Example: Find the number of Work in which the article on Construction of Kitchen Dresser appeared. Turn up the index for Vol. III., and we see Kitchen Dresser, p. 529. Now, $529 \div 16 = 33\frac{1}{16}$; add 1 for the fraction, and we have 34 as the result. As two volumes have been completed, we must add $52 \times 2 = 104$, and add 34 to this, and the total is 138, which is the number in which the article appears.—Ed.

Concertina.—H. H. (*No Address*).—The best steel for the reeds of concertinas is "spring steel." An old watch or clock spring answers the purpose admirably. The proper pitch of the reed can be obtained by *filing* it—at the *point* or free end of the reed to sharpen, and at the *heel* or fixed end to flatten. The steel may require tempering a little, and this may be done by heating in a gas-jet.—G.

Piano.—E. H. J. (*Bristol*).—I could have answered your query better if you had given a few particulars of your old piano, as to name of maker, etc., and a rough sketch of the action it already contains. If you intend to re-string it, do not alter the sizes of the wire. Put on the sizes, the numbers of which you will probably see marked on the wrest-plank, and when you have taken the strings off, see that the soundboard is secure in all the gluings. Also, I would advise you to place an extra bar at the back of the soundboard, and secure it with screws through the front of the soundboard, and glue a small block at the top and bottom of back for ends of bar to rest on. Then wash the soundboard carefully with soap and water, and when dry, varnish with white hard varnish; this will restore the tone. Your action probably only needs repairing. Send to Hallpike, 213A, Mare Street, Hackney, London, E. It makes no difference to your action, the compass of your keyboard.—T. E.

Staircasing.—Window Making.—J. O. (*Aston*).—Articles on Staircasing appeared in Work, Nos. 160, 164, 170, 177, and 184; on Window Making in Nos. 139, 147, and 153.

Six-inch Centre Lathe Mandrel.—Little Jim.—I do not know why you wish for parallel bearings, unless you want to have a traversing mandrel; but you say the lathe is to be "an ordinary one." I will suppose, then, you mean a foot

lathe, non-traversing, and intended for wood, not metal. Well, then, you would do well to make the front neck 1½ in. in diameter and 1½ in. long, and the back one may be ⅞ in. diameter and 1 in. long; this will run pretty easily. You might make the mandrel of tool steel and have the bearings in halves, of phosphor-bronze or bell-metal. I should have a hole bored right through the mandrel ⅜ in. diameter. If you want to turn metal, or if you have a motor to turn your lathe, you might have the front neck 2½ in. diameter, so, you see, "it all depends." It is difficult to explain the action of the oval chuck; get No. 1345 of the *English Mechanic*, where a very good one is described.—F. A. M.

Ferrotype Plates. — AMATEUR. — Ferrotype plates are usually coated with collodion, proceeding exactly in the same manner as in taking a glass positive. The only difference is that the ferrotype plate is opaque and the glass transparent. If AMATEUR does not understand wet plate work, he had better get instructions by word of mouth or by reading some work on the subject—orally, by preference—supplemented by seeing the whole process gone thoroughly into from first to last. Ferrotype plates are sold already prepared with emulsion, ready for exposure and development, but the collodion process gives rather the best results. A clearer and whiter image is obtained, the gelatine emulsion appearing muddy by comparison. To make the plates you have already procured sensitive, they must be first coated with a weak solution of albumen, dried, coated with iodised collodion, and sensitised in a solution of silver nitrate, immediately exposed, and developed by an acid solution of protosulphate of iron and barium nitrate, fixed with cyanide of potassium, washed and dried. But to make a success of it, you must be properly acquainted with the wet collodion process, of which the foregoing is an outline sketch.—D.

Fogging of Negative.—D. J. K. (*Roscommon*).—A friend of mine was troubled with fog on his negatives, and found the cause to be a lamp with orange-tinted glass used by him in the dark room. He at once discarded the orange for a ruby glass, and his trouble with foggy negatives ceased.—G. E. B.

Hammered Sheet Brass.—W. P. (*Widnes*).—Strip brass for the purpose required is to be obtained from Messrs. Smith & Sons, St. John's Square, Clerkenwell, London.—G.

Building Contracts.—W. R. (*Shrewsbury*).—The practice in London is to *include* the profit in pricing bills of quantities. We are pleased to find the articles on "Drawing Office Work" have been of help to you, and also to be able to state that they are not yet finished, as you have no doubt found out.—E. D.

Motor. — H. T. (*St. Helens*). — Your letter and many others have been sent to Simpson.

Looking-Glass.—H. H. (*London*).—Kindly say for what purpose you require the glass, I can then better advise you. In the meantime I may say the process is very difficult, and if you only want a small piece you had much better buy it, but if you simply want to have a try to see how it is done, I shall be glad to help you if you will write again.—W. E. D., jun.

Electric Current for Lamps.—H. B. McC. (*Spitalfields*).—As five 16 c.-p. lights should give a light equal to eighty candles, and each c.-p. will take 3½ watts of current, we shall need a generator giving at the least 280 watts of current per minute. As primary batteries soon become exhausted when current is taken from them at a higher rate than three ampères per minute, we must choose a lamp offering a fairly high resistance—say, 50 volts. With five such lamps connected in parallel to a battery, we shall use 5½ ampères of current per minute. We shall therefore require twenty-six cells, each of a gallon capacity, of the double fluid chromic acid type, and these will not run more than three hours with one charge of acid. It will therefore be seen that a primary battery will be a costly and impracticable generator of current for such a purpose. The least costly will be a 300 watt dynamo and a ½ h.-p. gas engine to drive it; or, better still, power derived from a steam engine.—G. E. B.

Organ, Harmonium — Conversion. — W. D. (*Nuneaton*).—It is not possible to alter a harmonium, which has a pressure bellows, to an American organ, which has a suction bellows; or, if possible, the case and bellows possessed by W. D. would not be large enough for such additions as he contemplates. When spare time permits, a scheme for uniting the two instruments shall be thought out, and W. D. must abate his demands, for he cannot accommodate in his altered instrument so many extra reeds as he wishes. Why not sell the harmonium and make or buy an American organ? I believe some papers are in hand on the American organ, which will be published in due course.—B. A. B.

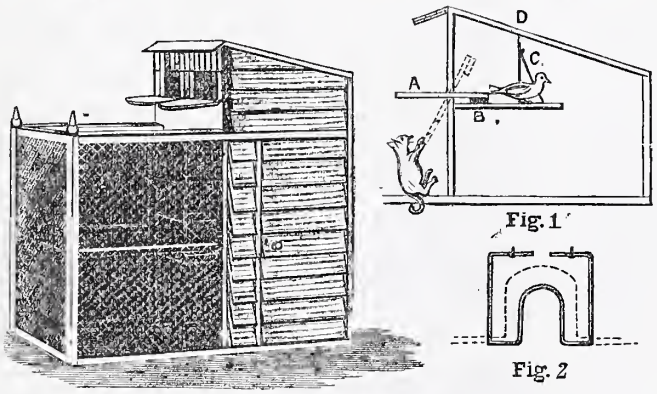
Drawing. — APPRENTICE ENGINEER. — Get "Linear Drawing and Projection" (Cassell & Company), 3s. 6d.

Chuck.—R. B. (*Galashiels*).—There is a self-centring chuck made with little levers, on the same principle as the one you sketch, you may see it in Churchill's catalogue. It is much more strongly made than you sketch it, far more compact, and without so much overhang as you show. The long screwed neck you show would be a most fatal objection, and would prevent any but the lightest cuts on small work.—F. A. M.

Phonograph.—D. E. P. (*Aston*).—Your question, "Whether the whole of this instrument is covered in?" is easily answered. It is not covered in, but should be exactly as described in the text and drawings referred to. The phonograms, or strips of foil, can be replaced by the strip of tissue, taking care that the indentations are exactly over the grooves in the cylinder. Great care and much patience are necessary to success. Most certainly a nut tapper would be much better than the piece of brass (Fig. 5). I am only an amateur at scientific instrument making, and have many a time to resort to a makeshift for the want of proper tools; so if you can conveniently make a better appliance by all means do so.—W. D.

Engineering Pupils.—F. W. (*Southampton*).—Whittaker & Co. now publish a 4s. 6d. book, "Electrical Engineering as a Profession, and how to Enter It," being a "Guide to the Electrical and *General* Engineering Profession." In it F. W. will find all information regarding premiumed pupils and firms.

Pigeon Loft.—L. M. (*Lee*).—I have sent a sketch of a dormer, with trap and balance board, to prevent the entrance of cats. Fig. 1: A, balance board; B, lead counter weight; C, stout wire trap, opening inwards. Fig. 2: Bent wire, dotted line; pigeon-hole cut in the partition, D, Fig. 1. The wire trap is fastened on the inside with two small staples, allowing it to work easy. The pigeons soon learn to push this and get in. When once in, they cannot get out, for the wire falls against the partition.—F. H.



Pigeon Loft. Fig. 1.—Section—A, Balance Board; B, Counter Weight; C, Wire Trap; D, Partition. Fig. 2.—Strong Wire Trap. Fig. 3.—Pigeon Dormer.

Geology and Chemistry.—C. R. (*Acton, W.*).—These subjects shall be treated when a thoroughly useful series of papers are submitted to me.—ED.

Tailors' Crayons.—A TAILOR.—Buy a penny square of pipeclay, scrape it to a fine powder with a knife, colour with red or yellow ochre, or any other earthy pigment that you may prefer, mix into a paste with milk, and dry in suitable lumps. This will generally be of about the right hardness, but if too soft a little starch may be added. This, however, must be used with caution, or the chalk may be too hard for use.—S. W.

Evening Classes.—P. F. A. (*Lewisham*).—As preliminary studies, you must take up mathematics and chemistry and elementary electricity and magnetism. Then your special studies will embrace the electric current, the laws of electro-magnetism and electro-magnetic induction, dynamos and motors, arc and incandescent lamps, accumulators, transformers, commercial distribution of electrical energy, and electric traction. Text books: Slingo & Brooker's "Electrical Engineering," Day's "Electric Lighting Arithmetic," Sylvanus Thompson's "Dynamo Electric Machinery."—J.

Measuring Cylindrical Vessel.—R. A. C. (*Poole*).—To measure any cylindrical vessel—by which I expect you mean to find out its capacity—proceed as follows: Multiply the diameter by itself in inches, and multiply this by ·7854; again multiply by the length in inches, and also by ·00360, and the answer will be in gallons. Or, in other words, diameter squared × ·7854 × length × ·00360 = answer in gallons. Another good rule: A cylinder 1 yard long holds as many *pounds* of water as the square of its diameter in inches. There are 10 lb. of water to the gallon.—T. R. B.

Bath-fitting for House.—R. B. T. (*Tyldesley*).—As you want to have the hot water quickly, you had best fix the cylinder in the kitchen. I have seen one fixed in the kitchen of a house similar in plan to yours, and they have a plentiful supply of hot water. A copper cylinder, though more expensive, will last a great deal longer than an iron one. They are sometimes fixed in the bath-room, the heat from them being utilised for heating the room; but in your case you would not get the hot water so quickly in kitchen. You might fix the hot-water cistern in the bath-room, and so get the benefit of the heat from it. With regard to your second question, you cannot heat the bedroom with pipes from the kitchen boiler.—M.

Driving Saw.—WARSAW will find his engine, if he drives direct from engine, and does not have too complicated driving gear, capable of driving a small circular saw (say, 6 in. or 8 in. diameter) in cutting wood 1½ in. deep. It must be understood that for every countershaft or cog-wheel, as the case may be, if it is to increase speed, there is a loss of power. WARSAW should have given the diameter of fly-wheel and revolutions of engine, and my reply might have been more satisfactory. He will be careful in feeding his stuff, and not feed it too fast, or he may overcrowd his saw, causing belt to slip, and giving other trouble. If properly sharpened and worked, he will find that his engine has a great advantage over a saw driven by hand, the engine being rather more than the power of four ordinary men.—A. R.

Cutting Opals and Other Stones.—T. P. (*London*).—This matter has been dealt with at length in two replies. One is on p. 111, No. 59, Vol. II., and the other is on p. 473, No. 81, also Vol. II. If these do not give enough particulars, another letter to WORK will gain the desired information.—H. S. G.

Making a Felt Hat.—FELT.—The formation of felt is the result of a property which certain animal fibres have (when assisted by gentle friction and moisture) of so interlocking together as to become inseparable. They do this in consequence of their having, as is shown by the microscope, jagged or serrated edges. We believe that beer lees and size are used in hatting to bind the material more firmly together. But FELT is not advised to attempt a hat. Without personal instruction and proper appliances, he could not hope to produce anything presentable. A hatter would only laugh at his work. He will do far better to show his new shape to the trade in some other material.—M. M.

Cork Frame.—CONSTANT READER.—I have met with no such design as that which you mention, and cannot tell you where such could be procured. Why not get some friend who can draw to sketch what you want? The clasped hands should be repeated at each corner, and the word "Friendship" made to occur on each of the four sides, to make the idea decorative; but it is scarcely a happy one for the purpose. Why not use one of the admirable designs given by Mr. Yorke in Nos. 159 and 164, and place a neat inscription to the friend for whom it is intended on the back of the frame?—M. M.

Tools for Engraving Letters, etc.—J. S. (*Burton-on-Trent*).—The tools you want for engraving names on medals, etc., are called lozenge gravers and "spit-stickers." The graver sharpened to an acute angle is used for cutting V-shaped cuts, and for cuts of a parallelogram form the tool is first sharpened in the usual manner, and the cutting angle is rubbed down on the stone till it makes a flat-bottomed cut of the required width. For work such as the ferrules of walking-sticks and umbrellas a square graver is used, the "setting-off" being very slight, and the angle less acute than for lettering. As regards the names and prices, the ordinary term "graver" includes all cutting instruments used by the engraver; the names only being altered when the graver is whetted up to do certain work—as, for instance, a graver whetted to form a semicircular cutting face is termed a round-nosed or spotting tool, for the simple reason that, when used, it makes a round spot, or, if the cut be prolonged, a grooved cut. As to prices, you can go to almost any expense, always remembering that good tools are cheapest in the long run. Here are some fair prices: One dozen lozenge gravers, 3s.; one dozen square gravers, 3s.; Arkansas oilstone, 5s. to 15s.; tracing point, 1s.; spring dividers, 2s.; steel rule and straight-edge, 2s. 6d.; set of sandbags, 2s. 6d. to 5s.; one dozen handles for gravers, 3s.; oilcan, 6d. Sundries: Eyeglass mounted on stand, letterpress ink, oil, turpentine, indiarubber, foolscap paper for prints, lead pencils, white wax, German silver for practice, pitch block for mounting German silver. If you get the first volume of WORK you will find therein a series of papers on "Engraving on Metal," which, I daresay, will help you.—N. M.

Microscope and Telescope.—J. G. (*Shepherd's Bush*).—An article on the Microscope appeared in WORK, No. 22, and on the Telescope in No. 142.

Mail Cart.—S. W. (*Fitzroy Square*).—If you were a careful reader, as well as a "constant taker," of WORK, you would have seen innumerable sketches of mail carts; but as you have, perhaps, mislaid your back numbers, you cannot do better than send for No. 30, Vol. I., and I think you will find in it all you require. You can get wheels and springs, etc., from the Victor Cycle Co., Grimsby.—E. D.

Cast Steel. — NO NAME (*Sunderland*). — In reply to our correspondent, it is held in the

law that the *substitution* of one material for another in a manufacture is *not* an "invention" that can be protected by a patent. A *mode* of manufacturing an article of the material named *may* be patented, and if properly set out in the specification, and the mode is novel, may be made to cover a great deal. We do not see what can be done in the circumstances he states, and he certainly runs a great risk in putting it before *any one* until he has lodged his application for the grant. We know of no trustworthy society, such as he mentions, in which he could have "full"—we say *any*—"confidence" in such matters, and should not advise him to be caught by any "professions" made with that object. If he stands well with his foreman, and he is a man he could trust, he might bring it to his notice, in *strict confidence*, to see if he would join him and find the means, on consideration of receiving a share in the right. Of course, our correspondent is in a better position to decide this than we are.—C. E.

Compound Engines.—NOVICE.—The object sought to be attained by the compound engine is the equalisation of the varying force of the expanding steam so as to produce and obtain a mean result of the pressure throughout the stroke of the engine. The first person to try and obtain it by the use of two cylinders of unequal sizes was Hornblower, who, in 1781, introduced the system. The steam at its full pressure is admitted to the smaller cylinder, and then allowed to pass into the larger one, which, by an increased diameter, allows the steam, at a diminished pressure, to produce or give off as much power as the smaller cylinder using the higher pressure, which result could not be attained by the use of two cylinders of the same size, supplied with a given quantity of steam at a given pressure. At the time of its introduction, and for a great many years after, the steam pressure used was too low to demonstrate the advantages of the system in a beneficial manner, and it is only in late years, when the use of steam at a pressure of from 50 lb. to 160 lb. and upwards on the square inch has been brought into use, that its advantages have been proved and made manifest; and now a given bulk of steam is expanded from ten to twenty times and upwards with great benefit to its users. The book mentioned contains some useful information, but, not being written by a practical engineer, is not, of course, more than a "popular" work on the subject. The great thing to be sought is a thorough practical acquaintance with the subject and a complete and thorough understanding of its principles and practice, which, it is needless to say, cannot be obtained from mere "popular" writings.—C. E.

Hartley's Catalogue.—J. G. L. (*Merthyr*).—Messrs. Hartley sent you their catalogue, but it has been returned. Your address was insufficient.

III.—QUESTIONS SUBMITTED TO READERS.

*** *The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Printing Press.—AMATEUR PRINTER writes:—"Will some reader kindly give me instructions for making a small printing press, to be worked by hand, to print about 10 in. by 7 in.; also, how to make black printing ink and the roller for distributing it?"

Hot and Cold Service.—IMPROVER writes:—"Will some reader kindly inform me how I should arrange pipes and connections and hot-water tank or cylinder and feed cistern, for circulating arch boiler of kitchener, 3 ft. long, small boiler to bathroom, which is on the second floor back, and range in back kitchen on the left, with one hot-water draw-off tap side of range? I should prefer the cold-feed cistern above bath, and hot-water tank in opposite corner and, of course, a little lower. What size tank shall I want for family of seven?"

Setting Bicycle Frames.—A. T. (*London, N.*) writes:—"Can any reader inform me of the method used for the above? Also any hints on building tangent wheels."

Oxygen Gas.—OXYGEN writes:—"Will some kind reader be good enough to inform inquirer of the various uses to which oxygen gas is put in the manufactures?"

Dark Oak Paint.—H. H. (*Sussex*) writes:—"Will any kind reader of WORK inform me how to make up about 20 lbs. of dark oak paint?"

"H. W. R." Monogram and Design.—LEEDS will thank any WORK reader for a monogram, "H.W.R.," for a small box, and a neat design for its end panel.

"W. O." Monogram.—W. O. (*Newhall*) will thank any kind reader for a design for this monogram for fretwork.

Scroll Saw.—NO PUFF writes:—"I want a reliable scroll saw that will cut through ¾ in. deal quickly. Would the 'Empire' be suitable? If not, could a reader name one?"

Moorish Frieze.—ALHAMBRA writes:—"I shall be obliged if any contributor could give me a design for a frieze in the Moorish style, to be cut in thin wood; also design for a wall mirror in same style with the opening for glass about 16in. by 14in."

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Folding Garden Seat.—J. BROWN (*Cambridgeshire Asylum, Fulbourn, Cambridge*) writes:—"If T. W. (*Cardiff*) (see No. 172, p. 254) will write to me, I think I can give him what he wants, as I have made half a dozen for our doctor for his garden."

Fuller's Battery.—J. BROX writes to N. C. G. (*Islington*) (see Vol. IV., No. 181, p. 446):—"In charging a Fuller's cell there are two different charges that can be used. In one, the porous pot with the zinc plug is charged with a solution of chloride of sodium (*i.e.*, common salt: 1 oz. of salt to 1 pint of water. In the other a solution of 12 parts of water to 1 part of sulphuric acid is used. In using either of these solutions about 1 oz. of mercury should be placed at the bottom of the porous pot, which ensures constant amalgamation of the zinc, thereby preventing useless waste. The outer jar, containing the carbon plate, is charged with a solution made by dissolving 3 oz. of bichromate of potash to every pint of warm water, and then adding 3 oz. of sulphuric acid gradually, stirring with a stick. After the addition of the acid the solution will become scalding hot, so care should be taken to make the mixture in a suitable jar or vessel that has no chance of cracking. All the solutions should be quite cold when the cell is put up for use. Any size of porous pot will do; all depends on the shape and size of the outer one. It should stand up about 1 in. above the outer pot, and should comfortably take the zinc plug without taking up too much room in the other."

White Wood Articles.—M. (*Bishop Auckland*) writes to A. M. R. (*Golden Square*) (see No. 186, p. 478):—"I think you can procure these from J. H. Skinner & Co., Harger Brothers, or Booth Brothers, who advertise in WORK."

Meerschaum.—M. (*Bishop Auckland*) writes to J. W. B. (*Castleford*) (see No. 186, p. 478):—"Make a cement of dry slaked lime, sifted through fine muslin and mixed with the white of an egg. Fix the tube with the screw on the end, with this, into the meerschaum, and, when set, screw on the amber."

Model House.—M. (*Bishop Auckland*) writes to T. B. (*Kirkbythore*) (see No. 187, p. 494):—"I do not think anyone supplies these articles. You might get a plumber to make the spouts and chimney-pot in sheet zinc, and use small brass or bone drawer knobs for door handles, which you can obtain from an ironmonger. If you cannot get them in your district, if you send me particulars and sizes, I will try to get them made for you."

Fuller's Battery.—EDDEFRA writes to H. C. G. (*Islington*) (see No. 181, p. 446):—"Fuller's battery consists of an outside stoneware pot or jar with an inner porous pot, the outer jar having a plate of carbon in chromic acid solution, with one-quarter of its bulk of sulphuric acid. The inner porous pot contains a rod of zinc, the bottom of which is covered with mercury, and remainder of cell filled with sulphuric acid and water. Electro-motive force, 1·50."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—A. T., JUNR. (*Birmingham*); TOM DOCTOR; J. S. (*No Address*); W. F. C. (*Coventry*); J. H. B. (*Pendleton*); W. K. (*Ditton*); C. M. (*Huddersfield*); C. D. (*Low Moor*); S. K. (*London, N.*); J. H. (*Stonehouse*); H. E. B. (*Newcastle*); A. A. (*Leeds*); E. S. (*H.M.S. "Victoria"*); REV. W. H. N. (*Cambridge*); R. W. T. (*Newcastle-on-Tyne*); W. J. M. (*Dundalk*); FRAME; AMATEUR TYPE; J. G. S. (*South Shields*); E. T. E. (*Summerhill*); W. S. (*Battersea*); BEGINNER; R. M. (*London, S.E.*); E. W. M. (*Redhill*); ONE INTERESTED; ELECTRIC LIGHT; CYCLOSTYLE; D. C. (*Blackburn*); M. C. S. (*London, W.*); B. (*Wolverhampton*); A. W. C. (*Walthamstow*); CYLINDER PLUG; H. C. S. (*Wellingborough*); C. H. S. (*Midsomer Norton*), T. C. M. (*Haverhill*); P. W. (*Stockport*); C. J. (*Gloucester*); W. C. B. (*South Queensferry*); F. P. (*London, W.*); FOLLOW ME; W. S. (*Newcastle*); E. S. (*Chelsea*); J. F. (*Selby*); J. F. M. (*Edinburgh*); H. V. T. (*Harrogate*; A. R. (*Scorrier*); J. W. (*London*); W. O. (*Carlisle*); C. L. (*Chorley, Lancs.*); S. A. L. (*Great Yarmouth*); T. B. (*King's Heath*); W. J. H. (*Market Harboro'*); A. E. M. (*Windsor*); T. D. (*Oldham*); J. W. (*Ashtead*); ROBIN HOOD; E. R. (*Portsmouth*); R. L. (*Pentre, Ruabon*); A. H. (*Adwalton*); H. S. B. (*Tipton*); W. B. (*Penzance*); W. W. (*Southport*).

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Each Suggestion should be fully described in respect to its purpose, construction, and working, and, where possible, should be illustrated with a drawing of the article itself and its various parts, to elucidate the description.

A Suggestion not illustrated will have an equal claim in the competition, provided the description be sufficiently in detail to convey a full idea of the article suggested.

In the work of judging regard will be had to the practical nature and utility of the suggestions, and their prospective popularity.

The Prize Suggestions and Drawings, and any others, to be published, if desired by the Editor, in WORK, but the copyright thereof to remain with the authors.

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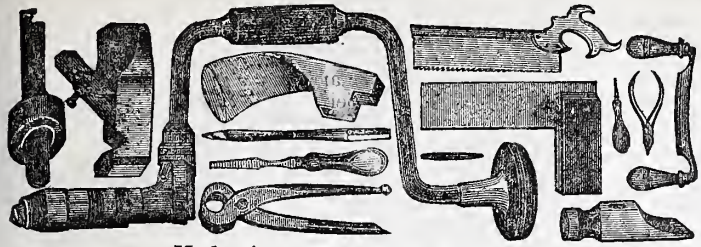

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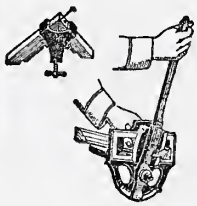

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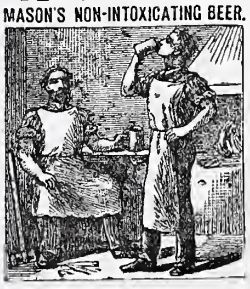

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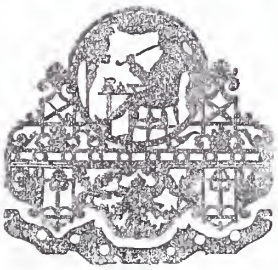

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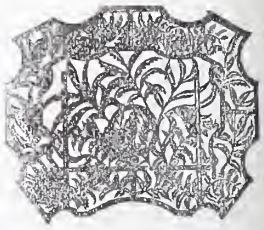

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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VOL. IV.—No. 193.] SATURDAY, NOVEMBER 26, 1892. [PRICE ONE PENNY.

WORK WORLD.

THE wires of the various telephonic systems in Switzerland extend to some 13,340 miles in length. * *

The world's production of silver has risen in thirty years from £8,000,000 to £21,000,000.

* *

The Indian Government offer a £200 prize for the best military cart for army service in India. The competition is open to all.

* *

Grave doubts exist as to the 124-ton Krupp gun being on exhibition at the World's Fair. There is a difficulty in transporting it across the water.

* *

Estimates of the firearms made in America place the number of pistols at 750,000; shotguns, double and single barrel, at 400,000; and rifles of all grades at 500,000.

* *

Experiments have been made to work silk from wood pulp. Specimens of silk were woven successfully in large pieces, but were found so inflammable as to be dangerous.

* *

Thanks to a legacy, a house of employment for artisans out of work is to be founded in Milan. English millionaires might take the hint. * *

One of the curiosities of the Chicago Exhibition will be a palace of salt. Large blocks of salt will be used, which, being transparent, will produce a strange effect.

* *

A detective camera has been devised, which is fitted into the crown of a hat, and the ventilating aperture in the crown is used for taking the photograph. The weight of this ingenious apparatus is 2½ oz.

* *

Next Spring will probably see an interesting Arts and Crafts Exhibition in connection with the Manchester Salford Refuges and Homes, in conjunction with other kindred institutions.

* *

Skimmed milk, used in the making of artificial ivory, is mixed with borax, and subjected to a high pressure. The product is used for toilet combs and brushes, pipe mouthpieces, and billiard balls.

A monster lathe, the heaviest ever built, has been turned out by the Putnam Machine Company for the United States Government. The length is 82 ft., and the weight over 100 tons. Between centres it will turn an object 52 ft. long.

* *

A new mineral like asbestos, discovered in large quantities in Colombia, has the colour of amber, and is perfectly transparent and incombustible. It is proposed to utilise it for the purpose of making bank notes.

* *

A new aluminium vessel is 12 metres (13 yds. 4 in.) long, 1·8 metres (72 in.) wide, and has a draught of 700 millimetres (28 in.), and weighs 3,500 lb. With a six horse-power naphtha motor it acquires a speed of 13 kilometres (8⅛ miles) per hour.

* *

The Union Pacific Railroad have sent out a locomotive engine which is 15 ft. 5 in. high from the rails to the top of the chimney. The boiler is 5 ft. in diameter, and over 23 ft. long. This is the largest locomotive that has ever been made.

* *

Glass-lined iron tubes may now be used for water service instead of lead tubes. A company has been formed for the manufacture of glass-lined tubes of all sizes and shapes required by the trade, including bends, elbows, and tees. The joints are made with gutta-percha washers.

* *

Profiting by the workmen's anxiety to outdo each other on the old piecework system, employers have been able to gauge to a nicety how much work is possible in a given time. Inspectors of feed and speed are now appointed in large machine shops, who compel the men to do, as it were, piecework for time wages.

* *

The Duc de Morny's method of photographically impressing paper of any size or thickness will be used in the French and Russian armies. By this process a likeness can be fixed like a monogram on note-paper or pasteboard. Eighty different silhouettes can be taken in a minute at small cost.

* *

The largest warship in the world is the new cruiser, *Ruric*, built at the Baltic Works, St. Petersburg. Its registered tonnage is 11,933 tons, and she can carry 13,250 tons. Two other ships have been laid down for the Russian Government of 11,700 and 12,000 tons respectively. Look out, British Admiralty! * *

In making optical instruments of aluminium, some difficulty has been experienced in cutting screw threads, and in forming rackwork teeth in this metal. This difficulty is met by fitting German silver sleeves over parts destined for small screws, and bushing unexposed parts with gun-metal or brass.

* *

Nearly eighty-four tons of ostrich feathers, which realised over £430,000, were disposed of at the auction sales in the United Kingdom during the past year. Readers of WORK may calculate how much was earned for labour, and at the same time it would be well in the interest of labour to consider whether it would not be worth while for our capitalists to invest spare money in promoting the ostrich feather industry in England.

* *

Smoke funnels, 100 ft. high, are being placed on American armoured cruisers. Though unsightly, appearance is sacrificed to utility. The increase in height gives additional draught, and does away with the necessity of forced draught in ordinary steaming. It will also carry the smoke and gas from the furnaces above the military masts of the ship, and give the men in the tops a chance to fight without being suffocated. * *

A new kerosene oil field covers a territory of 320 square miles in the State of Langkat, a very rich oil-producing country. The oil is fully equal in quality to good American kerosene, and quite double that of Russian petroleum. It has been pronounced by an English expert to be of first-rate "water white" quality, flashing, by Abel's test, at 83° to 86°, and burning at 124° to 126°. The present output is from 15,000 to 20,000 cases per month, and is easily shipped.

* *

The preliminary works for the drying of the Zuyder Zee have been commenced, and have proved easier than was anticipated. A dyke is in course of construction from the northern extremity of North Holland to the nearest point on the coast of Friesland, passing by the island of Wieringen. It will be about seventeen and a half miles in length. It is expected that when it is once constructed it will be strengthened by the action of the sea itself in accumulating large masses of sand on its flanks.

PRACTICAL PAPERS ON PLUMBING.

BY R. A.

Wiped Joint Making.

In writing these papers I am supposing a certain amount of mechanical knowledge in those who read them, so as to dispense with elaborated descriptions of tools and materials. There are a great many workmen besides plumbers to whom a knowledge of joint making and other things would be useful, and it is just to supply that want that these articles are written.

To proceed at once to business, we will take Fig. 1, which represents an ordinary horizontal, or, as it is termed in the trade, an underhand joint. Most people who have seen a plumber make one of these joints might fancy, from the ease and unconcern with which the task was accomplished, that it was one of the easiest tasks possible; but those who try it for the first time will be ready to admit that it is not so easy as it looks. The writer well remembers his first joint: it was in shape something like a kidney potato, and had about as many eyes in it—not to mention a burnt finger or two. However, practice makes perfect, and if the readers of this paper adopt that motto they may be sure of success.

Preparation of the Joint.—With the shavehook (Fig. 8) or a pocket-knife, take off the rough edges of the inside of both pipes where they are to be joined. Take the piece marked M (Fig. 4), and rasp off the end to a bevel edge. Next, with a tool called a turnpin (Fig. 12), open the pipe, F, sufficiently to allow the other pipes to enter about $\frac{3}{8}$ in.

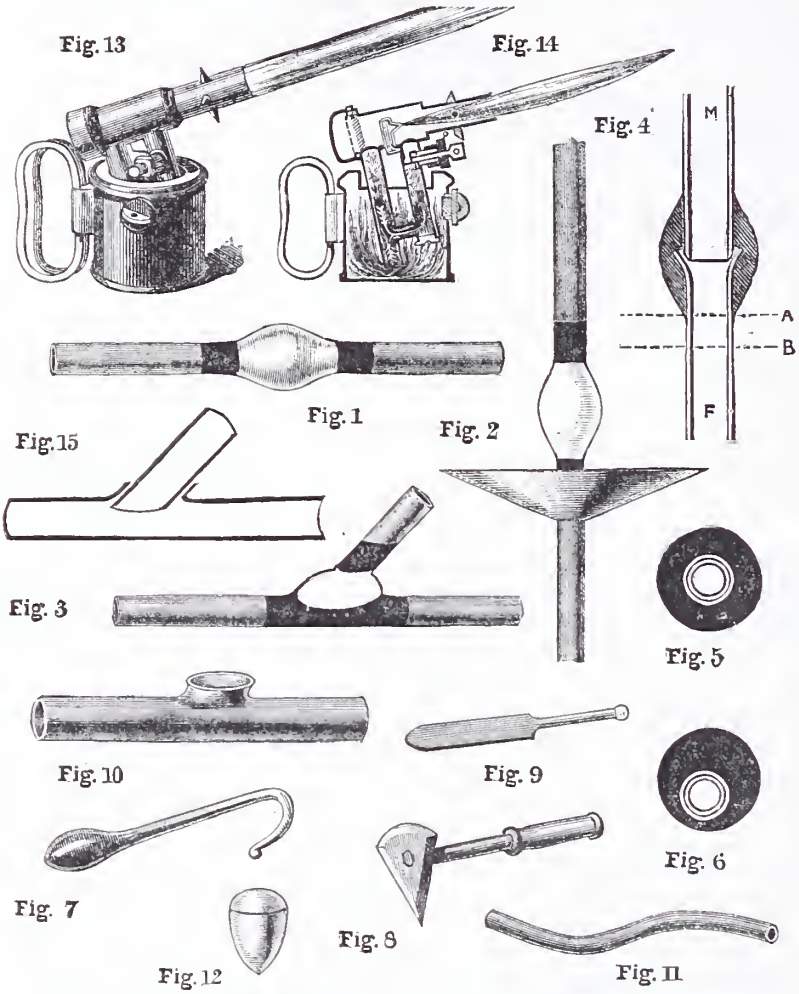
The swelled-out part of this pipe must be shaved inside, and the pipes are now ready for "soiling" and "shaving."

Preparation of the Soil.—"Soil" (also known as "tarnish" and "smudge") is prepared by mixing lampblack and chalk with glue-water. The lampblack should be first calcined in the metal-pot or ladle, then a small piece of chalk grated into it with a rasp, and the whole ground very finely together in a mortar with a little stale beer; then put it into the soil-pot—which is a tin or copper vessel, holding a pint or more—and warm it over a fire, and add about two tablespoonfuls of good glue, not too thick. Stir all together; test its quality by painting a piece of lead, previously freed from grease by rubbing over with chalk; dry it by the fire and try to rub it off with the fingers: if it easily rubs off it requires a little more glue, but if it peels and cracks in drying you have got too much glue in it.

Soiling the Pipes.—Soil the ends of the pieces of pipe to be joined about $4\frac{1}{2}$ in. if $\frac{1}{2}$ in. or $\frac{3}{4}$ in. pipe; if 1 in., or larger, an inch more. Do not let the edges of the soiling be ragged or uneven; it looks bad.

Shaving.—Next shave the pipes. The length of the shaving depends upon the size of the pipe and the length you intend the joint to be; 3 in. of shaving, measured after the pipes are together, is quite enough for $\frac{1}{2}$ in. and $\frac{3}{4}$ in. joints; 1 in. joints may have a little more. To get this, the male pipe, M, must be shaved $\frac{3}{8}$ in. or $\frac{1}{2}$ in. longer than the female pipe.

Fixing the Pipes.—When a joint is made in the workshop, there is no difficulty in fixing the two pipes in such a position as to be able to get to wipe the joint quite easily.



Plumbing. Fig. 1.—Underhand Joint. Fig. 2.—Upright Joint. Fig. 3.—Branch Joint. Fig. 4.—Section of Joint. Figs. 5 and 6.—Cross Sections of good and bad Joints. Fig. 7.—Plumbers' Iron. Fig. 8.—Shavehook. Fig. 9.—Splash-stick. Fig. 10.—Pipe prepared for Branch. Fig. 11.—Bolt, or Tommy. Fig. 12.—Turnpin. Figs. 13 and 14.—Soldering Lamp. Fig. 15.—Section of bad Branch Joint.

A tool, called a plumbers' soldering cramp, is very useful for holding the pipes in position; the work may also be secured by tying it to fixing chisels, which are pieces of round or square steel, pointed for driving into walls, beams, etc., where required. Various ways will, as needed, suggest themselves to the ingenious for fixing work.

Solder Cloths.—For making wiped joints several of these will be required. They are usually made of fustian, though some plumbers use ticking. Useful sizes for jobbing work are $2\frac{1}{2}$ in. × 3 in., 3 in. × $3\frac{1}{2}$ in., and 4 in. × $3\frac{1}{2}$ in. Four thicknesses of fustian, six or eight of ticking, will do. They should be folded and stitched together, and a little warm tallow rubbed well into the face side: they are then ready for use.

Plumbers' Solder.—The ordinary plumbers' solder for joint wiping is composed of lead and tin, in the proportion of two parts lead and one part tin; this will be found to work very well indeed. Plumbers' solder can be bought ready for use at any ironmonger's or lead merchant's. If you wish to make your own, always use pure lead and tin—no odd scraps of metal, compo pipe, etc., will do for plumbers' solder—and, above all, never get any zinc in it, or you will spoil it for a certainty.

Other Tools, etc., Required.—These will be a metal-pot, a small ladle, a splash-stick (Fig. 9), and some tallow, technically known as "touch." This should be rubbed over the shaved parts as soon as they have been shaved, and the shaving should be the last thing done before wiping the joint (except the fixing in position); the pipes will then not tarnish and the solder will take on better. The splash-stick may be wood or iron; some prefer one, some the other. The objection to wood is that it smokes on being put into the hot metal and gets into the eyes of the worker, and the objection to iron is that it might scratch the soiling; this, however, may be avoided with care.

Wiping the Joint without an Iron.—Heat your solder in the metal-pot, having the joint in readiness and fixed ready for wiping. Place something underneath to catch the solder that will run off the joint as the metal is poured or splashed on; then take a ladleful of the hot metal, hold your cloth underneath, and dribble a stream of metal upon the pipes; this will tin them so that perfect union between them may be the result. Pour on the soiled parts as well, to get up the heat, so that the joint may be clean and smooth at the edges, which it would not be if the ends of the joint were cold. Hold the cloth close up to the pipe, so that the underneath part will "tin;" keep the cloth in a hollow shape, so that it will hold a quantity of metal, and work it about underneath and up the sides, and when it feels nice and plastic, wipe round, keeping the cloth in the bulged shape and pressing firmly upon the outside edges of it. Should the joint be unsatisfactory, you can pour more metal upon it, wipe it all off, and try again; but if you get the pipes too hot the metal will not stay on them. A good-shaped joint can scarcely be expected at the first attempt. Fig. 5 shows a cross section of a true joint, Fig. 6 that of a bad one.

Wiping a Joint, using Splash-stick and Iron.—Take a ladleful of metal as before, and with the splash-stick splash the solder on to the joint and soiling to get up the heat (the iron should be heating at the same time). When you have sufficiently heated the pipes and got enough metal on to form the joint, take the iron, heated to a dull red, and rub it with a file to take off the dirt and

scale; then rub the iron all over the solder on the joint, and wipe as before.

Joint Wiping, using a Blowlamp.—It is very handy at times to be able to make a joint without the use of metal-pot or iron, and this can easily be done now with one of the improved forms of blowlamp. One of the best of these that I know of is called the "non-explosive," and is shown at Figs. 13 and 14. Messrs. Farmiloe are agents for it, but I believe it can be obtained at any oil merchant's. From personal experience, I can strongly recommend it as a reliable and handy piece of apparatus. Benzoline is used in it, and the temperature of it will reach, it is said, to over 2,000 degrees Fahrenheit. It can be held in any position, and the flame can be regulated—an advantage not possessed by all lamps of this class.

How to Use the Lamp.—Directions for filling and regulating the lamps are sent out with them, so space need not be taken up here with that. To make the joint, take a strip of plumbers' solder, run out about 15 in. or 16 in. long, and with the lamp warm up the joint (previously prepared as for wiping in the ordinary way, of course); then melt off portions of the solder, and shape up as you go with the stick of solder. Do not keep the lamp right on it full blast, but if you see the metal running too fast and dropping off, withdraw it a little or check the flame with the regulator. Having got sufficient metal on the joint and roughly shaped it, promptly pick up your cloth and wipe as before. One of the principal features of this lamp is that it can be turned down to a glimmer whilst preparing other work, so that there is no waste of oil.

Upright Joint (Fig. 2).—These are rather more difficult than underhand joints, and will require, therefore, more practice before the learner is proficient. They are prepared in the same manner as previously described, except that the "soiling" should be a little longer. A lead collar, or something of the kind, must be placed under the joint to catch the metal as it is splashed on to the joint; as this will keep the bottom part of the joint hot, splash more toward the top part; as you get sufficient metal on—which you will soon be able to judge—form it into shape with the splash-stick, then quickly run the warm iron over the solder, and wipe. Be sure and get the edges nice and hot, or they will not wipe clean; melt the surplus solder that has fallen in two or three places with the iron, and put back in metal-pot.

Branch Joints (Fig. 3).—This shows a branch joint finished. It is prepared by cutting a hole somewhat smaller than the pipe that is to enter it, and working it up to a kind of socket, as shown at Fig. 10. The entering pipe should never project into the other pipe further than the depth of this socket, or it would, in the case of waste or soil-pipe, cause obstructions. Fig. 15 shows a section of badly-fitted branch joint. The socket is worked up by means of the bolt-pin, or tommy (Fig. 11), which is inserted in the hole and struck with a hammer. Great care must be taken in fitting branch joints that they fit perfectly close, or the solder will run through. The wiping process will be similar to those already described. There are many other kinds of joints, known as block joints, flange joints, taft joints, etc., which, however, must be reserved for the next article.

Circles.—The circumferences of circles bear an equal relation to each other as their diameters; their areas, however, are as the squares of their diameters.

LIGHT FOR LANTERNISTS.

BY O. BECKERLEGGE.

Sources and Forms of Light—Lamps—Oxyhydrogen Appliances—Procuring Oxygen—Retorts: Chadwick's—Purifying—Storing Oxygen—Bottles—Drums—Bags—Hydrogen—From the Main—Contained in Bags—Danger of Mixing—Pressure—Oxycalcium Light—Spirit Lamp—Limes, etc.

Since the publication of my article on the lantern (see Nos. 174 and 179), a correspondence has arisen as to the best mode of obtaining light for the same. Instead of answering separate questions, I purpose in a short article to say all that need be said to assist the inexperienced lanternist; possibly I may leave much unsaid that might be explained as to matters of detail, but I think such points may be safely left to the individual operator to state, as his needs require, rather than to unduly extend this article. The ideal light should be reduced to the smallest compass possible, consistent with the utmost intensity, steady and without flaring, and also with the smallest amount of heat. This ideal light has, as yet, to be discovered; that being so, we must obtain one which shall contain the largest number of advantages with the fewest disadvantages. Ordinary house gas is nowhere in the competition; in illumination it is feeble and is exceedingly unsteady. The electric light was at one time the hope of the lanternist. As to its intensity, there is no question, but so far, I believe, it is found too unsteady. Some years ago I saw it used with a lantern-microscope, and as far as intensity was concerned I deemed it perfect; ordinary microscopic objects were thrown upon a screen about twenty feet square, but the flickering was most painful to the eye. I believe this defect has not been remedied. But apart from this drawback, if it were all that could be desired, it certainly would be for the few only, as the cost is altogether out of proportion to the results.

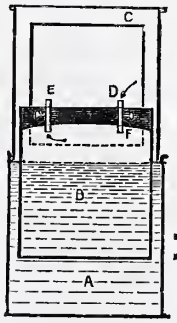


Fig. 1.

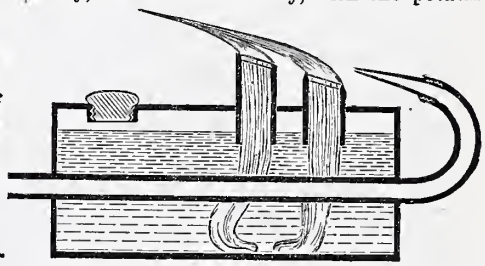


Fig. 2.

Light for Lanternists. Fig. 1.—Oxygen Gas-holder—A, Water Tank; B, Gas Tank; C, Skeleton Frame: dotted Lines showing the Frame completed; D and E, Pipes with Taps for Inlet and Outlet of Gas; F, Division slightly convex to resist Pressure of Water. Fig. 2.—Oxycalcium Lamp: Section.

At the extreme pole—so to speak—is placed the lamp. In our younger days vegetable and animal oils were used, such as colza, whale, etc., but these are poor when used with a modern lantern. Such is the perfection to which mineral oils are now brought, that they can be used without fear of explosion, and I should advise anyone who does not require more than an eight or ten feet disc to be exhibited in a room large enough to seat, say, from two to three hundred people, that a good four or five wick lamp is the best. In itself it is portable, and mineral oil can now be procured almost in any village in the kingdom; if not, a quart bottle is not a great addition to the other *impedimenta*. Such a lamp can be purchased for, say, 16s. No doubt a fairly skilful amateur could construct one as serviceable as the most expensive one to be purchased, but the details of its construction lie outside our present plans. Midway between the sources of light mentioned lie those kinds in which pure oxygen, under pressure, is used. The most familiar form, perhaps, is the one known as the oxyhydrogen lamp, in which the gases oxygen and hydrogen are combined to raise a piece of lime to a state of incandescence, and is known sometimes as the limelight. As will be understood, the illuminating power of the flame produced by the combustion of these gases in combination is feeble, but the heat developed is intense, so that really it is the incandescent lime, and not the burning gases, which is the source of illumination.

The first question is, how can we procure oxygen? As the mere tyro in chemistry knows, there are many substances which have a great affinity for oxygen, which may be liberated by heat and other means. In practice, however, the lanternist finds his oxygen in chlorate of potash. This, with binoxide of manganese, is placed in a retort, and heat applied. There is no particular proportion that need be observed between these further than this: that the potash must be largely in excess of the manganese. The following proportions are as good as any: $1\frac{1}{2}$ lb. potash, $\frac{1}{2}$ lb. manganese. The reason for this somewhat unscientific method of working is, that the evolvement of oxygen is not the product of some chemical combination or change between these substances; the manganese simply acts mechanically, and not chemically, with the potash. If the potash were placed in the retort without an admixture of some kind, when heat was supplied it would solidify, and the gas would come over with a great rush. Other substances besides manganese may be used, but as this gives up a portion of oxygen, and is cheap, it is generally used.

One word of caution. It sometimes happens that matter containing carbon gets mixed with manganese in the form of soot or charcoal. When heated, the carbon and potash become an explosive compound; these, with the addition of sulphur, constitute gunpowder. Many frightful accidents have occurred through the mistake of using impure manganese. To know if your manganese is pure mix it with a little potash, and hold it in an iron spoon over a lamp or candle; if the oxygen is liberated without explosion it is all right; if, however, there is a sudden flash like powder it must not be used. It is only a few pence per pound, and should be purchased at a respectable place, where, no doubt, its quality will be guaranteed.

Some makers pound the potash fine, others leave in coarse grains. Most men have their fads; the one thing is to perfectly mix the two together. For simple experimental work it can be heated in a Florence oil flask. If one only wanted a jar of oxygen this method would answer very well—I have done it many times—but to fill a bag with the gas, then a retort capable of

great resistance must be used. A proper retort, either of iron or copper, can be bought—any chemist would procure one. I recommend the former, which should cost about 6s. Put in the mixture, fasten down the lid, attach the leading tubes, and place it over a gas burner—Bunsen is best—and in a few minutes the gas will commence passing over; should it come with a rush, then either remove the burner or lower the heat.

With the oxygen there will also be a proportion of chlorine. This is in every way detrimental, and must be got rid of, and to do so we must employ a wash bottle. Procure a large bottle with a wide mouth, such as confectioners use. Fit it with a wood bung, in which must be made two holes to receive the glass tubes, one of which must reach to within, say, half an inch of the bottom; the other must only just project beyond the lid on the inside. The bottle must now be two-thirds filled with water in which common soda is dissolved, or ordinary lime-water may be used; the object being to afford the chlorine something to combine with for which it has greater affinity than the oxygen. If the gas were taken direct into the bag, there would be a probability that moisture would also be taken from the wash bottle, so that we shall require a similar bottle; only it must be dry. Whatever moisture the gas may take up will be dropped on the way. Sometimes I have found in practice that as soon as the gas ceases to come over a kind of syphon action takes place, and a portion of water is forced back into the retort; though this is not attended with much danger, possibly none, yet it is better to keep the retort dry. If a similar bottle to the last is placed between the retort and wash bottle, the syphon action will only result in drawing water into it, where it will remain.

Perhaps my remarks may be considered incomplete if I do not refer to an excellent arrangement designed, I think, by Mr. Chadwick, in which the retort consists of two parts—a metal plate, and a bell-shaped vessel ground to fit the plate gas-tight. A loop passes over the bell which secures it to the plate. The potash and manganese are moistened sufficiently to form a paste; a cake is then made of it in a mould, so as to go into the retort loosely: this is dried and placed on the base-plate, and the cover is secured by the loop. To provide for any sudden evolvement of gas tending to burst the retort, two springs are so arranged that when the pressure rises above a certain degree, the bell is forced up sufficiently to allow the excess of gas to escape.

I have seen it in operation, and know it to be exceedingly good; though, of course, while it has many advantages—that I need not point out—it is much more expensive than the ordinary retort which I have referred to. The next matter for us to consider is how to store the gas when procured. During the last few years gas has been supplied under high pressure in steel cylinders or bottles. It will be readily seen that this is, under some circumstances, a most portable and convenient arrangement, but it has some disadvantages. They can only be filled at certain centres; the carriage, therefore, is in some cases a serious item; and then the price for the gas per foot is necessarily high, seeing it has to be forced into the cylinders under great pressure by special machinery. Then taps and regulators are expensive, so that if time and trouble are of less importance than money, many will still adhere to the old method; but if money is of no moment, and convenience is everything, then certainly this method of storing has great advantage. An arrangement similar to the ordinary gasometers, so called, is very good, and the principle has been adopted by Chadwick and others. As the making of this is simple, and comes within the skill of many amateurs, I will describe it at some length. Fig. 1 will assist in making it plain. A is a tank two feet square—that is to say, it is a cube made of light galvanised iron or stout tin plate. C is a skeleton frame made to fit easily into it for packing; it is closed at one end. B is the gas tank; this is made half an inch all around smaller than A. It is opened at both ends, but is divided into two unequal portions at F, the smaller division being three inches deep, and the larger a fraction less than one foot nine inches. At D and E two pipes must be soldered, as shown, into which taps are to be screwed, to which rubber tubes are to be attached. On the top of the outer tank, under the wiring, four small bolt holes are made, as shown, and on the lower edge of C are corresponding holes. In travelling, the lantern, retort, etc., may be packed in the gas tank B; arrangements can be easily made by removable divisions, so that everything can travel safely. We will suppose ourselves at our journey's end. Draw out the skeleton, and remove lantern, etc., from the tank; invert the gas tank B, so that the shallowest part is uppermost, as in Fig. 1. Screw taps D and E in their places, and secure the skeleton frame C to the base by four bolts and nuts. Pour water in the tank A until it is about level with the top of tank B, leaving the taps D and E open, to allow the air to escape. The top of the tank F must now be filled with water, which will serve as a weight to force the gas out. Close the tap E, leading to the lantern, and join up the tube which leads to the retort. The gas will now come over, and lift the tank B until it is full. Perhaps in practice it will be best to put but little water in the top tank until the lower portion is filled with gas. When this is done, turn off the tap D, put what weight is required in the top part to give the requisite pressure on the gas, and the exhibition is ready to commence. This, for many reasons, is an excellent arrangement, and may be modified in many ways. For example, in the gas tank no space need be left for water; but the whole space may be occupied by gas, and the pressure supplied by weights, bricks, etc. Seeing that the gas-holder can be utilised as a case for lantern, etc., in travelling, it does seem strange that amateurs have not more frequently turned their attention in this direction instead of bags.

But perhaps there are some who still prefer using bags, and with reference to them nothing particular need be said beyond this: that the pressure board must be so arranged that they admit of the weight being so applied that it is even and continuous; a ledge should be fixed so that the weight is in no danger of slipping suddenly off. Care must be taken that the bag is quite empty before commencing to fill with gas. Hydrogen may be obtained from the main in many cases. Exhibitions, however, have sometimes to be given where there is no gas to draw on in this way; bags have then to be resorted to. Everyone knows that hydrogen and atmospheric air, owing to the oxygen contained therein, when combined in definite quantities, form a highly explosive compound. Much more care is, therefore, needed in working with this than oxygen. The bags must be carefully emptied before admitting the gas; and further, as house gas contains more or less sulphur, etc., it has a tendency to decompose the substance of the bag. Chlorine is carefully eliminated from oxygen for the same reason; amongst others, it is exceedingly destructive to the bag. It is not my purpose to describe the various kind of burners, mixing chambers, etc.; all methods of using the gases are practically safe if rational precaution is taken. The one danger, and the one thing to be avoided, is the mixing of the gases in the bags; should this take place the flame may travel back and an explosion take place. To prevent this, equal pressure has to be applied to the bags, and care observed that no one or anything touches the bags to alter the pressure. If the pressure is removed, then suction takes place, and a portion of one gas passes to the other bag.

It sometimes so happens that it is desirable to give an exhibition, not only where there is no house gas, but under circumstances when it is not practicable to convey it. Several schemes have been wrought out with more or less success, and some of them are superior to the best oil lamp. But not one has been produced which is equal to the oxyhydrogen lamp.

The oxycalcium light in some of its modifications stands next to the one described for brilliancy, and is perfectly safe, as hydrogen gas is not employed. A spirit lamp is so arranged that a stream of oxygen, with a blowpipe action, is directed on the flame, and impinges in the ordinary manner on a lime cylinder. The flame, though not so intense as the other, is yet sufficient to raise the lime to a state of incandescence, which becomes the source of illumination.

Procure a tin box, say 4½ in. long, 3 in. wide, and 2 in. deep. Holes must be made in the end to admit the tube conveying the oxygen; this is a mere matter of convenience, and any other method may be adopted. If this plan be decided on, care must be taken that the tube is soldered strongly and without any leaks. In the top, one or two wick tubes must be soldered in a line with the blowpipe; a third hole must be made to take a screw-plug, to be used in filling the vessel with spirit. The arrangement is exceedingly simple, and need cost only a few pence. Fig. 2 will give a general idea of the lamp, and render further description unnecessary.

The only thing that remains is to arrange the fixing of the lime cylinder. As the intense heat soon pits the lime, it must be so arranged that it can be turned round; it is better if, in turning, it can be made to rise in a spiral form, as then a new portion is brought before the flame, whereas if it simply revolved it would come back to its starting point. But these matters will present no difficulty to one who is able to accomplish what we have already described.

An illustrated catalogue is exceedingly helpful to an amateur, and I should advise all young lanternists to avail themselves of such sources of information; the writer has learned many a wrinkle from them. I do not think more need be said, as I believe no one with any mechanical skill will find it difficult to follow out the directions given, which, if followed, will put them in possession of useful and reliable adjuncts to the lantern.

Electrical Test for Money.—A recent discovery suggests an electric test for bad money, based on the fact that the spurious coin is relatively a bad conductor.

TIN CLIPPINGS.

ıE owners of a sardine factory have ınd a way to get rid of the piles of tin ıppings which have encumbered their ›cks. These clippings are carefully col-›cted; those made by the dies which stamp e bottoms and covers of the cans are ›unded into suitable shape for handling, hile the strips made by the shears in cut-ıg the tin for the sides are carefully ındled and boxed. The clippings find eir way to the smelting furnace, where the ı with which they are coated is melted and ·awn off separately, while the molten mass steel which composed the ate is run into moulds, and rmed into window weights ıd other useful articles. he bright tin strips of ırious widths and lengths e made to serve manifold ırposes, being made into ı tags which ornament ug tobacco, button moulds, ·namental baskets, and hun-·eds of other articles.

LECTRIC TRACTION IN-'LUENCE ON WATCHES.

'E know that many watches ıve been injured by the cinity of machines pro-ıcing electricity. It seems ıat in countries where elec-ic traction is common, avellers very frequently are ›posed to the annoyance seeing the delicate organs their watches, thus influ-ıced by the magnetic field the motors, refuse their ·dinary work, or accomplish badly.

Electricians are occupied ith this question, since it akes electric cars, for in-ance, convenient in other ›pects, objects of suspicion. They recognise the fact, hich, indeed, is well known, ıat watches are particularly ›posed to danger when ectrically charged cars as-nd hills; then the quan-ty of the current absorbed y the motor is much greater › that requisite on levels ıd with a small charge. In such circum-ances the iron of the motor is almost ıtirely saturated, and the development of ıe field of the lines of power must influence ıe tempered steel organs of a watch. his inductive action becomes injurious to ·gular movement. The radical remedy ould clearly be the employment of non-agnetic metals in watch-making.

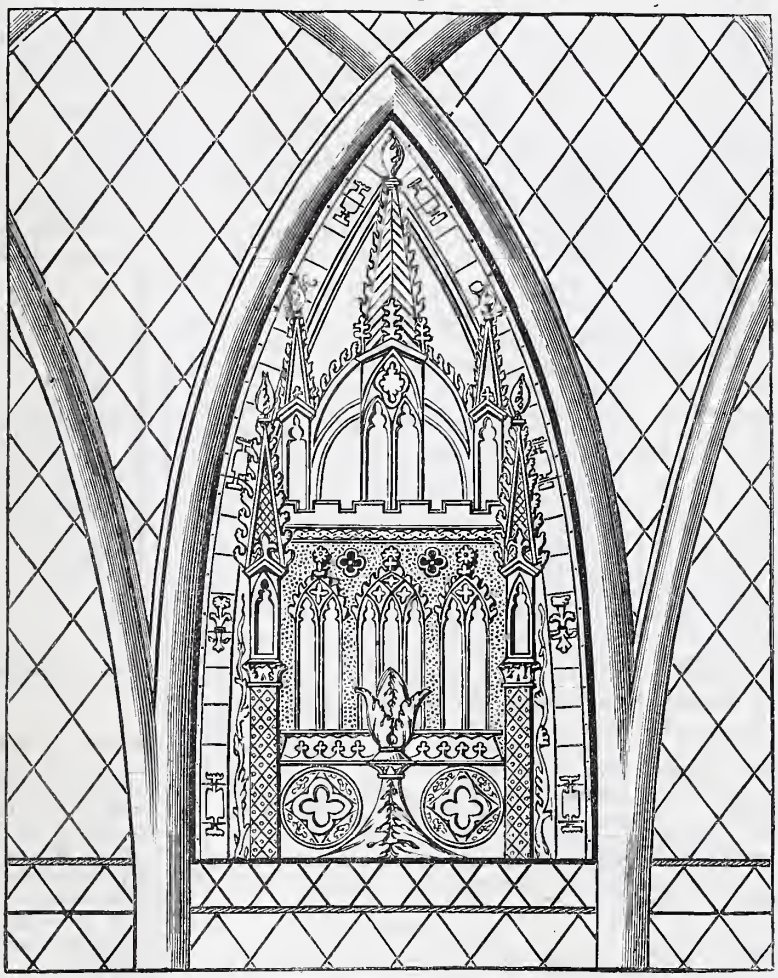
The idea is excellent, no doubt, and watch-akers will do well to consider it; but must e all change our watches for the new type? -*Cosmos.*

Boilers.—On lighting up a boiler, after it ıs been lying idle and the water is cold, ıe fires should not be hurried or forced way, but should have time to warm the oiler thoroughly. If they are hurried, the ıdden unequal expansion will in many ıses cause an explosion.

STAINED AND LEADED GLASS WORK.

BY RICHARD MATHEWS.

At what time the art of glass-making was first invented is altogether uncertain. Some imagine it to have been invented before the Flood, but of this we have no direct proof; though there is no improbability in the supposition, for we know that it is almost impossible to excite a violent fire such as is necessary in metallurgic operations without vitrifying part of the bricks or stones wherewith the furnace is built. This, indeed, might make the first hints of glass-making, though it is also very probable that such imperfect vitrifications would be observed a long time before people thought of making any use of them. The Egyptians boast that this art was first thought of by the great Hermes; Aristophanes, Aristotle, Alexander Aphrodisius, Lucretius, and St. John the Divine put it out of all doubt that glass was used in their days. Pliny relates that it was accidentally discovered in Syria, at the mouth of the river Belus, by certain merchants driven thither by a storm at sea, who being obliged to continue there, and dress their victuals by making a fire on the ground where the herb kale abounded, that plant burning to ashes, its salts mixed with the sand and produced glass; and that this accident being known, the people of Sidon, in that neighbourhood, essayed the work and brought glass into use, since which time the art has been continually improving. Be this as it will, however, the first glass-house mentioned in history was erected in the city of Tyre, and here was the only staple of the manufacture for many ages. The first time we hear of glass being made among the Romans was in the reign of Tiberius, when Pliny relates that an artist had his home demolished for making glass malleable, or rather flexible, though Petronius Arbiter and some others assure us that the emperor ordered the artist to be beheaded for his invention. It appears that before the conquest of Britain glass-houses had been erected in the island as well as in France, Spain, and Italy, relics having been found, and which were probably in former times used as armlets by the Druids. It can scarcely be questioned that the Britons were sufficiently well versed in the manufacture of glass to form out of it many more useful articles than the glass beads. History assures us that they did manufacture a considerable quantity of glass vessels, these being of a green, blue, yellow, or black, and many of them streaked with other colours.



Stained Glass in the East Chancel Window of Petistree Church.

According to the Venerable Bede, artificers skilled in making glass for windows were brought over into England in the year 674 by Abbot Benedict, who was employed in glazing the church and monastery of Weremouth. According to others, they were first brought over by Wilfred, Bishop of Worcester, about the same time. Till this time the art of making such glass was unknown in Britain, though glass windows did not begin to be common before the year 1180. Till this period they were very scarce in private houses, and considered as a kind of luxury, and as marks of great magnificence. Italy had them first, then France, from whence they came into England. Venice for many years excelled all Europe in the fineness of their glasses, and in the thirteenth century the Venetians were the only people that had the secret of making crystal looking-glasses. The great glass-works were at Muran, or Murano, a village near the city, which furnished all Europe with the finest and largest glasses.

The glass manufacture was first begun in England in 1557. The finer kind was made in the place called Crutched Friars, in London. The fine flint glass, little inferior to that of Venice, was first made in Savoy House, in the Strand, London. This manufacture appears to have been much improved in 1635, and a monopoly was granted to Sir Robert Manfell, who was allowed to import the fine Venetian flint glasses, the art of which was not brought to perfection before the reign of William III. But the first glass plates for looking-glasses and coach windows were made in 1673 at Lambeth, by the encouragement of the Duke of Buckingham, who in 1670 introduced the manufacture of fine glass into England by means of Venetian artists with great success. The French made a considerable improvement in the art of glass by the invention of

a method of casting very large plates, till then unknown, and scarce practised by any but themselves and the English. The Court applied itself to cultivate and improve glass manufacture. A company of glass-workers were established by letters patent, which provided not only that the working in glass should not derogate anything from nobility, but even that none but nobles should be allowed to work in it.

An extensive manufacture of this elegant and valuable branch of commerce was first established in Lancashire about the year 1773, through the spirited exertions of a respectable body of proprietors who were incorporated by an Act of Parliament. From those various difficulties constantly attendant upon new undertakings, when they have to contend with powerful foreign establishments, it was not, however, conducted with any great degree of success.

Painted Windows.—The ancient manner of painted windows was very simple; it consisted in a mere arrangement of pieces of glass of different colours, in some sort of symmetry, and formed what is now called mosaic work. In course of time they came to attempt more regular designs, and also to represent figures, heightened with all their shades, yet they proceeded no farther than the contours of the figures in black with water colour, and hatching the draperies after the same manner on glass of the colour of the object required. At length the taste for this sort of work improved considerably, and the art being found applicable to adorning of churches, palaces, etc., they found out means of making the colour fast by firing it into the glass. A French painter at Marseilles is said to have given the first notion of the improvement upon going to Rome, under the pontificate of Julius II., but Albert Dürer and Lucas of Leyden were the first that carried it to any height. The art, however, has frequently met with some interruption, and sometimes has been almost totally lost. The first interruption given to it was by the Reformation, which banished the art out of churches; yet it was in some measure kept up in the escutcheons of the nobility and gentry in the windows of their feats. Towards the end of Queen Elizabeth's reign, indeed, it was omitted even there, yet the practice did not entirely cease. The Chapel of Our Lady at Warwick was ornamented anew by Robert Dudley, Earl of Leicester, and his Countess, and the cipher of the glass painter's name still remains on the window, with the date 1574, and in some of the chapels at Oxford. The art again appears, dating itself in 1622, by the hand of no contemptible master. Many dates could be supplied in the gap of forty-eight years on Flemish glass, but nobody ever supposed that the secret was lost so early as the reign of James I., and that it has not perished since will be evident by the following series reaching to the present hour. There are twelve windows, 1518, in the library at All Souls, Oxford, in the chapel of Queen's College. In a chapel at Warwick, a cipher, P. C., dated 1574, can be seen on the painted glass. The windows at Wadham College, the drawing of which is very good, with fine colours, are by Bernard van Linge, 1622. In the chapel at Lincoln's Inn a window with the name Bernard, 1623, is probably the preceding Van Linge. In the church of St. Leonard's, Shoreditch, are two windows by Baptista Sutton, 1643. There are several windows to give testimony to the fact that our predecessors were no mean artificers. It would not be unwelcome to the curious reader to read some anecdotes of the revival of taste for painted glass in England. Price was the only painter for many years in his own particular style in England. Afterwards, one Rowell, a plumber at Reading, did glass work particularly for the Earl of Pembroke, but Rowell's colours soon vanished. At last he found out a very durable and beautiful red, but he died in a year or two, and the secret with him. A man at Birmingham began the same art, and fitted up a window for Lord Lyttelton in the church of Hagley. After this, one Peckit began the same business, and made good proficiency. A few lovers of art collected some panes from ancient buildings, particularly Lord Cobham, who erected a Gothic temple at Stowe and filled it with the arms of the old nobility, etc. A glazier named Palmer, of St. Martin's Lane, bought glass which came from Flanders, and fitted up entire windows, and with mosaics of glass of different colours. Painted glass from Flanders was sold by auction in the Strand, consisting of Flemish coats-of-arms, birds and flowers in colours, and Scripture stories in tracing black and stain. Oliver Cromwell during his time did great havoc in the churches, the ideas of his people being to destroy everything associated with the opposite religion. With this view, beautiful statuary and stained glass windows suffered sad demolition, and were denounced as sinful. Some old windows that now remain had to be buried to save destruction, and some can now be seen in the colleges at Cambridge that have been dug up and restored. The design accompanying this article represents an enamelled window, the date of which is not known, but which must be very old. The colouring of the background was bright pink and blue, the ornament being in yellow stain and white. The diamonds surrounding it were white sheet. This beautiful remnant of antiquity was totally destroyed in the reparation of the windows in 1793, and formed the east window of the chancel of Petistree Church. By following the history of glass, it will be seen what improvements have been made in its manufacture. The progress was very slow in the first place, but in the last few centuries stained glass became very popular and much more developed, and not so conventional as in the first stages of the art. The modern style, which is altogether different, represents the real more than the ideal.

GLUE FOR TICKETS ON GLASS, PORCELAIN, AND IRON.

Nothing is more difficult than to make tickets adhere, especially when made of parchment-paper, to glass, iron, or porcelain. The following formula gives excellent results:—120 parts of gum arabic and 30 parts of tragacanth gum are separately steeped in water. The solution of tragacanth is stirred until it forms a viscous emulsion. Then the solution of gum arabic is added and filtered in a fine cloth; 120 parts of glycerine are incorporated with the liquid, in which $2\frac{5}{10}$ parts of thyme oil have been dissolved. Finally, the liquid is raised to about two pints by adding distilled water. Glue thus made is very adhesive, and to remain in perfect condition merely requires to be kept in bottles with hermetic fastenings.—*Génie Civil.*

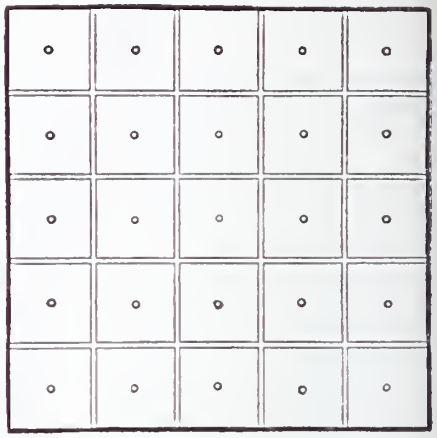
Fire.—Lime-water is fire-proof protection for any light woodwork.

ROADWAYS AND HORSE-SHOES.

BY J. C. KING.

Non-slipping roadways or non-slipping shoes for horses—which is it to be? There cannot be a doubt that roads should be of such form and surface material as not to entail the compulsory use of shoes to meet the exigencies of bad roads, especially as it is known that good non-slipping roads can be made.

The question is being trifled with by people who seem to view the matter from a distance or hearsay. One paper with a large sale says, "the asphalte is so clean and sweet." It is clean and sweet when kept so, but the writer should go along the asphalted streets in the City, where many vehicles pass on a summer's Sunday afternoon; the stench from urine and horse manure, with the desiccated dust blowing into mouth, nostrils, and eyes of passengers, would convince the writer that he had made a serious mistake about sweetness of asphalte. It is silent for wheel traffic, but silence can be obtained in other ways; and if it were



Iron Sole Plate for Wood Blocks.

not attainable, animal torture and individual loss should not be made to follow to please callous and indifferent people. The torturers of old built their massive dungeons to shut in the shrieks and groans of human agony. We parade animal torture day after day before the gaze of thousands and no one is punished, and by the avidity shown for road contracts, and the growing wealth of contractors and parish officials, who work together, the horrors go on flourishingly. If the parish or municipal authorities were compelled to pay for animal losses through asphalte pavements causing them, it would be simply just to the horse-owner, and a useful lesson to ratepayers who tolerate or aid the wrong done by their officials.

Wood pavements for roads are far less slippery than asphalte, and could be made quite "shoe-biting" for horses if the plan explained in Work about a year ago were adopted. We repeat it now. Between all wood blocks, well tarred before putting down, leave $\frac{5}{8}$ in. space in line, to be filled with polygon granite, not less than $\frac{1}{4}$ in. in size, well rammed in; or put $\frac{5}{8}$ in. thick slabs of granite to fill every joint between the wood; this would form a bite for an iron shoe, and as it wore and crumbled away it would grit the road surface. It is not patented; there is nothing to prevent a trial. It was submitted to the Animals' Institute three years ago; yet animals are tortured and permanently lamed in London, causing an estimated loss to horse owners

and carriage users of about £6,000 a year, at the lowest estimate.

It must not be lost sight of that wood-paving does not lighten the draught of vehicles, but if worn in hollows and bumps, as arranged between contractors and ignorant road surveyors, the draught is from ten to fifteen per cent. more than granite pitching, so that horses suffer this way also.

If, instead of drift-sand or slimy mortar, stone pitching had a packing of ¼ in. oak between the line-joints of the stones, the sharp clatter sound of iron hoofs and wheel-tires would be lessened to an appreciable extent, without impairing the durability of the road.

Before speaking of non-slipping horse-shoes, in another paper to follow this, wheels may be mentioned, with noiseless tires, now in use. It has been urged by writers like the advocate of sweet asphalte that their general use might be enforced. As well try to make people walk about in slippers. Here, again, such writers assume that rubber tires lessen draught, when a grain of experience would help to show that they augment draught on smooth roads, as asphalte. The metal-tired wheel, with ring rubber felloes, is the most advanced of all elastic wheels, and lessens vibratory noises considerably on stone pitching.

In America, where the roads are so bad, they take warning by England, and say —"We do not go in for sham good roads and highway corruption, as in England, to kill horses."

They are now seeking for knowledge of the best. The latest report is as follows of "an improved system of road-making":—

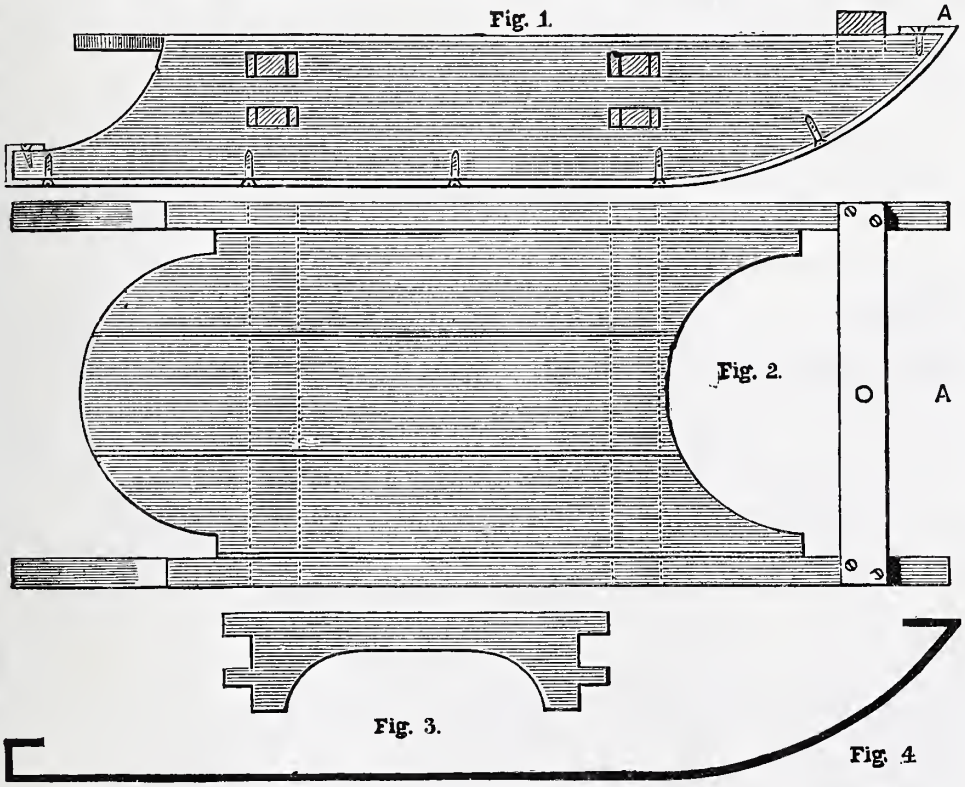
Iron foundation for wood roads is on trial at Columbus, Ohio. This pavem nt has the merit of serving to make permanently level roads, such as the road-makers of the metropolis of London persistently make unlevel by making the foundation for the wood of uneven density, so that the soft parts sink and the hard parts remain as projections above the sunken level. This is avoided by plates of iron with ½ in. fillets, standing up 3 in. to form 5 in. square pockets, into which end grain oak is driven, and left to stand up 2 in. above the iron fillets. The sketch shows a plate with wooden parts. This pavement has been tried in a position where heavy cart and waggon traffic is constantly running over it. A year and a half showed only ¼ in. wear. The adjacent macadam road had to be renewed in three months, and the asphalte in four months, while this pavement will endure for three years longer without the block being renewed, the iron plates being almost uninjured. A hole in each pocket allows drainage.

HOW TO MAKE A SNOW SLEDGE.

BY "CHOPSTICK."

INTRODUCTION — MATERIALS REQUIRED — FITTING TOGETHER—MANNER OF USING—CONCLUSION.

In some parts of the country where I have been such a thing as a snow sledge is never seen, and only heard of as being common in foreign parts; but in the northern counties, as soon as the ground is covered with snow, every little hill is the scene of excitement; sledges of all sorts and all sizes can be seen, from the proper sledge, similar to the one I am about to describe, to the improvised one made out of an old soap-box obtained from the grocer; and though accidents may sometimes occur with the home-made ones, through their not being made so as to surmount obstacles, that is not the case with those after the pattern of mine, as they will mount over anything and continue on their course until they get to the bottom of the hill; and when used by an experienced rider they can be steered almost as well as though they had a horse in front of them. The pattern of this sledge was taken from one in use in Canada, where sledges are the rule instead of the exception, so that it may well be said that it cannot be beaten. And, indeed, I have never seen one to beat it—and I have seen dozens: in fact, I might, without exaggerating, say hundreds; and during the last winter I made several of the pattern, as in the accompanying drawing. The full size of sledge outside is as follows: 3 ft. 6 in. long, 17 in. wide, and the sides 7 in. deep, so we shall want two pieces of inch board (American birch is as good as anything) 3 ft. 6 in. long × 7 in. wide. Cut these to the shape shown in Fig. 1, and make the mortises for cross-pieces (Fig. 4), of which we shall want two; these must be 2 in. thick and about 4 in. deep; they must be tenoned as shown, so that the top cross-pieces are ¾ in. below the top of sides; this is to allow for the top boarding, which will bring it all level at the top. The cross-pieces being put into the sides and fixed there with wedges, as shown in Fig. 1, the top boards can be put on; these will be ¾ in. match-boarding, and can either be rounded at front and back, as I have drawn it in Fig. 2, or they can be cut square across, but the former makes the best job, and it is not much trouble. A cross-piece can now be fixed on the top at the front, and let down partly between the sides, as shown by dotted lines in Fig. 1; it is fixed by screws at the top into the sides (see Fig. 2); a hole must also be made in the middle, as shown, for the cord to fix in, which is used to pull it up the hill again after running down. The sides must now be shod with half-round iron, as shown in Fig. 1, which also shows the screws for fixing; the iron itself is also shown separately in Fig. 3. The screws must be well countersunk into the iron, or they will catch and overthrow the sledge. A coat of paint or varnish, according to what kind of wood it is made of, will now complete the job; and if made according to my instructions the sledge will last for years, and the cost will be very little in proportion to the amusement to be got out of it.



Snow Sledge. Fig. 1.—Side Elevation of Sledge. Fig. 2.—Top of Sledge. Fig. 3.—Iron for Sides. Fig. 4.—Cross-piece.

Perhaps, for the benefit of those who are not familiar with the article, I had better describe the method of using it. If only one is riding on it, he will sit astride facing the end A, which is the front, holding the cord in his hands. He will then, with his feet, work it forward until he gets quite on the brow of the hill, and when he finds that it will go by itself he lifts his feet and plants them firmly against the cross-piece to which the cord is fixed. After once starting, the speed will increase until on reaching the bottom the sledge will be propelled for fifty or more yards on level ground—that is, of course, if the ground is suitable. The steering is managed by throwing the weight on one side, but this requires a certain knack, which will only come by practice. On a sledge the size of the one described there is room for two, and, at a pinch, three and four can ride with safety, but the steering as well as the starting must be left with the front one, or most likely they will find themselves bottom up before they reach their journey's end. I do not think there is a better or more healthy amusement for boys in snowy weather than sledging, and I hope this short paper will enable many who have never enjoyed the fun to do so this coming winter, when I am certain they will say the same as I do. Tradesmen readers should make snow sledges for sale.

NOTICE TO READERS.

Next week's Work (No. 194) will contain, among other illustrated papers, the following:—

Boot and Shoe Making.
Vulcan Torch for Plumbers.
Historic Links in the Progress of Electrical Science.
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*** The Editor makes this intimation in the hope that readers, having friends interested in any of these subjects, will bring the same to their notice.

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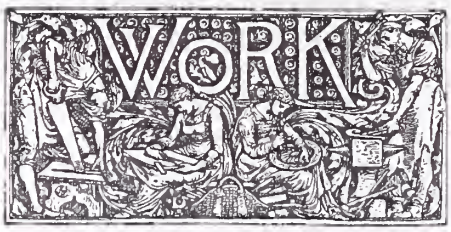

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Work correspondents are wanted in every Town.

Inventions and Manufacturers.—Influenced by the wishes of a large number of our subscribers, expressed in letters constantly reaching us, it is our intention to give effect to a scheme which we have had in mind some time past, and which we are led to believe, from the correspondence referred to, will add another really valuable feature to our columns. This plan concerns inventors, patentees, and manufacturers—in fact, all having to do with inventions. It is well known that Work circulates very largely among mechanical workers, and that patent agents, manufacturers, etc., follow its pages closely for novelties and processes which find their first publicity in Work. Much correspondence, as the "Shop" pages testify, has already passed between inventors and manufacturers, or, as they might be termed, the idea man and the money man; and it will be for the purpose of bringing these closer together that the intended section of the journal will be started. The framing of this department is of importance, and how to make it quite meet the needs and requirements of inventors having novelties and inventions to dispose of, as well as to suit manufacturers who are prepared to take up or purchase such, will, it seems to us, be best secured perhaps by our taking the views of our readers thereupon. Several suggestive letters as to how such a department could well fulfil its purpose have already reached us. Now, however, that we propose to go into the matter, we hope those of our readers who are interested in facilitating matters for inventors will at once write us (*i.e.*, the Editor of Work), stating their ideas and views respecting this proposed section for the journal. In possession of such suggestions, we will proceed to formulate a plan which will, we hope, prove serviceable to inventors and traders alike, the object being to bring inventive minds and capitalists closer together. Such a section ought to prove useful all round. Firstly, to the unrecognised worker who may have an idea which he of himself is quite unable to formulate into tangible shape; secondly, to the mechanical mind which has not only formed an idea, but possesses a practical ability to shape it out; thirdly, to the patent agent, whose special knowledge of patent office law and file should qualify him to answer and advise a possible inventor upon the value or freshness of an invention; and fourthly, useful to the manufacturer in bringing him into closer touch with inventors generally, and enabling him to enter upon business arrangements wherever he may see an opening for capital which he can invest with prospective advantage to himself and profit to the inventor. If our readers—and there are many thousands of such whose special hobby is "inventions"—will go to the pains of making this matter known among their friends, the success and utility of our proposed plan will be well secured. We await the views of our readers, even the humblest, upon this matter.

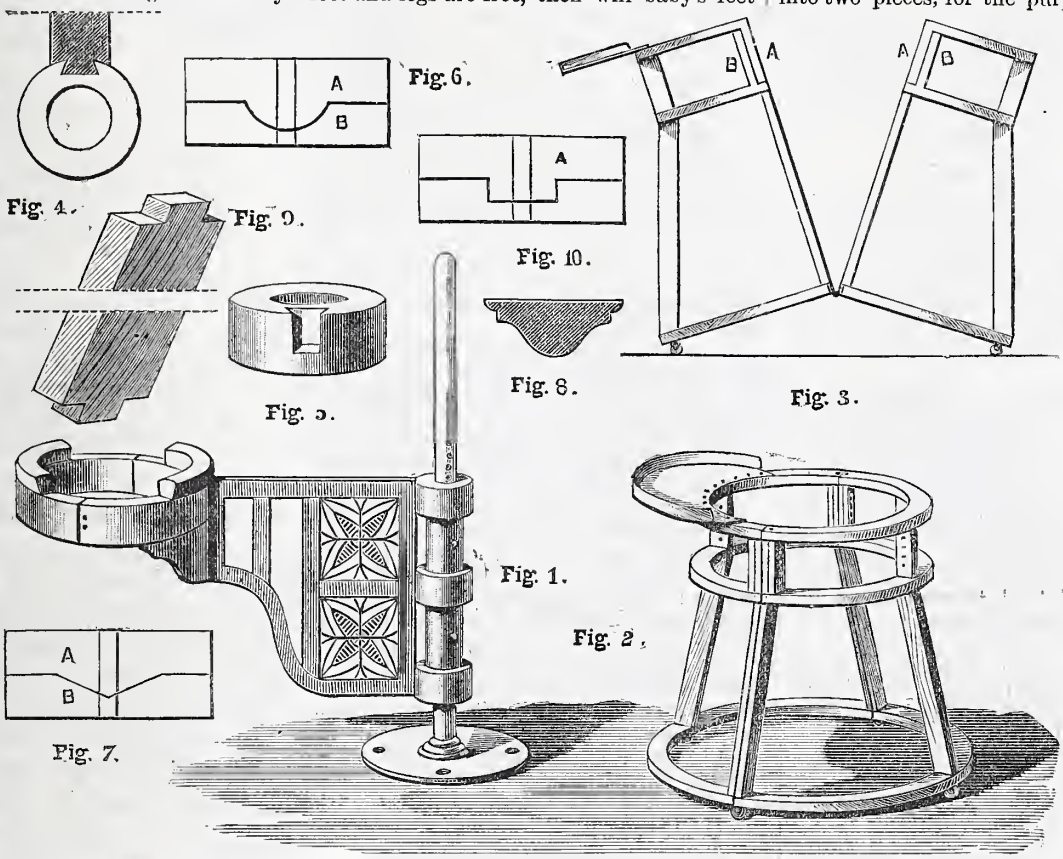
Thrift and Thraldom.—In the everlasting and inevitable struggle which, so long as human nature remains as it is, must continue to be waged between employer and employed, the workman whose only possession is his skill is placed at a great disadvantage. While the rate of wages paid in his district is satisfactory, and trade remains brisk, a clever workman finds everything plain-sailing and comfortable; it is only when wages fall or a failing trade finds employment for fewer hands that he discovers the necessity for something else in addition to his skill. His skill and knowledge are only valuable so long as they can be brought to the place where they are marketable, and before this can be done the workman must be able to remove himself and his belongings to the better-paying district. To the married man with wife, family, and furniture, this is naturally a matter of serious expense, so much so that he is often compelled to take a lower rate of wages because he has not the money to take his skill to the best market. And so it follows that, unless he has learnt to exercise thrift and economy by putting by a certain amount of his earnings for such contingencies, he finds himself the slave of circumstances, never safe from the effects of fluctuations in his trade, or accidents to himself and his belongings. It is a stern truth that he must either learn to save or remain a slave, in the sense that he is not at liberty to better his condition, but must take the terms dictated to him. Thrift need not be confounded with niggardliness. There is no economy in putting money in the savings bank that ought properly to be spent in good food, fresh air, and education: these are all remunerative investments that will more than repay their cost afterwards. But the possession of money in hand will often enable a man to seize the opportunity that he would otherwise have to let escape him; it may be by allowing him to buy some special tool or appliance, or some book which will give him the information he is in want of; or, as is often the case, it is the possession of a small sum in hand that puts it within the power of a clever workman to mature and profit by an invention which would otherwise have gone to the limbo of the good things left unfinished. It may be a hard thing to find any surplus out of the week's wages after paying for the multifarious demands of a small family; but when work slackens, and wages fall off, then comes the pinch of poverty. It is not only prudence, it is a duty of every worker to exercise such economy as he can, both as a preparation for misfortune, and as a means of helping him to get the best value for his skill and knowledge. The present are times when men must look out for themselves—which means, of course, their families.

CHILDREN'S WALKING APPLIANCES.

BY JAMES SCOTT.

INTRODUCTION—FIG. 1: APPLIANCE—FIG. 2: APPLIANCE—TRAY—FIG. 1: FOOTPLATE—HOOP—HOLES—SIZES—FIG. 2: DIVISION—SLOPING RAILS—SIZES.

Introduction.—Some few months ago I was asked by the Editor to supply a paper dealing with appliances having for their object the lending of assistance towards enabling children to accomplish that most important process—walking. Now, I find it a much more difficult affair to apply one's thoughts to a single purpose, and endeavour to evolve something new in a specific direction. As a rule, my practice is confined to noting down stray ideas which may occur to me by chance, as it were, and dress those ideas with the view of introducing them in an article of furniture as being new and suggestive. But I am afraid that, in the present case under attention, I cannot enter a claim for much originality. The main object to secure in connection with an article of this kind is ostensibly the maintenance of a child's body in a perfectly upright position, at the same time allowing due freedom for the limbs to follow the dictates of the juvenile's budding will, and render it a matter of impossibility for the youngster's legs to follow the undesirable pattern of either an O or an X.



Children's Walking Appliances. Figs. 1 and 2.—Two Forms of Contrivances to assist Children in learning to walk. Fig. 3.—Elevational Diagram, showing how Fig. 2 opens to allow Child to enter. Fig. 4.—How to join the Frame in Fig. 1 to the Top and Bottom adjacent Rings. Fig. 5.—One of the aforesaid Rings. Figs. 6, 7, and 10.—Sectional Diagrams (optional) of certain Rails in Fig. 2. Fig. 8.—Bracket to be bent to support Hoop in Fig. 1. Fig. 9.—Upper and Lower Ends respectively of the Sloping Rails, Fig. 2.

(Corresponding Letters of Fig. 6, etc., and Fig. 3 identify same parts.)

Fig. 1: *Appliance.*—An individual whose relationship to me is a maternal one told me, when I hazarded the topic recently, that in her native county, Oxfordshire (as, I daresay, elsewhere the same), it was customary for parents to adopt the proceeding of fixing a pole from ceiling to floor, and attach thereto a revolving kind of wicker basket or a light framing, the intentions on the parents' side being an ultimate, but a tediously limited, excursion round the pole. Acting on this information, I have advised myself to produce the article delineated in Fig. 1. So far as I can form an opinion, it is a different contrivance to that which acted as a suggestive foundation towards it. It is a matter of impossibility, on the part of the relative just briefly alluded to, to use a pen or pencil with any degree of intelligible translation of forms or patterns; therefore it will be understood that I had but a feeble conception of what was what; but I believe that the country articles were non-adjustable, which omission of utility must have caused an extensive amount of inconvenience. I will leave Fig. 1 alone for a while, but will revert again to it shortly.

Fig. 2: *Appliance.*—Fig. 2 to the front! Not a very nice-looking concern, my conscience forces me to confess; but I opine that it is needless for me to impress the fact that a good deal of shaping can be introduced, if desired. Simplicity, however, is the most preferable point to follow in a thing of this kind. Baby's ingenuity will attempt to display some ornamental effects—personally admirable, undoubtedly—upon the affair; for so soon as baby discovers that he or she is being supported under the arms, and that feet and legs are free, then will baby's feet travel on a voyage of discovery, and some incised work will probably remain to testify to the fact.

Tray.—I have placed a tray in one part of article (Fig. 2), but I will not guarantee that baby will always remember that the tray is supposed to be in the front of him. He will, doubtless, be very curious to learn what is behind him, and eventually proceed to discover what exists there, when, of course, the same inquisitiveness will prompt him, and he will reverse his body and gaze once more upon the tray, which, if painted a bright colour, cannot, in the course of time, fail to so enchant him that he will be induced to acknowledge practically that he will continue to face the front of the article.

Fig. 1: *Footplate.*—I propose that the footplate of Fig. 1 be composed of metal, and that it be screwed to the floor when the job is about to be used. I also suggest that the central upright should be of metal. The latter should be firmly united to the footplate, as there is no necessity whatever for it to revolve. A light, yet strong, framework should be tenoned at one side to an upper and a lower ring—wood or metal, as deemed best—having a middle ring screwed to it. It will be advisable to allow the mortises in the rings to stop at a short distance from their bottoms, as shown by one in Fig. 5. This will obviate any tendency arising on the part of the framing to slip down through the mortises when the child's weight is brought to bear upon the supporting hoop. The small end of the framing might be similarly connected to the hoop.

Hoop.—The hoop is intended to be divided into two pieces, for the purpose of opening and facilitating the entrance of the youngster into its domain. It should have a description of fastening which will not be likely to rouse the inquisitiveness of children. A lock will be the most preferable form of connection, as the use of such will avoid any possibility on the part of the youngster to tamper with it. This is a very desirable feature; for the termination of a release of itself by the child, by undoing the fastening, might end far from happily.

In order to strengthen the hoop portion of the job, I advise the reader to cut a piece of wood, similar in shape to that shown in Fig. 8, and, after bending it, screw it firmly to the framing and dovetail it to the hoop. In reference to the process of wood-bending, I may mention that I have frequently successfully followed the treatment of immersing it in boiling water for several minutes until pliable, ultimately binding it securely round a cylindrical object possessing the desired curve, and allowing it to remain so until the wood became thoroughly dry, when the end aimed for is attained. The only additional stipulation to be observed is that the grain of the wood shall run downward in the bend, and not around or along it; in fact, I have failed to serve the wood in the latter manner.

Holes.—There will be a series of holes in the central upright. Over this upright should slide a couple of tubes, between the respective rings adjoined to the revolving frame. A hole is needed through the middle of each tube, through which hole will work a thumb-screw, the latter also passing through

one of the holes in the central upright. It should now be understood that by raising or lowering the frame and the tubes, and by finally fixing the thumb-screws, the hoop may be adjusted to suit any desired height.

It will be advisable, for the sake of comfort, to attach a pad to each side of the hoop. If the reader finds himself in a position unable to accomplish this portion of the work, after he has referred to the numerous details of upholstery in his back numbers of WORK, I must ask him to despatch a query to "Shop," asking the needful, as I cannot enter here into particulars of this kind of industry.

I must revert again to the topic of the thumb-screws mentioned as being used in connection with the tubes which slide along the central upright. Their heads must not protrude beyond the flush of the rings adjoined to the revolving frame, as, if they do, the latter will be prevented from fulfilling its destined purpose. That is why I show the revolving rings as being rather larger than they need otherwise have been.

Sizes.—With a few general sizes, I will close my reference to Fig. 1. Of course, the harder the wood used for the article, the better. Inside diameter of hoop 7 in., depth 3 in., thickness ½ in.; outside of revolving frame 20 in. long and 15 in. deep, general thickness of same ½ in.; central upright any length, as deemed best, and about 1 in. thick; adjoined rings about 2½ in. outside diameter.

Fig. 2: Appliance.—Now I reach Fig. 2. Lightness of construction in connection with this contrivance should be a matter deserving of important consideration; yet lightness must not be adopted to an extreme likely to produce a weak article, by allowing insufficient means of jointing the several parts one to another. If the thing is not very substantial, the weight alone of the child will tend to produce an instability of all parts. If mounted on easy working castors, it should travel freely.

Division.—The article is supposed to be divided into two equal parts, in order to open and admit the youngster to its embrace. As will be understood from a reference to Fig. 3, the hinges are placed against the divided portions of the lower hoop. Something will be required to fasten the top hoop when the article is closed. A connection such as will not be exposed to examination by the juvenile will be best, as, should it be a fastening which he could release by tampering with, the consequences of such conduct might prove highly disastrous. It is really not too much to expect the maker to fit a small lock into each side of the top hoop near its division; for it is a matter of importance that, when in its closed state, the halves of the upper hoop be as rigid, one against the other, as possible. It will also be advisable to have a hook and eye in use at each side of the middle hoop, for reasons which may be obvious.

Sloping Rails.—The sloping rails will be tenoned top and bottom, as shown respectively in Fig. 9, and inserted into similar mortises.

The extreme upper ring halves will each have tenoned into them pendant rails, shaped in section as at A (Figs. 6, 7, or 10), they working telescopically in uprights united to the middle ring, the latter rails being in section the same as at B and A. If holes are pierced along both rails, A and B, the upper ring can be raised and lowered, and maintained at the desired elevation by simply thumb-screwing two of the rails, A, to rails B, and no fear need be entertained that any parts will become loose or separated from the others.

It will thus be seen that the article is divided into two distinctly separate parts: one consisting of the upper ring halves, having the pendant rails, A, and proposed to be made one by being locked together at the top; the other being constituted by the middle and lower rings, and the sloping props being united by hinges, as shown in Fig. 3.

The tray is nothing more than a thin-shaped board with a surrounding rim, screwed to the top ring, and intended to act as a table, whereby the youngster may while away the time that he does not feel inclined to devote to travelling. Pads may be used on the top of the article if desired, but it will be found a very difficult matter to fix them in such a way as to prove of any great degree of comfort, on account of the divisions of the job; which divisions, however, could be regarded as being placed at the front and back of the job if the tray is omitted; in which case, of course, no anxiety need transpire relative to the fixing of pads.

Sizes.—Suitable general dimensions will be: Height to the top of the article when closed, 18 in.; inside diameter of the top and middle rings, 7 in.; distance between the same when closed, 5 in.; all rings being about 1¼ in. wide and ¾ in. thick; sloping rails being ½ in. thick, rails A and B being each about ⅝ in. thick.

In order to arrive at the dimensions I have given respecting this article, and also Fig. 1, I have submitted to the indignity of measurement a juvenile of the male persuasion, who did not attempt to facilitate matters by exhibiting a quiet acquiescence, and who is perpetually striving to call me "dad"—in fact, a first-born—from which I hope the reader will see that I have not guessed haphazard what I deem to be serviceable sizes; and I add to this hope another: that my present paper will not have proved devoid of interest and utility, although it deals with a subject which may be reasonably assumed to appeal to but a limited section of our readers; although, of course, many elder brothers may be possessed of natures so benevolent as to induce them to give attention to such matters, with the view of providing their younger brothers and sisters with such a means whereby the art—is it an art?—of walking may be properly accomplished.

SEAM IRON.

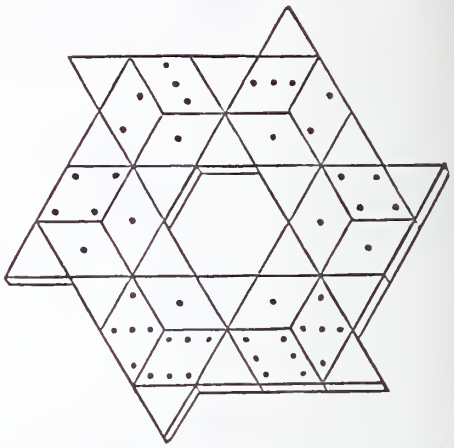
THIS is an American invention, simple in construction, thoroughly practical, and so

American Seam Iron.

constructed as to readily open any seam and thoroughly press it. It does not touch any portion of the garment except that which forms the seam, which should render it useful, as many articles are ruined by the pressure of the ordinary iron upon the fabric. The iron is made in four sizes, from 5½ lb. to 15 lb., and is designed for the use of tailors, dress and cloak makers, and for family use.

JAPANESE DOMINOES.

THE game of Japanese dominoes differs very much from the ordinary game in the shape of the pieces, their composition, and especially the variety of combinations; for this reason it deserves mention. The pieces, thirty-six in number, are triangular, inlaid with a hexagon of bone, ivory, or pearl, level with the sides, imitating a dice seen from three sides at the same time. Each piece



Fortune-telling Figure with Japanese Dominoes.

has three kinds of spots of different colours, black, red, and yellow, and in each shade there are 6 ones, 6 twos, 6 threes, 6 fours, 6 fives, 6 sixes; each piece has a fixed value according to the black spots, which are tens, and the reds, which are units. Thus the black 3 + red 4 = 34.

The number of players is variable. Each person takes six pieces. The game begins by the highest domino taken up according to its value. Red is played on red, and black on black; on yellow nothing is played, but if a higher piece in yellow is played than that it covers, you can play again on either side of the line until the yellow played is less than the preceding. The player who draws from the stock can only take one at a time. Nothing is taken from the stock when the game is shut—that is to say, when the six pieces with the requisite spots are already placed. The player closing the game can reopen it if advantageous, by taking a domino from one end to the other, which counts as a turn. The game is won by the player with least dominoes in hand when the game is definitely concluded. When equal, the game belongs to the player who closes the game. The last domino played gives the points won. If forty-three, for example, the game is forty-three points.

The "Japs" also with these dominoes tell fortunes, generally by the construction of regular figures according to rules given with the game. The accompanying diagram illustrates one of these figures.—*Inventions Nouvelles.*

LIQUID PARAFFIN dissolves camphor. The solution becomes perfectly limpid with a little heat.

SCIENCE TO DATE.

Caoutchouc from Turpentine.—Isoprene is a volatile liquid hydrocarbon, boiling at 36° C., and having the composition C_5H_8. It was first obtained by the destructive distillation of indiarubber, but Professor Tilden obtained it from the products of the action of a moderate heat on oil of turpentine and other terpenes. Specimens of isoprene prepared by the latter method, which had been kept for some time, were found to have changed to a dense syrup, in which large masses of a yellowish solid were floating. This, on examination, proved to be caoutchouc and to possess all the properties of Para rubber. It is formed by polymerisation of the isoprene.

Action of Metals on Indiarubber.—Recent experiments on the action of metals on indiarubber show that copper is most destructive in this respect. Platinum, palladium, aluminium, and lead only act very slightly, while magnesium, zinc, cadmium, cobalt, nickel, iron, chromium, tin, arsenic, antimony, bismuth, silver, and gold have no action. Of metallic compounds, those of copper are most destructive, but nitrate of silver, manganese dioxide, and several salts less common are equally so. The nitrates of iron, of soda, of uranium and ammonium also exercise a deleterious action, but less pronounced than in the case of the preceding salts.

Hexaiodobenzene.—This substance, of composition C_6I_6, has lately been discovered by Mr. Shaw at the Finsbury Technical College. It crystallises in white needles, melting at 248° C., and is soluble in aniline and nitrobenzene.

Onyx.—A deposit of onyx of considerable importance has been discovered in Mexico. It is said to be of superior quality, and richly shaded with delicate and varied tints. Blocks of considerable dimensions can be extracted.

Monster Search Light.—The Americans have now got the largest and highest search light in the world. It is placed on Mount Washington at a height of 6,300 ft., and is calculated to have 100,000 candle-power. The light is produced by an electric current of 90 ampères, with a voltage 56, and is concentrated by a lens 30 in. in diameter. It is stated that the beam is powerful enough to permit of a newspaper being read at a distance of six miles.

NOTES FOR WORKERS.

A REMARKABLE clock is being exhibited in New York. It is the work of an artisan, and contains 34,000 pieces, comprising about 325 varieties.

THE aperture of the great telescope at the Californian observatory at Mount Washington is 36 in. The new equatorial to be put in the Royal Observatory at Greenwich will be of 28 in. aperture.

THE spectacles in use for subaqueous or underwater work can be made by putting two watch glasses of 1¾ in. diameter and 1 in. radius back to back, or with concavity outward.

THE United States in 1891 produced 1,604,840 oz. of gold and 58,330,000 oz. of silver.

IN mines classed under the Coal Mines Regulation Act, the total quantity of mineral wrought during 1891 was 197,693,592 tons, of which 185,479,126 was coal and 29,150 ironstone, the rest being fireclay, oil shale, and other minerals. This means a total increase of 3,087,705 tons over the production in 1890—there being an increase of 3,864,838 tons of coal, but a decrease of 888,326 tons of ironstone.

YELLOW prussiate of potash, or potassium ferrocyanide, is made by fusing dry refuse animal matter—as leather, etc.—with impure potassium carbonate and scrap iron at a red heat in a closed iron pot. The melted mass is treated with hot water and filtered; the liquid is evaporated when the potash salt separates out as large yellow crystals.

WHEN looking through a microscope keep both eyes open, which is much less fatiguing than screwing one up. It only requires practice; and also use either eye indifferently.

A GLAND is an organ which has the power of separating certain materials from the blood which flows through it.

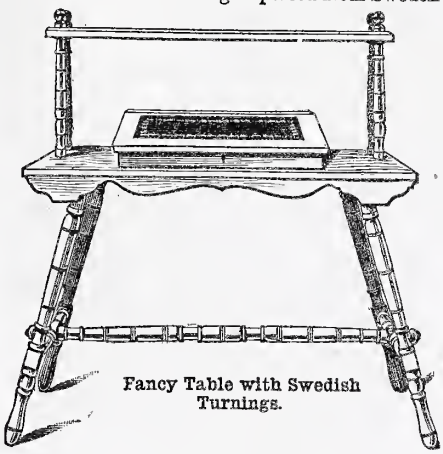
THE new organ in Meanwood Church, Leeds, controlled electrically, must be something of a novelty. The keyboard is detachable, enabling the performer to play from any part of the church.

THE printing press on which *La Chronique Industrielle*, Paris, is printed is worked by electricity, a Miot motor of 2 horse-power being connected to the printing machine.

SOME GOOD THINGS.

*** Manufacturers, Inventors, and others desiring notices of their specialities in WORK, are requested to send samples and full particulars to the Editor of WORK.

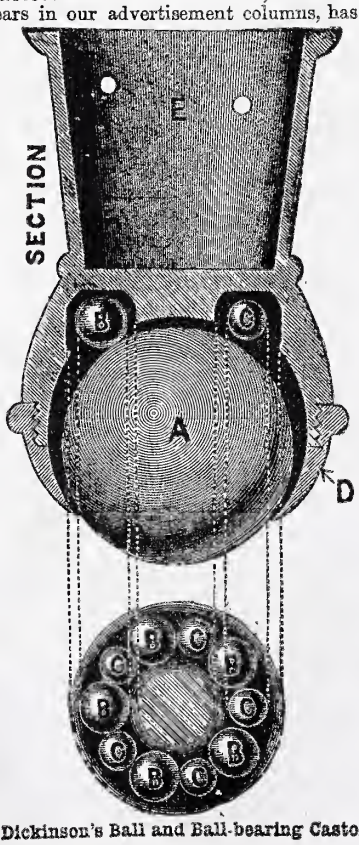
Swedish Turning.—Many of our readers who are not turners make inquiries for turned wood spindles and parts for making up. Such turned wood is now being imported from Sweden



Fancy Table with Swedish Turnings.

by Mr. R. Lee, whose address will be found later in our advertisement pages. We give the photograph of a writing-table made up from such turnings, which will give an idea of how it is utilised. The turnings, which are in white birch, screw together, making the table portable, and they pack into a small space. The price of the turnings complete (seventeen pieces) is 3s. 6d. per set. The wood for such a table should be American whitewood, and the whole thing should not cost over 8s. The turnings can also be made into a dressing-table with swing glass at about the same price. In this latter a small silk curtain, run on a ¼ in. wooden rod at back of shelf, fixed with two steel screw rings, would give it a good finish. We cordially recommend these turnings, which are cheap and good.

Castor.—Mr. J. T. Dickinson, whose address appears in our advertisement columns, has submitted to us his patent ball and ball-bearing castor to test. As the result of the trial and the test we have made of it, we can unhesitatingly pronounce it a good thing. Here is a description of it:—A is a large or main ball, made of steel or any suitable material. B shows the steel bearing-balls, three (or more) in number, placed in the concentric annular groove. C represents steel anti-friction balls, also three (or more) in number, which are a little smaller than the bearing-balls. One (or more) of these is placed between each adjacent two bearing-balls. D is the cap to screw or otherwise fasten on edge of cup, or the edge of the cup may be turned over so as to enclose and retain the balls in the cup. E shows the socket, or any other arrangement to suit any kind of furniture, piano, safe, etc. It will be clear that as the large ball can only rest or bear on the three or more bearing-balls, there must be, and is, the minimum of friction, and that it is impossible for the large ball or the bearing and anti-friction balls to stick or get jambed. To what better use, for instance, could these turn-any-way castors be put than as fittings for the "Children's Walking Appliances" described in another column?



Dickinson's Ball and Ball-bearing Castor.

BOOKS.

General Knowledge.—"Everybody's Pocket Cyclopædia," by Don Lemon (Saxon & Co.). When, with the lapse of time, the world drifts to some epoch which may be known as a "grateful age"—when gratitude will be meted out in proportion as it is deserved—publishers may expect to be large recipients of the beatitude, if only for their amazing industry in providing man with his books. The only drawback to this blessedness may be a counter-reckoning for the tempting trail of excellence and cheapness which has made the buying of literature an incurable complaint. Here under notice is a veritable world of learning reduced to its least possible elements, and which, could any head carry it all, would make its owner wiser than Solomon, and more philosophical than Socrates. Yet all this can be bought for 4½d.! In the pocket volume before us are some 225 pages brimful of information which men and women ought to have more or less "at their fingers' ends," as the saying runs, and relating to matters eventful, historical, geographical, literary, love, marriage and etiquette, sport, scientific, agricultural, household, arithmetical, commercial, physiological, medical—all with a complete index encased between cloth covers of a handy size that can, and should, be carried in the pocket. Truly this is a wonderful publishing age, and the "Everybody's Pocket Cyclopædia" is one of its wonders.

Gardening.—"Garden Design and Architects' Gardens," by W. Robinson, F.L.S. (Murray). A protest against defiling, or, as it is considered, *improving* Nature, is unfortunately much needed at the present and for some long time to come, until the false views which have obtained are completely obliterated from the modern teachings relating to gardening. Mr. Robinson—an authority than whom no better exists—is well qualified to raise objection against the barbarous practice which has long been rampant of hacking at all foliage in order to render it more in consonance with the ideas of those to whom it may happen to belong, and therefore, as it is urged, to render it more beautiful! In the little volume under notice—quite a work of the printer's art—Mr. Robinson yearns to show, by actual examples from British gardens, that clipping and aligning trees to make them "harmonise" with architecture is barbarous, needless, and inartistic. We heartily agree with Mr. Robinson's views, and hope that the men he has taken to task will stay the ruthless hand where mischief may yet be wrought. The wealthy, contemplating gardens of any extent, might well ponder over Mr. Robinson's remarks. Poor people's gardens, curiously enough, are commonly on Nature's lines. Hence they are generally admitted to be "beautiful."

TRADE: PRESENT AND FUTURE.

*** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

Glass Trade.—Owing to the depression in the glass trade, one of the largest firms in St. Helens has given notice of a 5 to 15 per cent. reduction in wages.

Flannel Trade.—This keeps in a fairly prosperous condition.

Cutlery Trade.—The Sheffield cutlery trade shows signs of improvement, many manufacturers being busy.

Rolling Mills Trade.—There has been a slight spurt in the business done at the rolling mills in the Sheffield district.

Cabinet Making Trade.—The operative cabinet makers of Bolton have decided to establish works of their own on the co-operative principle. Upwards of £200, in £1 shares, were subscribed by the men at the meeting. The men say they have been forced to take this course by the masters, and that they believe it will be a direct blow to the sweating system.

Silver Trade.—Accounts of trade differ in a remarkable degree. One house is busy with large orders, and another cannot find full employment for their men. On the whole, trade is not so good at this time of the year as it generally is.

Tailoring Trade.—The tailors of Liverpool are taking means to strengthen their organisation; the majority of them are members of the Jewish persuasion. There is a good demand for hands in this trade at present.

Stove Grate Trade.—A strike has been averted at Rotherham. The men objected to the dismissal of a fellow-workman, believing the action arose through shortness of work. The Stove Grate Workers' Union have sifted the matter, and find the firm were fully justified in their action, and supported them accordingly.

Engineering Trade.—The Lancashire engineering trade shows no signs of improvement. By the wreck of the *Roumania* several large orders will be placed shortly in this district, as that vessel had on board two or three sets of engines, several boilers, shafting, etc., which had been supplied by local firms, and which will have to be replaced. Our Rochdale correspondent writes:—This trade is in a bad state, only one firm in the town doing anything like full time.

Timber Trade.—In the timber trade there has been little animation lately, and prices are difficult to maintain. Yellow pine timber: waney moves off slowly, but square is more difficult of sale; there is no change in value. The demand for red pine is very limited, and prices are low. There is a fair inquiry for prime oak wood, but inferior qualities are almost unsaleable. Ash is in fair request, but prices are unchanged. There is no improvement in price of pine deals. The stock of pitch pine is too heavy, and prices are, therefore, low. Of deals, the consumption has been limited, and the prices are fairly steady. The recent furniture woods auctions were well attended, and considerable business resulted; the prices were fairly good for all classes of fancy woods. The following prices were obtained: Birch planks, £7 to £7 5s. per standard; spruce deals, £5 10s. to £5 18s. 9d. per standard; oak waggon scantlings, 16d. to 2s. per foot; flooring boards, £7 2s. 6d. to £7 5s. per standard for first quality, 1 in. by 6½ in. or 7 in.

Iron and Steel Trades.—The outlook is dull, and demand poor. The depreciation of the purchasing power of the rupee in India, and the stagnation of the Australian trade, are among the causes. During the past ten months there has been a falling-off in the exports of railway material of 260,000 tons. Last month alone showed a decline of 7,000 tons. There is a good demand for crucible steel. Swedish irons are unchanged in value, and it is almost impossible for them to fall lower. Charcoal, an important factor in the manufacture of Swedish irons, is 40 per cent. dearer than four years ago. There is very little doing in the steel trade of the Lancashire district. The Bolton steelplate mills have now been restarted after several weeks' stoppage. Local makers are quoting £7 per ton for boiler-making qualities of plate, but other district brands can be obtained at £6 15s. per ton.

Cotton Trade.—Our Rochdale and district correspondent writes:—The long-talked-of lock-out is now an accomplished fact, and there are between 40,000 and 50,000 operatives "playing them" in Lancashire, though only about 150 are doing so in Rochdale, the masters keeping the mills working, and paying the necessary fine for doing so to the Federation. This mode of procedure does not suit the millowners in the surrounding towns, and great pressure has been brought to bear on some of our local masters to get them to close their mills—but, so far, unsuccessfully. In the meantime, there is much talk as to whether these Rochdale "blacklegs" will cause the lock-out to collapse. The operatives, although still at work in this district, are feeling the effects, having to pay a levy of 5s. 6d. per week towards the society funds; and the children employed as "piecers," etc., are levied on at the rate of 1s. per week.

SHOP:

A Corner for Those who Want to Talk It.

I.—Letters from Correspondents.

Hobbyists' Emporium.—Thomaso writes, in reply to E. D. (*London, W.*) (see No. 183, p. 428):—"E. D.'s reply to my objections to his scheme is in exactly the style I anticipated. It is one of those high-flown epistles used from time immemorial to cover the retreat of a defeated writer. To be in character, it ought to be heralded by trumpet fanfares, and punctuated by the big drum. He says it is not 'worth while' to answer me. What a poor proposition it must be, not to be worth while defending! Perhaps its indefensibility may be the cause of this 'not worth while' frame of mind. He continues, 'The more so as I (Thomaso) have apparently no personal interest in the object in view.' That should be a reason for answering my objections; for if I have no interest in the matter, then am I unprejudiced, and my opinion of the more value. But no one but E. D. would dream of saying I apparently had no interest in the matter when there is nearly half a page of my criticism staring him in the face. Then he falls foul of me for drawing conclusions from what he calls his 'primary' suggestions. Whatever was the good of his making suggestions if no one was expected to follow them up and discuss their possibility or otherwise?—chiefly otherwise, as it happens. I give him credit for not doing that which he wishes others to abstain from. He certainly has not followed up, or drawn conclusions from, any of his own suggestions. Hence his scheme. He goes on to say that many of my conclusions 'are totally wide of the intentions and ideas of the writers.' I have not the slightest doubt they are, and I appreciate that statement in E. D.'s letter as a confession of shortsightedness. Where the 'writers' do not tell us what their intentions and ideas are, or, indeed, whether they have any at all, and one 'writer' merely makes what he calls 'primary suggestions,' which are primary to nothing, I do not think a disagreement is to be wondered at. E. D. then remarks that I do not offer the crudest suggestion myself. Of course not; and I gave the reason on p. 332. Further, the crudest suggestions being E. D.'s special prerogative, I thought he might resent a feeble imitation. As to the descent to the marine store, that was of necessity, being in the nature of the subject. Finally, E. D. says that the conclusion of my letter was 'totally uncalled for.' I daresay it was. We get many things in this world we do not expect. And when we 'call for' eulogy and, instead thereof, merely get our faults pointed out by someone who is not 'a little blind' to them, it is somewhat exasperating. He continues: 'And, fortunately, foreign to the usual kindly and courteous columns of 'Shop'.' The columns of 'Shop' are, I admit, usually useful, and bear evidence of thought and consideration; and communications hall-marked 'E. D.' are, 'fortunately, foreign.' Perchance some of my remarks would be discourteous if they were not general in their application. I can only say that any generalisations of mine do not include E. D., or anyone else for that matter, unless such inclusion would be condign; and that is, of course, a matter of individual opinion. It would have looked less significant if E. D. had not appropriated to himself all my remarks. The idea of a place for the sale of amateur work is a good one. The only question is, How is it going to be worked? It is no use having a bad superstructure, even if it does only consist of 'primary suggestions.' I did not think, when I poured cold water on E. D.'s red-hot scheme, that it would have resulted in such a mournful little fizzle as his reply on p. 428. I thought that the correspondence would have become general, and that, amidst the smoke of conflict, we might possibly have caught the glint of a few bright ideas. But, to judge by the very few letters appearing on the subject, the idea, in its present form, has not 'caught on.' Never mind, Mr. E. D. Cheer up, as the sparrows say; you will be visited by brighter and more useful ideas presently, and will, no doubt, communicate them to us when time shall have had its usual healing influence on your feelings."

Weighing and Measuring.—Axe writes:—"Supplementary to E. D.'s reply to J. H. K. (*No Address*) in Work (No. 182, p. 430), permit me to say that the publishers of the book entitled 'Weighing and Measuring,' by H. W. Chisholm, are Messrs. Macmillan & Co., Bedford Street, Covent Garden. The book is now out of print. I have been trying to procure it from various sources (including the author), but without success, for more than two years. I shall now try the Britannia Co. on the strength of E. D.'s advice to J. H. K. I have read the book, which is a very good one on the subject by a very good authority."

II.—Questions Answered by Editor and Staff.

Patent.—Bono.—To do what he requires, Bono should prepare, or, in vulgar parlance, "write out," what he wishes to say, in bringing his invention to public notice. Having done this, he should send a copy of it to the *publisher* of such periodical or periodicals as he may select, asking him to send price for one, two, or more insertions, as he may decide, and he will not wait long for the required information.—C. E.

Science Exams.—B. St. C. (*Lincoln*).—You cannot do better than communicate with the Secretary, Science and Art Department, South Kensington, London, S.W., stating your case, and enclosing stamp for reply. He will advise you what to do, as you are at a distance from a science class. Any little points in electricity not clear to you shall have my attention, if you will send on a list of your difficulties to me.—G. E. B.

Silver Plating.—E. R. (*Plaistow*).—You cannot easily make a silver plate, bend it to the form of a bicycle handle, and solder the plate thereto. Bicycle handle-bars are usually plated with nickel or with silver by the electrolytic process. To do this will require the use of costly apparatus and some skill, acquired by long practice. You will find it cheaper to get such things done by a professional plater. If you do not know of one, I shall be pleased to get it done for you.—G. E. B.

Planchette.—F. A. C. (*Pendleton*).—Full directions for making this apparatus, with explanatory diagrams, were given in Vol. III., p. 317 (No. 124).—S. W.

Bending Bamboos.—R. H. M. (*No Address*).—Either steaming or placing in dry heat, as over a lamp, will enable you to bend bamboos. If you will look through your back numbers, you will find that this and most other points connected with bamboo working have been freely discussed, and useful information given upon them. More especially you are referred to Vol. I., p. 591 (No. 33), and Vol. III., p. 252 (No. 120).—M. M.

Cores for Casting.—J. B. (*Weymouth*).—You do not say what you wish to cast, but, broadly speaking, cores are made, both for brass and iron castings, of well-tempered clay or wet loam, and afterwards dried; but perhaps a few hints on foundry work will be found useful. Patterns for moulding require to be made rather larger than the cast required, to allow for the contraction of metals when cool. That for brass is $\frac{1}{8}$ in. Patterns for iron founders are, therefore, made larger than the finished size of the casting, in the proportion of $\frac{1}{8}$ in. to 1 ft. in linear measurement, and known as "shrinkage;" the pattern-maker's rule is longer by that quantity than the ordinary engineer's rule. The principal requisites of a good foundry sand are fine and uniform grain, a certain amount of cohesiveness without being sticky, infusibility at the time of pouring the metal, and freedom from combustible or other substances. These are best fulfilled by a nearly pure quality of siliceous sand, with about from 3 to 4 per cent. of clay, and a slight proportion of hydrated peroxide of iron. The particles, when moulded, should allow free passage for the gases to escape, while perfectly impermeable to the melted metal. The sand may be used over and over again, fresh sand being added from time to time to maintain its elasticity. A little ground coal or charcoal will be found a good addition. Although the sand is, in the first instance, actually red or brown, by constant use it is turned to a grey or black. In loam moulding, as used for large pipes, a hollow core of iron or brick is placed in the centre of the foundry, and around it a layer of loam—that is, a mixture of sand and clay—rendered plastic by mixture with water, laid on by trowels, and finished by a revolving template working round a central vertical spindle to the diameter of the interior forming the core, which, when dried, is washed with finely ground charcoal and water. In brass foundry work there are three kinds of castings: (1) Common castings, made from any plain mould; (2) cored castings, such as tubular work, requiring a central core; (3) false-cored castings, where the pattern is so undercut that the mould must be built up of such a number of sections as the intricacies of the pattern may require. But beware of explosions, as they are something awful in their effects. Unless you are about to follow foundry work as a business, you will give the work into the hands of practical men. If you make your pattern and send it to the brass or iron founder's, they will make the necessary cores. As to prices, in this district we can get iron cast from our own patterns at 1d. per lb., brass castings at 10d. per lb., and gun-metal (copper and tin) at 1s. per lb. Mr. W. Elshaw, brass founder, 107, John Street, Sheffield, will be found reasonable in his charges, at the same time producing good and clean work.—N. M.

Pin.—J. C. (*St. Helens*).—We think you had better apply to a Birmingham manufacturer for such pins.

Perspective.—H. L. (*Norwich*).—You should send to Winsor & Newton, Limited, Rathbone Place, W., for the "Elements of Perspective," by Aaron Penley, price 1s.; postage would be additional.

Butter Pot.—H. B. (*Yorkshire*).—I am afraid it would cost you more money to patent the article you speak of than you would be prepared to pay. I think something very like it has already been protected, if not patented. If you take my advice, you will try anything in preference to "patenting,"

in the hope of earning money whilst you are out of work.—E. D.

Veneers.—WISEMAN.—For all kinds of veneers for inlaying, try either of the following firms, who will be pleased to quote you:—Witt & Palmer, Drummond Street, Euston Square, N.W.; L. Marshall, 14, James Street, Old Street, E.C.; and J. Wright, 51, Great Eastern Street, E.C.—A. J. H.

Photographer's Sink.—W. O. (*No Address*).—A very serviceable sink may be made of inch deal, and well coated with paraffin. The size of the sink may be made to suit the position in which it is proposed to place it. Supposing it is about 2 ft. long by 18 in. wide and 6 in. deep: procure two lengths of inch deal 7 in. wide and 26 in. long, also two 7 in. wide and 18 in. long. Rebate them as in diagram, and screw them together as a frame. Then cover one side with inch deal, firmly screwed on. Make a hole with an auger, and countersink

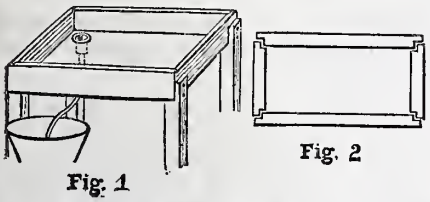


Fig. 1 Fig. 2

Fig. 1.—Sink Complete. Fig. 2.—Sink showing how Corners are put together.

it on the inside of the tray. Procure a few inches of lead piping, fit it into the hole, and burr it out to fit into the countersunk part. A piece of indiarubber tubing can be slipped over the narrow end to conduct the waste water into a bucket underneath. When the tray is firmly screwed together, melt together equal parts of pitch and paraffin. Make the tray warm before the fire, and then pour in the composition, and with a hot iron smooth it over the whole of the inside of the tray. When set, a most useful sink will have been made. Four uprights may be attached to the sink, which will then assume the table form.—D.

Boilers.—P. R. (*Alloa*).—A reply has been sent which will most likely appear in "Shop" columns before you see this. If you have not seen it, please refer to p. 492, No. 187, when you will see the reply under the heading of "Steam Economiser."—M.

Circular Saw Bench.—SAWSTICKS.—I have been obliged to read your letter through a few times before I could find out what you were driving at, and all I can make out now is that you are simply finding fault for the sake of doing so. The cog wheels will, no doubt, cause a certain amount of friction, but not so much as short straps would; and as to its being "monsterous," you should try it and see, as well as the speed of 13 to 1 being "rediculus." I am glad you give me credit for designing a good frame; it shows the article has something good about it. I do not wonder at the first bench you state you made being for sale; there would be friction indeed. You are the first I have known who has stated that to do good work the saw should travel as slowly as possible. If this is correct, why not mount the saw on a spindle and turn the same direct without any gear at all? I am afraid I must class your ideas among the "rediculas" ones. As you say, you are quite free to "critise" my article, but before you attempt to do so, you should endeavour to know what you are writing about.—CHOPSTICK.

Lanterns—Cameras—Printing.—J. L. (*Aberdeen*).—Back numbers contain much on lanterns and cameras. For printing press, look out for articles shortly to be published.

Photographic Addresses.—G. W. S. (*Harley Bank*).—E. & T. Underwood, 130, Granville Street, Birmingham; J. Lancaster & Son, Colmore Row, Birmingham.—D.

Card Tables.—A COUNTRY CABINET MAKER.—Remove the scratches from the varnished surface by means of fine glass-paper, on the face of which has been sprinkled some methylated spirits. Should the varnish when softened with spirits be of too sticky a nature to allow this to be done, try linseed oil. Touch up the flowers, etc., by means of suitable pigments, mixed with one part white polish and three parts spirits; wipe all over with an oily rag and work up with white polish.—LIFEBOAT.

Cement.—A. F. M. (*Liverpool*).—Dissolve shellac in wood-naphtha till of the consistency of treacle; mix this with marble dust sifted through fine muslin. Apply the dissolved shellac to the edges of the fracture, and fill up. When set, rub down level with fine emery and finish with crocus or putty powder; then paint three or four coats, rubbing down between each coat with fine glass-paper, and varnish. Or dissolve black sealing-wax in naphtha, make a fence of paper on each side of fracture, and pour in. When set, polish and paint if required. If the fracture is at the lower edge, fix a piece of thin leather across each end, which will protect it from being chipped when moving the clock. If you cannot manage the above satisfactorily, fix a thin black moulding round, of sufficient height to cover the fracture. I am glad to hear you appreciate WORK, and hope more of your friends may become subscribers.—M.

Winding Dynamo.—H. C. (*Axbridge*).—The drum armature of your machine being 6 in. in length and 3 in. in diameter, and running in a $3\frac{5}{8}$ in. tunnel, you have $\frac{1}{4}$ in. of space all around. As No. 16 d.c.c. copper wire occupies twelve coils to the inch of space, two layers will well lie within the $\frac{1}{4}$ in. As the circumference of the armature will be about $9\frac{1}{2}$ in., and each coil will take 18 in. of wire, two layers will take about 112 yards; but as one-third of this will be "dead wire," it will be necessary to wind on 5 lb. = 120 yards, to get an E.M.F. of 60 volts at a speed of, say, 1,500 revolutions per minute. The resistance of the coils on this drum armature will be 0·25 ohm. As the machine is a small one, the field-magnet coils must not have a resistance more than 100 times this, or that of 7 lb. of No. 22 copper wire. If, however, you can get on 20 lb. of No. 20 wire, this will be preferable to 7 lb. of No. 22, because No. 20 wire will heat less, and the machine will have, in consequence, a higher efficiency.—G. E. B.

Electric Light.—AXLE.—Three 10 c.-p. incandescent electric lamps will give ample light for a room 10 ft. square. Current for these may be obtained from a model Siemens dynamo of from 50 to 60 watts capacity, driven by a gas or water motor of 1 man-power. An arc lamp will be altogether inadmissible, as the light from one of these would be from 100 to 200 c.-p. at least.—G. E. B.

Electro-deposition of Bronze.—AXLE.—The appearance of bronze may be obtained from an electro-brassing solution if you work it in the right way to deposit an excess of copper over that of the zinc. By putting a resistance-board in circuit, and altering the resistance to suit your requirements, you may get almost any tint of brass or bronze in the deposit. In this way we can get a drab, greenish-yellow, pale yellow, full yellow, orange, or bronze-tinted brass from the same solution.—G. E. B.

Ribs and Keel of Two-masted Model Screw Steamer 3 ft. long and 5 in. Beam.—M. F. H. (*London*).—It would be better, in the case of a boat only 3 ft. long, to carve it out of a solid block of wood, as described in WORK, No. 160, pp. 58 and 59, as building any boat, especially a small one, is a very delicate operation. However, since you wish to build it, the following is one method of doing so: There are eight ribs altogether, one being placed every 4 in. Their position, as they appear at the deck, is shown in Fig. 2. Fig. 2 is a side view of the boat, showing the position of the ribs and the shape of the keel, the upper side of which extends along the line AB. Each rib is numbered—1, 2, 3, etc.—for the sake of reference. The stern end of the keel is cut out for the screw, as shown in the figure, the shape of the hole and its size, of course, depending upon the size of the engine that is to be used. The width or beam of the different ribs is: Of the first, $2\frac{1}{2}$ in.; of the second, $4\frac{1}{2}$ in.; of the third, 5 in.; of the fourth, $4\frac{3}{4}$ in.; of the fifth, $4\frac{1}{2}$ in.; of the sixth,

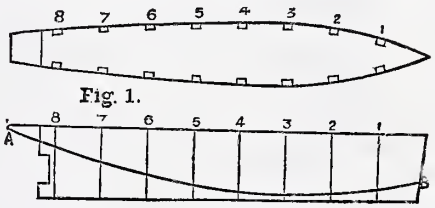


Fig. 1.

Fig. 2.

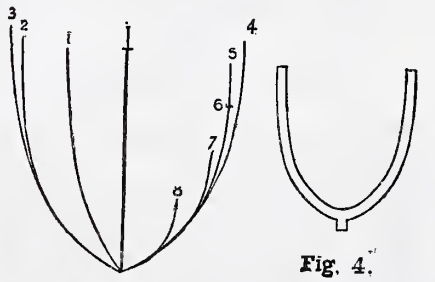


Fig 3 Fig. 4.

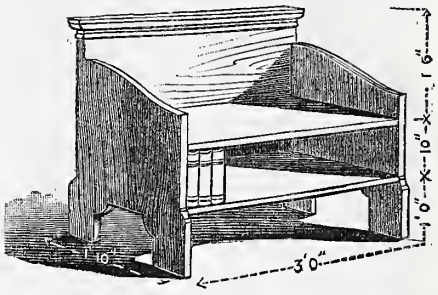
Fig. 1.—Rib Position. Fig. 2.—Side View of Boat, showing Ribs and Keel. Fig. 3.—Shape of Ribs. Fig. 4.—Relative Thickness of Ribs.

$4\frac{1}{4}$ in.; of the seventh, $3\frac{3}{4}$ in.; of the eighth, 3 in.; of the stern, $2\frac{1}{2}$ in. The height of the top of each of the ribs from the top of the keel is: Of the first, $4\frac{3}{4}$ in.; of the second, 5 in.; of the third, $5\frac{1}{2}$ in.; of the fourth, 5 in.; of the fifth, $4\frac{1}{2}$ in.; of the sixth, $3\frac{3}{4}$ in.; of the seventh, $2\frac{3}{4}$ in.; of the eighth, $1\frac{3}{4}$ in. Fig. 3 shows the shape of each of the ribs as nearly as can be calculated, the scale being 6 in. to 1 ft. They are cut out of mahogany—which is the wood generally used for this purpose—of the thickness shown in Fig. 4, a tongue being left at the lower parts so that they can be mortised into the keel. When this has been done, they are further strengthened by short wedge-shaped pieces of wood being fastened on to the keel on both sides. The prow consists of an upright piece of wood, which is mortised on to the end of the keel. The part of the stern which projects over the keel must be carved out of a solid piece of wood and fitted on to the keel by a tongue-and-groove arrangement.—C.

Hand Lathe.—J. H. H. (*Catford*).—Write to the Mason Hand Lathe Co., Des Moines, Iowa, America.

Electric Belt.—J. E. C. (*Redcar*).—The zinc plates next the body. Copper plates outside the belt. Connect the zinc plates of one pair to the copper plate of the next, and so on. By no means can such a belt "throw a continual current through the body." The best it can do is to stimulate or irritate the skin in contact with it.—G. E. B.

Stool.—W. G. B. (*Eastbourne*).—The sketch represents "a stand for portmanteau, with shelf under for



Stool for Portmanteau.

boots and shoes," as requested. To be made out of $\frac{3}{4}$ in. stuff, a curtain sliding on a brass rod being fixed in front of the boot cupboard.—F. J.

Analysis.—FARADAY.—It would take too much room in "Shop" to give a description how to make a full quantitative analysis of a complex substance, as blend ore; and, unless you were experienced in chemical analysis, it would be beyond your powers of manipulation. You can estimate the amount of zinc, however, as follows:—Weigh out accurately a small quantity (0·5 to 1·0 gm.) of the finely pulverised ore, dissolve in aqua regia (a mixture of three parts hydrochloric and one part nitric acid), and evaporate to dryness. Heat the residue with water and a little hydrochloric acid, and filter from sand and other insoluble matters. Through the filtrate pass sulphuretted hydrogen, which will precipitate any lead and copper present—both are often present in blende. Filter, boil off the sulphuretted hydrogen, add a few drops of nitric acid, and evaporate to dryness again. This is to ensure that all the iron present is oxidised. Re-dissolve in a little hydrochloric acid and dilute with water to about 100 c.c., add 30 c.c. of ammonia, heat to boiling, and exactly neutralise with acetic acid. Now add 100 c.c. of acid ammonium acetate (made by adding together 20 c.c. of ammonia of sp. gr. 0·900, 15 c.c. of concentrated acetic acid, and 65 c.c. of distilled water) and dilute with water to about 500 c.c. The zinc will be precipitated and then re-dissolved by the ammonia, and thus we have now the zinc in solution and the iron floating about as precipitated ferric acetate. The presence of this ferric acetate does not interfere with the subsequent process. The liquid is heated to 50° or 60° Cent., and kept about this temperature till the process is finished. A standard solution of potassium ferrocyanide is now gradually run in from a burette, till all the zinc is precipitated. To accurately find the exact point when this result obtains, drops are taken from the solution and brought in contact with a solution of uranium acetate on a white plate until a faint brown colour appears. The number of c.c. of standard ferrocyanide used is read off and the percentage of zinc calculated. Thus, if 0·75 gm. of ore had been taken for analysis, 45·3 c.c. of ferrocyanide had been used, and the strength of the ferrocyanide was such that 1 c.c. was equivalent to 0·01 gm. zinc; then if 1 c.c. ferrocyanide = 0·01 gm. zinc, 45·3 c.c. will equal 0·453 gm. zinc; and this is the amount of zinc in the quantity (0·75 gm.) of ore taken. Then, if 0·75 gm. ore contains 0·453 gm. zinc, 100 gm. ore will contain $\frac{\cdot 453 \times 100}{\cdot 75} = 60\cdot 4$ gm. zinc—*i.e.*, the zinc present will be 60·4 per cent. To make the standard solution of potassium ferrocyanide dissolve 41·25 gm. in distilled water, and make up to one litre, 1 c.c. of this solution is equivalent to 0·01 gm. zinc, but it is best to actually determine its strength by filtrating it with a standard zinc solution. If 10 gm. of pure metallic zinc be dissolved in hydrochloric acid and the solution made up to one litre, then 1 c.c. will contain 0·01 gm. Take 25 c.c. of zinc solution, add 15 c.c. strong ammonia so as to make the solution alkaline, then acidify with acetic acid, add 50 c.c. acid ammonium acetate, dilute to 250 c.c., and warm to about 50° or 60° Cent. Titrate with standard ferrocyanide as before explained. Now we have here $(25 \times 0\cdot 01) = 0\cdot 25$ gm. zinc, and so whatever quantity (somewhere about 25 c.c.) of standard ferrocyanide is used, that quantity is equivalent to 0·25 gm. zinc. Thus, if the quantity of ferrocyanide used be 24·7 c.c., then 24·7 c.c. of ferrocyanide will

equal 0·25 gm. zinc, and therefore 1 c.c. of your standard ferrocyanide will correspond to $\frac{0{\cdot}25}{24{\cdot}7}$ = 0·01012, etc., gm. zinc. To study the subject use "Clowes' Practical Chemistry" (published by Churchill at 7s. 6d.), for learning the reactions and separations of the metals; "Thorpe's Quantitative Analysis" (published by Longmans at 4s. 6d.), for general quantitative work; and also "Sutton's Volumetric Analysis" (published by Churchill at 16s.), for quick volumetric methods.—F. B. C.

Mathematics.—MIDLAND.—For arithmetic use Pendlebury's, published by Bell & Sons at 4s. 6d. The best algebra is "Hall & Knight's Elementary Algebra," published by Macmillan at 4s. 6d. Any Euclid will do, but one of the best is that by Dr. Casey, published by Hodges, Figgis & Co., Dublin, at 2s. 6d. Cassell's also publish books on mathematics, which are good and cheaper than the above; send for one of their catalogues. If you have plenty of time, start all three subjects and divide your time between them. This is less wearisome than sitting too long at a stretch over one subject. If your time be very limited, leave the algebra for a while and start the arithmetic and Euclid. Books on mathematics are generally on sale at second-hand book dealers. Join a class on mathematics as soon as you can.—F. B. C.

Stripping Silver from Copper.—D. M. (*Stonehouse*).—Immerse the copper cuttings in strong sulphuric acid, made hot and kept hot. Add crystals of saltpetre to this until all the silver has dissolved. Remove the copper cuttings, dilute the acid with an abundance of water, and add muriatic acid to throw down the silver as a chloride. Allow this to settle, pour off the acid, and stir fragments of zinc among the wet chloride of silver for some time. Zinc will take the place of the silver, and this will form as a grey powder, which must be well washed, and may then be melted, or dissolved in nitric acid to form silver nitrate.—G. E. B.

III.—QUESTIONS SUBMITTED TO READERS.

*** *The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Transfer Pictures.—J. H. (*Holyhead*) writes:—"Will some kind reader advise me where I can purchase transfer pictures?"

Sheep Dye.—LOST SHEEP writes:—"Would any kind reader tell me how to mix a fast black dye for a sheep skin?"

Double-action Harp.—A CONSTANT READER.—"Would any kind reader oblige me with an illustration of a double-action harp mechanism, showing the working of altering the strings for half-tones? Also, if anyone knows where I could obtain a book on harp construction, and price?"

Fret Monogram.—CHERRY writes:—"Will some reader kindly give me a monogram consisting of the letters 'W. J. L.'?—the L. to be principal letter, and W. and J. both being of about equal prominence."

Monograms.—T. McC. (*Pendleton*) writes:—"Will some reader kindly give monograms of 'M. B. T.' and 'Y. M. C.' for engraving on metal?"

Briar Root.—SAW writes:—"Can anyone tell me where I can get a small quantity of genuine, well-seasoned briar root, suitable for turning tobacco pipes?"

Trousers Cutting.—T. H. H. (*London, W.*) writes:—"I beg to ask AMATEUR TAILOR (see No. 182, p. 412) to give us the history of the trousers system or plan he uses. What is the ground for the bases of his divisions? How did he evolve it? Did he pick it up from some of the tailors' cutting papers, or in what way did he get hold of it? I ask these questions because, since Lord Kilmorey, I have heard of no amateur, beyond the 'Jack tars,' who cut their own trousers. Any information on this point would, I am sure, be most interesting."

Monogram.—H. T. H. (*Merthyr*) writes:—"Would R. D. T. (*Marylebone*) kindly give me an 'H. T. H.' monogram something like the one he sent to SHAMROCK, in No. 164, and about the same size?"

Robes and Gowns.—G. M. (*Lambeth*) writes:—"Is there any tailor or robe-maker who can cut and make robes and gowns, from her Majesty's and the State officers to clerical, etc., who is willing to give a brother craftsman instruction, or tell him how to get the desired information for the same?"—[Tailoring articles are arranged for, but a good series of Official Robe and Gown Cutting would interest a large craft, and would be considered.—ED.]

Fuller Battery.—H. C. G. (*Islington*) writes:—"Will some fellow-reader of WORK kindly inform me how to make up a Fuller battery, quart size? Is the current from this battery steady, and for how long? as mine becomes jerky after a few minutes' work on a coil."

Water.—J. S. (*Glasgow*) writes:—"Having noticed often that in our supply of water for home purposes—at a pressure of 50 lb., I think, on the square inch—it is at times as white as milk, and, when left, gradually becomes all right again, I have tried many means to do this with water for a purpose I have in view. I should feel grateful if you or any of your staff would give me a hint as to what mechanical means I should adopt to do this when required, although it should last for a short time in this white state."

IV.—QUESTION ANSWERED BY A CORRESPONDENT.

Perfect Ellipse.—GULIELMUS writes to OVAL (see No. 184, p. 446):—"METHOD I. (Fig. 1): By means of intersecting lines.—Let the diameters, A B and C D, bisect each other in O at right angles. Through C and D draw parallels to A and B, and through A and B draw parallels to C and D, thus forming a rectangle, E_1, E_2, E_3, E_4. Divide A O and A E into the same number of equal parts. We have chosen four, but the greater the number the more perfect the curve. Join the divisions of A E_3 with C, and then from D draw lines through the divisions of A O, meeting the former lines. The curve traced through the points thus found gives one quarter of the oval. Proceed in the same way with the other quarters. METHOD II. (Fig. 2): With two pins and a thread.—Place diameters as before. With D as centre, and A O as radius, cut A B in F_1 and F_2. Drive a pin into each of the three points, A, F_1, and F_2. Tie a thread tightly round A and F_2, so that it cannot possibly slip.

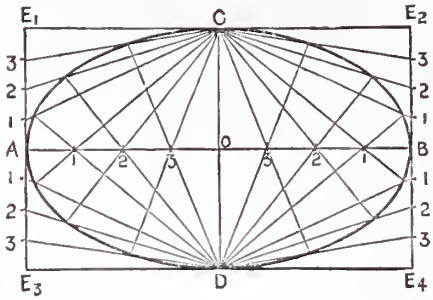


Fig. 1

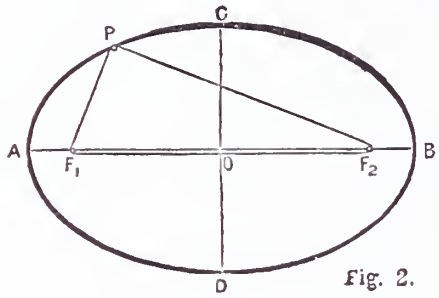
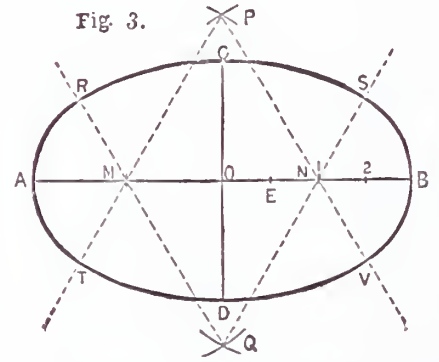


Fig. 2.

Fig. 3.



Methods for drawing Ellipses.

Withdraw the pin from A, and insert in its place a lead pencil. Carry the pencil round, keeping the thread tight against the pins. The pencil will strike an oval through points A, C, B, D. METHOD III. (Fig. 3): With pair of compasses.—Diameters as before. From A, with C D as radius, mark the point E. Divide the distance E B into three equal parts. From O, with two of these parts as radius, cut line A B in M and N. From M and N, with M N as radius, describe arcs intersecting in P and Q. From P and Q, with radius P D, describe arcs T D V and R C S, and from M and N, with radius M A, describe arcs R A T and S B V to complete the oval. Lines drawn from P and Q through M and N show where the four arcs unite. There are various other methods of drawing true ovals, but I think above three methods are sufficient for all practical purposes. Method I. is, of course, the most perfect."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—R. R. W. (*Longsight*); N. R. (*Reddish*); W. W. (*Lateleford*); B. & J. (*London*); J. L. W. (*London, W.*); F. G. (*Liverpool*); F. B. P. (*Leith*); SPIRITS; C. W. H. (*Wandsworth*); CYMRO; IRON WORK; F. H. R. (*Queen's Park*); E. P. D. (*Sherborne*); E. B. C. (*Old Kent Road*); OLD RED GUN; TINKER; P. B. (*Portobello*); FIREPROOF; H. J. (*Coventry*); G. W. B. (*Baildon*); T. W. (*Preston*); J. A. H. (*Cardiff*); W. B. D. (*Liverpool*); APPRENTICE; T. C. (*Yeovil*); GAS PIPE; C. K. (*Shoreditch*); MOWER; A. E. S. (*Keighley*); H. O. (*N. Wales*); G. B. (*Highgate*); G. S. W. (*Dewsbury*); ELECTRICIAN; R. D. (*No Address*); H. W. (*Rochester*); W. S. (*Leeds*); T. H. F. (*Cornwall*); YERRUS; F. L. (*Tunstall*); W. F. (*Ripley*); CANNON; M. L. (*Naples*); W. J. R. (*Northampton*); S. P. (*Newport, Mon.*); C. L. (*Birmingham*); G. F. W. (*London, W.*); C. W. (*Chelsea*); W. F. (*Bolton*); R. W. R. (*Glasgow*); HAIA (*Walsall*); P. N. V. (*Grays*); COKE BREEZE; P. H. (*Staines*; PUZZLER; J. R. H. (*Redbridge*); WHITESMITH; E. O. (*Wellingborough*); G. H. (*Yorkshire*); J. B. (*Glasgow*); D. T. D. (*Manchester*); W. C. (*West Bromwich*); G. S. (*West Hampstead*); WORK; E. W. *Balsall Heath*); W. M. (*Accrington*); J. H. E. (*Rastrick*); NELSON (*N.Z.*); A. W. M. (*Hackney*); T. M. P. (*London*); W. D. (*Newington Butts*); A. T. (*Manchester*); J. P. A. (*Walthamstow*); A. R. S. (*Derby*); J. H. S. (*Sunderland*); W. H. (*Stockport*); W. M. (*Cardiff*); J. E. (*Liverpool*); ROE; E. J. S. R. (*Limavady*).

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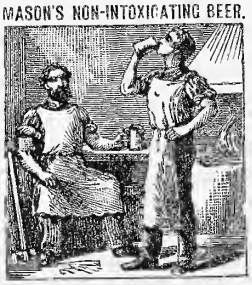

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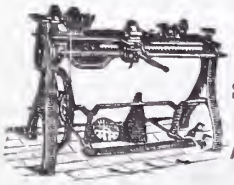

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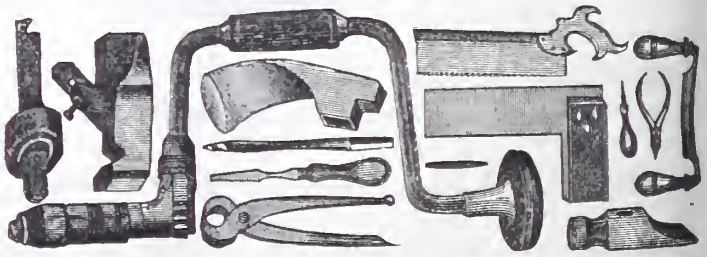

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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VOL. IV.—No. 194.] SATURDAY, DECEMBER 3, 1892. [PRICE ONE PENNY.

WORK WORLD.

PNEUMATIC mail transportation through wrought-iron tubes is becoming general in America. * *

The total cotton crop of the world for 1891 is estimated at 12,570,000 bales, averaging 400 lb. weight.

* *

An electrical cigar-lighter is the latest scientific novelty. It is likely to find favour on the counters of retail tobacconists, etc.

* *

Philadelphian steamers are busy loading oil for France. Encouraged by the low prices the oil refinery business is growing apace.

* *

The Indian wheat crop of 1892 is officially reported to be 5,422,000 tons—the smallest since 1884.

* *

Skilled workmen who arrive in America from Europe are returned under the law prohibiting the importation of contract labour. * *

We hear of the invention of an electric locomotive capable of travelling at a rate of 123 miles per hour. We look with interest for the actual trial results.

* *

A newly invented cotton-picking machine does as much work in two hours as an average farm hand in a week. The hardest problem in cotton-raising is thus solved.

* *

While the London, Brighton and South Coast Railway are extending the electric lighting in their trains, some of the Northern lines are abandoning it and reverting to older methods of illumination.

* *

A new steel vessel, built at Barrow, for the carrying of oil in bulk, is pronounced to be the finest sailing craft that ever entered the Delaware. She carries about 850,000 gallons of petroleum.

* *

A Spaniard has invented a pneumatic tube for the submarine transmission of letters, by which a letter deposited in the tube at Rio de Janeiro would arrive in Europe during the same day. No details, however, are given to show how the air friction in a small tube of such length is dealt with.

The largest power dam ever built in America is now being constructed across the Colorado River at Austin, Texas. It is intended to utilise the power of the river for electric lighting, railways, water pumping, and factories. When completed, it will be 1,150 ft. long, 60 ft. high, and 18 ft. wide at the top. The up-stream face is vertical, and built in limestone; the down-stream face is of Texas granite, and the interior is of rubble masonry of small stone and cement.

* *

The tallest wrought-iron chimney in Great Britain has been erected at Darwen, in Lancashire, for carrying off blast-furnace gases. The total height, including foundation, is 275 ft. The weight of ironwork is 114 tons 7 cwt., and 17,000 rivets have been used to connect the plates. It is steadied by twelve foundation bolts, each 16 ft. 3 in. long by 2½ in. in diameter. The brick lining is 18 in. thick at the bottom, and 3 in. thick at the top. The base-plate is 27 ft. 6 in. in diameter. * *

A new lighthouse has been erected at Douglas Head, Isle of Man. The lantern which crowns the tower is 9 ft. in diameter and 7 ft. 3 in. in height. It has a four-wick burner, which consumes eighteen gallons of paraffin per hour, giving a light of 288 candle-power. The apparatus makes one revolution in thirty seconds, the result being that six beams of light, following each other in rapid succession, are shown during a period of fifteen seconds, succeeded by a period of darkness for fifteen seconds.

* *

An extensive deposit of kerosene shale has been found at Capertee, New South Wales. The shale yields, on distillation, an average of 150 gallons of crude oil per ton, which latter gives over 60 per cent. of refined kerosene oil, the remaining products being gasoline, benzine, spongaline, paraffin, lubricating oil, and creosote oils. Its gas-producing capabilities are 18,000 cubic feet of gas per ton, with an illuminating power of thirty-eight to forty candles. The shale is, therefore, valuable, as it can be mixed with poor coal for the manufacture of illuminating gas. * *

An invention that looks well on paper, but might prove dangerous in practice if entire reliance were placed upon it, is the automatic brake for road vehicles of M. Jules des Georges. Instead of tightening the brake on the wheel, the driver has only to exert an effort through levers, rods, and the articulated brake-shoe, to bring the block into contact with the rim of the wheel, the rotation of which tightens the block through drawing it along a groove in the shoe. A spiral spring in the shoe brings back the block when pressure is removed.

* *

Cellulose is being used as a protecting shell for bottles, in place of the straw coverings commonly employed. Sheets of common cellulose are stamped with small oval indentations, about 1 in. long by ½ in. wide; they are then cut into strips the height of a wine bottle, and long enough to go twice round it. These are rolled round the bottles so as to form a double covering, and fastened at the top and bottom with metal sprigs. A bottle so packed can be thrown on the floor without breaking. Space is saved in packing, as the cellulose takes up less room than straw; it is also cleaner.

* *

In a new method of photographing the sound of vowels, the vowels were sung out before one of Edison's phonographs. Immediately afterward they were reproduced very slowly, and the vibrations recorded by a microphone. The latter was furnished with a mirror, which reflected the light of an electric lamp upon a registering cylinder covered with sensitised paper, and protected by another cylinder with a small opening, which gave passage to the rays of light from the reflector. By this means was obtained very distinct photographic traces, and the constancy was remarkable for the different letters. * *

An interesting collection of English tramway and railway rails of the earliest and latest types—from 1767 to 1892—has been forwarded to the Chicago Exhibition. Amongst others are sections of cast-iron rails laid in Wales in 1767, upon which locomotives ran in 1804; edge rails laid in 1879 in Loughborough; edge rails laid in 1793, and used continuously for ninety-nine years, presented by the Duke of Rutland; wrought-iron rail laid in cast-iron chairs at Swannington in 1820; and a specimen of the Liverpool and Manchester Railway rail on which was made the famous locomotive test which resulted in the victory of Stephenson's "Rocket."

BOOT AND SHOE MAKING.

BY WILLIAM GREENFIELD.

STITCHING, AND THE ACTION OF THE STITCHING AWL—THE WAY THE CHANNEL IS LAID DOWN—HOW TO FIX THE SOLE-PIECE ON—THE WAY TO MAKE THE SPLIT-LIFTS—THEIR PROPER PLACE IN THE HEEL.

Stitching, and the Action of the Stitching Awl.—Previous to commencing to stitch, run the fudge wheel round the welt. This will make an impression upon it somewhat like a stitch; then while stitching—if the awl be carefully put into each mark of the wheel—you will be able to set a nice, regular stitch.

In making a boot for your own feet, you need not necessarily stitch the waist, or even the fore-part. It is, however, better to do so, since it makes the work so much more solid. Anyway, should you wish to sew them, either for quickness or because you find at first any difficulty in using the stitching awl, you will find the seam will be made much stronger by using a small sewing awl, the side of which you have rubbed off a little on the emery stick.

Stitching is the stronger, because you can get the stitches closer together than in sewing, and, owing to the shape of the awl and the way it is used, a much smaller hole is made.

Before putting the awl in for the first time, place the strap over the left knee and waist of the boot. The boot should lay on the lap while the legs, or knees, are held quite firmly together: the toe must be towards you, with the upper to the right and the sole to the left, when, with the thumb-nail of the left hand, the channel can be opened for about 2 in. This is to prevent the awl from cutting or notching the thin piece of grain which was cut up to form this channel. This, if cut about, would become very unsightly when laid down and finished.

It will be seen by Fig. 1 that the stitching awl is put into a similar handle to the sewing awl, only it is a little smaller. It is an instrument made like the sewing awl, but the point is flat the reverse way, and more square; in fact, it is often called a square awl. It is constructed so that when it is in the handle, as seen at A, the point shall have a certain drop or pitch, as at B to C. This makes it handy to get into awkward places, and, by pressure on the handle, a power is secured which it would otherwise be hard to obtain. The action of this awl is peculiar. It must not be wriggled, as the sewing awl is, but passed right through by one rapid and almost straight jerk, the boot being held exceedingly firm, or the awl will break.

Now, assuming you have stitched or sewn the waist, let us see how to stitch the fore-part, this being the point where you set the fudge on the welt. The left thumb is pressed against A (Fig. 2), just beyond where the awl is coming out, as shown by B. The awl is laid on the upper, as seen at B (Fig. 1) and C (Fig. 2), with the point against the flat of the welt. It must then be pushed through by one sharp push, just dropping the elbow while doing so, sending the point through to the other side of A, and seeing that it comes out quite in the pit of the channel. Then it must be pulled out just as quickly, and in the same way, but this time raising the elbow while doing so.

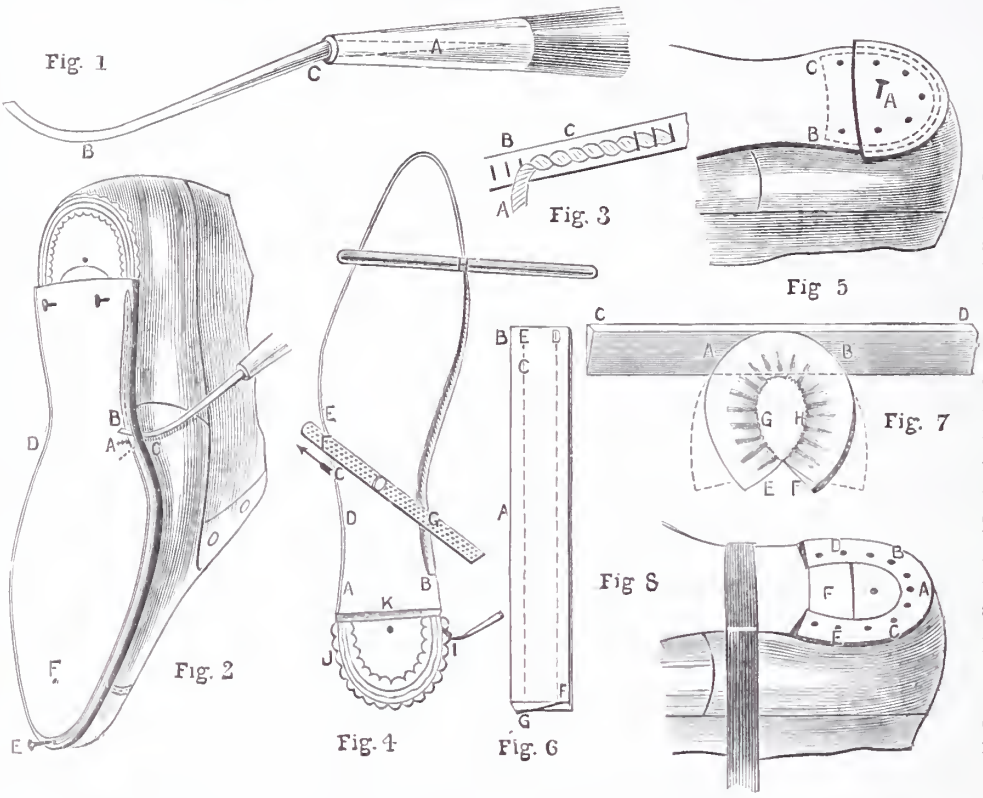
The way the stitch is set depends, to some extent, upon whether the work is to be "pricked up," "fudged," or left plain, which is called a "blind-welt," or the stitch sunk in order that the welt may be fudged to imitate stitching. For the two former, the stitch will have to be set up boldly by over-casting the stitch, and by letting the end of the thread in the right hand pass under the stitch during the whole time it is being set, as at A (Fig. 3), until it is finally pulled to the same tension as the other stitches.

The three perpendicular lines at B show the mark of the fudge wheel, and where the awl is to be put in each time. The part at C is left plain to show how the stitch is each time thrown the same way.

If the stitch is to be left plain, the stitch and thread can have the reverse action, and so much care need not be taken with it. I would say, however, always try your hand at the stitch shown in Fig. 3, since, as it wants learning, this is the best place to get the practice. If you require to sink the stitch in order to fudge it, take the sewing awl and lay it on the upper as though you were going to sew. With the point just against the welt, draw it the whole way round the welt from C to D (Fig. 2), letting it cut a channel in the welt just the depth of the grain, and precisely in the same place as where the stitches are to be set.

You can now go on with the stitching, opening the channel with the left thumb-nail at about every inch or so, at the same time not forgetting to put a little wax on the thread on the left side. This process you continue the whole way round, pulling the nail at E out when you come to it. It will be seen that it is placed in the channel to prevent a mark or hole at F, where the tack is generally put, and a peg, or piece of leather, is added afterwards to fill up.

The Way the Channel is Laid Down.—After the boot is stitched, the stitches that lay in the channel must be rubbed down the whole way round with a piece of bone, and then a little paste is applied here and there, and rubbed in, so that there is a thin, uniform coat all round inside the channel. This is done by placing a piece of old soft rag over the right thumb, and putting the nail in the channel and rubbing it up and down the channel from one end to the other. The boot is held between the knees, heel towards the worker, and the channel is lightly laid down by passing the smooth side of an old file over it from A to B (Fig. 4), holding the file one end in each hand, and taking strokes from A to C, and D to E, and so on. Give the file an outward direction, as indicated by the arrow, by starting at F, on file, and finishing at G. This will throw the narrow margin of grain—made in the cutting of the channel—over the edge as a burr. This is thrown back again by the action of the back of the knife on the edge of the sole, as was done with the file on the top. Then the boot is turned round, and the knife is held in the right hand and the boot in the left, the blade of the knife being flat on the sole. In this position it is passed round to cut off this burr level with the top of the sole. The sole is then slightly damped entirely over, and rubbed down with a long-stick—a piece of round boxwood about a foot long, made very smooth by rubbing with fine sandpaper. The sole is worked down by well rubbing first the seam all round as at H, and the centre afterwards. It must be passed over the leather briskly, but not so much as to generate heat and so injure the grain. For this process the boot has to be held firmly between the knees, using the long-stick, one end in each hand, as the file.



Boot and Shoe Making. Fig. 1.—Stitching Awl, showing how it is put into Handle. Fig. 2.—Section of Boot, illustrating how the Channel is cut, and how and where the Boot is stitched. Fig. 3.—The way the Stitch is thrown and pricked up. Fig. 4.—Showing how the Channel is laid down and the Seat Stitch picked out. Fig. 5.—The Method of splicing and putting Seat Piece on. Fig. 6.—How the Split-lifts are split. Fig. 7.—The way they are turned. Fig. 8.—Their place in the Heel.

Each end must be at right angles with the channel, and the rubbing done with the centre of it, as at H. When this is accomplished, and the bottom is smooth, the stitches on the welt can be very lightly rubbed down with the bone, and the sole also hammered all over until it is perfectly even. For the waist a round-headed hammer is necessary, this part being nicely hammered.

How to Fix the Sole-piece.—The point of the sewing awl is dipped into a piece of soap so that the wax of the thread will not stick to it. It is then passed under the stitch of the rest as at I. It must not be put through very far, only sufficiently to make the stitches, that were tight before, just lay a little way from the upper, as at I, J. The edge of the sole, at the end, K, is filed a little to throw the grain up and make it smooth, and the piece of leather that is to make the sole-piece must be cut straight at one side, and filed in a way shown at K. These two ends are pasted and put together, and a nail is placed as at A (Fig. 5), with about five pegs driven in, and two in the sole, as indicated by the dots on top. The piece then wants paring up at the dotted line to the shape required, leaving plenty of stuff all round to cover the stitch. It should overhang the stitches about a quarter of an inch, not more. A little angular piece must now be taken off round to the second or inside dotted line, and for about a third or bare half of the substance of the leather. The nail is drawn out, and the tops of the pegs taken off, at the same time cutting away the grain of the leather quite round them: in fact, from the whole of the top, from B to C, being careful to take most away where the pegs are fixed. These should be half an inch from the edge all round, and when the cutting away has been done it can be rasped to make it rough, though fairly level.

The Way to Make the Split-lift.—The split-lifts are made from a piece of butt leather, generally first-cut, as, while it requires to be tight, it must at the same time be supple. The leather should be about 7 in. long, and say 1 in. wide. Such, with splitting down the centre while quite wet, makes a pair. The splitting is done as follows:—Place the leather on a board, grain side up, and while the board is on the knees, put the left hand upon the board, letting the thumb rest at A and the little finger at B (Fig. 6). With the first, second, and third fingers press very hard upon the leather (to keep it firm on the board), as at point C. The knife is then held in a slanting position, so that when it is put in at D, on top, it will come out at E on the other side. In this way the knife is drawn along the dotted line, D, until reaching F, bearing in mind that the point must come out on the other side along the dotted line, C, to A. Then you secure two pieces of leather, as A B (Fig. 7), which should be quite wedge-shaped, as shown. If you have not succeeded in this while splitting, you must trim them up afterwards. One is then laid on the lap-iron with the thin edge towards the worker, as shown in the diagram. The left thumb is placed upon A, and the right upon B, with thumb-nails towards you, the hands back to back, and the two forefingers against C and D. In this way the thumbs can be pressed very hard, and the two ends brought round to E and F. This will make the thin edge pucker up in the centre, as G and H, but these are hammered down flat by tapping down round the centre while you hold the two ends between the thumb and finger of the left hand. Thus one split-lift is made, and the process must be repeated for the other.

Although the split-lifts must be cut (or split) while wet, it is best to let them dry a little prior to blocking them on the lap-iron. When this is done, you will find that in drying they open a little at the ends, as shown by the dotted lines. For this reason the ends are held together in order that they may dry the proper shape.

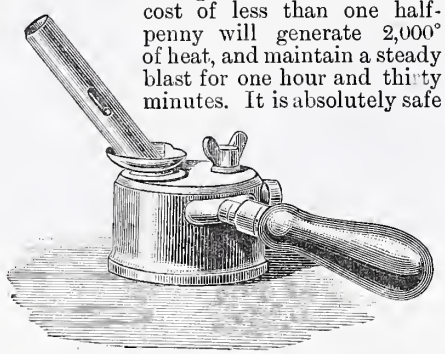
Their Proper Place in the Heel.—The heel, as you left it in Fig. 5, was rasped off and made rough. This is done so as to receive a thin coat of paste all round the same width as the split-lift, which is rasped on one side and treated similarly. It is then put on the sole, as shown in Fig. 8, the boot being held firmly on the knees by the strap passing over the waist and between the knees, while the heel end is on the right and the toe on the left knee.

The edge of the split-lift is fixed just flush with the edge of the centre of the seat-piece at A, and a peg driven in. Another is put in at B, and one at C, then one at D, and another at E. This will keep it in its place while another is put in between each of these, but they must all be placed as far away from the edge, or as near the centre, as the thickness of the split-lift will admit.

It is then nicely pared round. The outside corner (if a gent's, or lady's square heel boot) should be left square, while towards the back and inside corner it can slant in somewhat. Then the tops of the pegs may be cut off and the top rasped as was the seat; also remove the two ends just over the mark, F. In doing so, slip a piece of zinc under the end previous to cutting, so that you do not cut the grain of the sole in the process.

VULCAN TORCH.

For artisans the vulcan torch, as illustrated herewith, will be found useful—if they can get it imported from America. It is referred to as burning 76° naphtha, and at a cost of less than one halfpenny will generate 2,000° of heat, and maintain a steady blast for one hour and thirty minutes. It is absolutely safe



Vulcan Torch.

and extremely simple, little likely to get out of order, and can be taken apart and carried in the pocket. It has proved invaluable to railroad men, coppersmiths, tinsmiths, plumbers, gas-fitters, carriage and waggon builders, machinists, and constructors of electric subways, etc. It is, too, unequalled for burning off paint.

When electric light mains of uncovered copper are laid in underground culverts, the wires should be stretched taut over the best quality insulators placed 14 yards apart, and the culverts be made impermeable to water and to gas.

HISTORIC LINKS IN THE PROGRESS OF ELECTRICAL SCIENCE.

BY H. JOHNSON.

Properties of Amber—Mythic Origin Attributed to Amber—The Lodestone—Thales and the "Soul" of Amber—Researches and Wisdom of Thales.

It is proposed to present in these papers a brief account of the chief events and discoveries in the history of electrical science. No attempt will be made to explain any of the phases, theories, laws, mechanical contrivances, or practical results connected with the science, whilst technicalities will be avoided as far as possible. Epoch-making occurrences and discoveries, and important contributions towards the development of the subject, will receive due prominence; but to chronicle all the experiments which took place prior to each distinct advance, and to mention all the industrious workers who sought to increase the sum of electrical knowledge, is not within the scope of these articles. The progress made during the last ten years has not only created a widespread interest, but has demonstrated the fact that electric force contains the promise of becoming the most useful phenomenon ever brought under the control of man.

The attractive properties of amber when rubbed formed the first intimation of the existence of electric force. Who first observed such properties it is impossible to say. Perhaps some fisherman in far-off ages, wandering along the shores of Asia Minor, picked up a piece of the beautiful fossil-resin, and found to his surprise and annoyance, when polishing it, that particles of dust and litter would persist in clinging to it as fast as he proceeded with the operation. Or, perhaps, the Queen of Syra, who, according to Homer, received a present of a gold and amber necklace from Phœnician chiefs, discovered the secret power of the much-admired gems. *Elektron*, the Greek name of amber, is supposed to be derived from *ēlektōr*, the beaming sun. Fable tells us that when Phæthon was hurled into the river Eridanus, for his youthful rashness in attempting to drive the solar chariot, his three sisters were so afflicted at his loss that the gods changed them into poplars on the banks of the river, and their tears, which flowed continuously, into amber as they dropped into the stream. Herodotus says that in this river amber abounded. It was, however, obtained in other places—Liguria and on the shores of the Baltic: a fact which rather weakens the force of the myth, unless it happened that enterprising merchants exported the golden tears to distant parts, and made gain of the sisters' grief.

The lodestone, with its attractive properties, was also known to the ancients. It was to be found at Heraclea and at Magnesium, from which name came the words *magnet* and *magnetism*. According to another version, the words originated with a poor shepherd named Magnes, being detained on Mount Ida by the nails in his boots.

Under whatever circumstances the secret power of amber first became known, it evidently failed to awaken any profound attention.

Thales (600 B.C.) of Miletus, the "water philosopher," and the "father" of electricians, is accredited with handing down to the ages, through his disciples, original observations of the phenomena which amber exhibits. He believed that almost everything was possessed of a god or dæmon, and to this "spiritual" cause he ascribed

the peculiar power of amber. He also believed that the properties of the lodestone had a similar origin.

To Thales were attributed a good many discoveries and speculations. He believed that water was the origin of all things, that earth is only water condensed, and air water rarefied. He was the first to predict the eclipse of the sun; and he "defined the magnitude of the sun," says Diogenes Laertius, "as being 720 times as great as that of the moon." He said the earth was in the middle of the world, and moved round its own centre, the sea, upon which it was poised, being the cause of its motion. He discovered the Lesser Bear, defined the seasons, and divided the year into 365 days. He was the first to describe a right-angled triangle in a semicircle, and sacrificed an ox in honour of the discovery. When in Egypt, learning geometry from the priests, he measured the heights of the Pyramids from the dimensions of their shadows. He was "a person who spoke little and thought much." He originated the famous apothegm "Know thyself," which was afterwards engraved on a plate of gold and placed in the Temple of Apollo. He founded at Miletus the Ionic School of Philosophy, and was the first to affirm the immortality of the soul. No wonder that—for all his varied knowledge and wisdom—he was placed at the head of the seven wise men of Athens. The saying that "no man is a hero to his valet" was verified in his case. One day he fell into a ditch, and his aged female domestic impertinently reproached him. "Do you think," said she, "you can understand what is in heaven when you can't understand what is under your feet?" He was one of the world's greatest workers, and lived, some say, until he was nearly ninety. On his tomb were inscribed the words:—

"You see this tomb is small—
but recollect
The fame of Thales reaches to
the skies."

His statue, erected by the proud Milesians, bears this tribute:—"Miletus, fairest of Ionian cities, gave birth to Thales, great astronomer, wisest of mortals in all kinds of knowledge."

It is probable that his keen observations of the properties of amber and of the lodestone formed the foundation of much of his philosophical teaching.

In my next paper I shall hope to speak of Gilbert's discoveries, Robert Boyle, and Sir Isaac Newton; Conductivity, Attraction and Repulsion, the Leyden jar, etc.

Do not construct solid doors of two kinds of hard wood, as the action of the atmosphere on one or the other will cause the door to warp.

AN ORGAN FOR THE COTTAGE.

BY MARK WICKS.

Requirements—Specification—Cheap Pipes—Size of Instrument—Tone Lengths of Pipes.

In designing an instrument which shall satisfy the requirements of those whose apartments are small, it is necessary that certain conditions should receive due consideration. These conditions are:—(*a*) The instrument must be contained in the smallest amount of space which will permit the pipes to give a good tone. (*b*) It must at the same time have a fair variety of stops. (*c*) Having regard to the thinness of the walls separating one house from another, the instrument must not be noisy, or it will be a nuisance to neighbours, and result in discord instead of harmony. (*d*) The cost of building must be moderate.

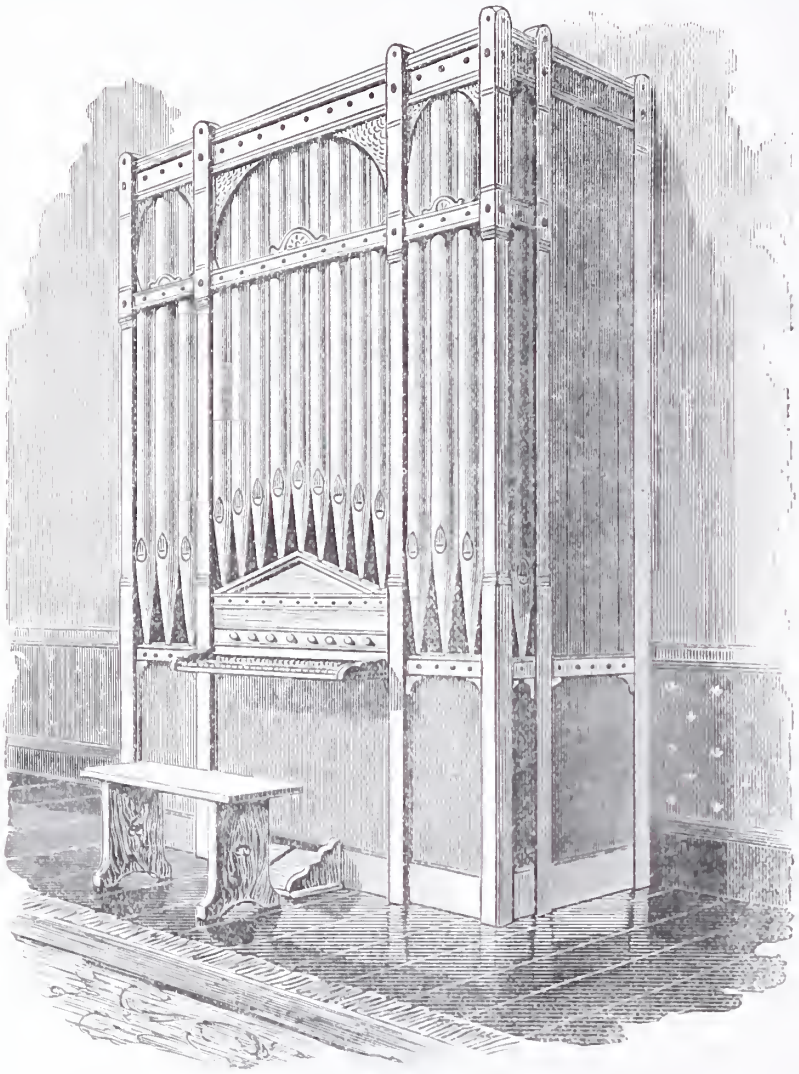


Fig. 1.—A Cottage Organ.

Having carefully considered certain schemes which have suggested themselves to me, I have arrived at the conclusion that the following specification will most satisfactorily meet the several conditions which I have laid down, as I will hereafter indicate. It complies with the first of the conditions, as the extreme size of the instrument is about 4 ft. 6 in. or 4 ft. 8 in. wide, 2 ft. 3 in. deep (not reckoning the projection of the keyboard, as that need not be taken into account, owing to the keyboard being made to slide in like a drawer when not in use), and from 8 ft. to 9 ft. high. A glance at the list of stops comprised in this small space will show that the second condition has not been neglected.

Stops.		*Tone length.*	*Number of pipes.*
1. Dulciana	to Tenor C ...	8 feet	56
2. Flute	" ...	4 "	56
3. Gamba, or Gemshorn	" ...	8 "	56
4. Vox Angelica	" ...	8 "	56
5. Stopped Diapason Bass	...	8 "	12
6. Flute	" ...	4 "	12
7. Octave coupler throughout the entire compass (48 pipes).			
		Total ...	248

The pipes being made of small scale will secure the necessary quietness of tone, whilst the stops selected ensure that there will also be sweetness and variety.

There now remains only one more condition, and I think readers will admit that I meet it in a very satisfactory manner. The most expensive item in an organ is the music-producing part, namely, the pipes. To purchase a complete set for this instrument would cost about £25 or £30, according to their quality; but if made according to my instructions, the outside cost will not be more than £2, and may quite possibly be very much less. "How is it done?" Well, the secret simply is that you can make pipes of paper, which will satisfy the most fastidious as regards tone and appearance. Besides being very cheap to make, they are only about one-sixteenth or one-twentieth of the weight of wood or metal pipes, which is another *desideratum* in an instrument that may have to be shifted from one house to another. Added to this, the process of manufacture is so simple that it may be easily acquired by the older boys and girls in a family, who may thus help their father in the work whilst he is engaged on the more laborious portions of it. All the hard work of sawing, planing, and jointing of wood is dispensed with.

But whilst pointing out the advantages of this material I do not propose to neglect the requirements of those of my readers who, being skilled workers in wood, are likely to prefer making their pipes of that material. But I do say that even the most skilled cabinet-maker or joiner would find a great saving both in time and money if he adopted paper for his pipes; whilst the amateur, who may be a novice, will be entirely relieved of what is rather a difficulty to such persons: namely, the making of long glue joints, which are required in the larger wood pipes, and which must be well done if the pipes are not to be a failure.

Metal pipes I do not propose to deal with, as they require so much skill to make that it would not be worth anyone's while to devote the time and money necessary to its acquirement, merely in order to build a small organ such as I am describing. It would be much cheaper, and very much more satisfactory, to purchase such pipes from organ builders.

On glancing again at the list of stops it will be seen that pedals are not mentioned. They are not required for so small an organ, being too noisy, and as they would take up a considerable amount of room they are, for those reasons, excluded from our consideration.

The complete instrument only requires about the same amount of floor space as a moderate-sized harmonium, although it must be remembered that it will appear much larger on account of its height. This result is obtained by bringing the stopped diapason pipes to the front, so that they form a part of the casing. All the other pipes are enclosed in a swell-box, and greater expression will thus be attainable in playing the instrument. The lowest notes of the other stops are planted off the soundboard at the ends of the instrument, with the view of keeping down the height as much as possible, but the same end may be obtained, without any planting off, by making the lowest four or six notes of stops numbers 1, 3, and 4, of stopped (shortened) pipes instead of open pipes.

But for some of my readers even the small sizes now given may be too large, and in their case I would suggest that the Gamba stop should be omitted: thus reducing the depth of the instrument by about 3 in. If the organ is still too large the Vox Angelica might be left out, or the treble stops carried down from middle c to tenor c, with stopped pipes instead of open ones. This would reduce the height of the instrument to about 7 ft., and the width to about 4 ft. 4 in.; but I must not be understood as recommending the substitution of stopped pipes. Open pipes and the original specification would give a much more satisfactory result from a musical point of view.

It may be convenient that I should here explain what is meant by 8-foot tone in connection with pipes. An open pipe 8 ft. long would give the note c c, which is the lowest note on the ordinary organ keyboard, and *all* pipes belonging to that stop would be termed 8-foot tone. The 8-foot tone is, in fact, the ordinary unison scale or gamut, and from this it follows that any pipe sounding the note c c when that key is pressed is termed an 8-foot toned pipe. A stopped pipe to sound that note would only require to be 4 ft. long, yet it is termed an 8-foot toned pipe. The stopped pipes being only half the size of open ones sounding the same notes enables us to reduce the height of an instrument by introducing them in the place of open pipes for the lower notes of the scale, but as they do not sound nearly so loud as open pipes they must not be too largely used, or the balance of the tone between treble and bass will be destroyed. A stop sounding an octave above the unison is called a 4-foot toned stop, and one sounding two octaves above is called a 2-foot toned stop, and the length of the pipes on the c c channel would be 4 ft. and 2 ft. respectively if open pipes; but only 2 ft. and 1 ft. if stopped pipes. Pipes sounding an octave below the unison are termed 16-foot toned stops, and those sounding two octaves below are called 32-foot toned stops, the latter being only used on the pedal organ in unusually large instruments.

I give a drawing of the organ as it may be made to appear when finished, and will commence instructions in actual work in my next chapter.

The intervening time can be usefully employed by my readers in maturing their plans in the light of the foregoing suggestions.

GOLD EXTRACTING IN VICTORIA.

Gold extracting in Victoria is, all things considered, carried on at a loss, and, with the exception of some fortunate speculators, the public would gain if most of the mines were abandoned.

Two things are absolutely essential for the mining industry in Victoria to become remunerative:—

1. A great reduction in the high salaries of gold miners.

2. A more economic, and particularly a more effective, method of extracting the precious metal than that of amalgamation by mercury, as practised at the present time. With this object the Government of Victoria sent an expert to Germany to study the method of extraction called by the name of its inventor, "Luhrig."

It is not yet possible to express an opinion about the chances of success presented by the application of this method to the auriferous quartzous rocks of Victoria. The following table speaks for itself:—

Years.	*Ounces.*
1881	886,416
1882	879,481
1883	740,373
1884	774,330
1885	783,671
1886	640,872
1887	611,417
1888	636,200
1889	615,055
1890	584,770
1891	621,986

As we see, the past year gives a difference of more than 37,216 oz. over the 1890 product.

In general, the mines of alluvion have been less profitable than those of quartz, and competent men think that this decrease will be further marked in 1892.—*Moniteur Scientifique.*

PHOTO-BICYCLE SUPPORT.

The photographic apparatus is now tending more and more to become one of the indispensable accessories of the bicyclist's kit, and several inventors have set their wits to work to find some light, easily detached supporting arrangement that will permit of reducing the different parts of the device to the smallest possible bulk.

The leg, A, consists of three telescopic tubes, the last of which is provided with an iron point designed to be inserted in the earth. The two end tubes are provided throughout their length with grooves, in which slide two screws that are fixed to the intermediate tube, and that lodge in a slot at right angles to the grooves, so that the tubes cannot accidentally re-enter one another.

The arranging of the leg with the steering gear is clearly shown in the detail of Fig. 3 in the drawing. The vertical bar of the steering gear carries a socket held in place by a screw. A pivot, forming one piece with the socket, allows of the relative displacement of the latter and of the piece to which the leg is fixed. This latter piece is provided with an aperture into which enters the tube upon which the camera is mounted. This camera is provided beneath with a ball and socket joint, and at the top with a spirit level, by means of which the operator can cause the inclination of the camera to vary or to obtain a perfect horizontality, whatever be the respective positions of the bicycle and its leg upon the ground.

For travelling, the camera, E, is removed from its support, folded up, and fixed to the bicycle, as shown in Fig. 2, by means of straps or otherwise, care being taken to interpose small rubber cushions in order to prevent the jarring due to the motion of the bicycle from causing the camera to strike against the cross bar that supports it.

The tubes are afterwards slid one into the other, the upper screw is loosened, and the tube is given a quarter revolution in order that the support, B, may take a horizontal position, and, finally, the end of the telescopic tube is made to enter the ring, C, fixed to the bicycle frame.

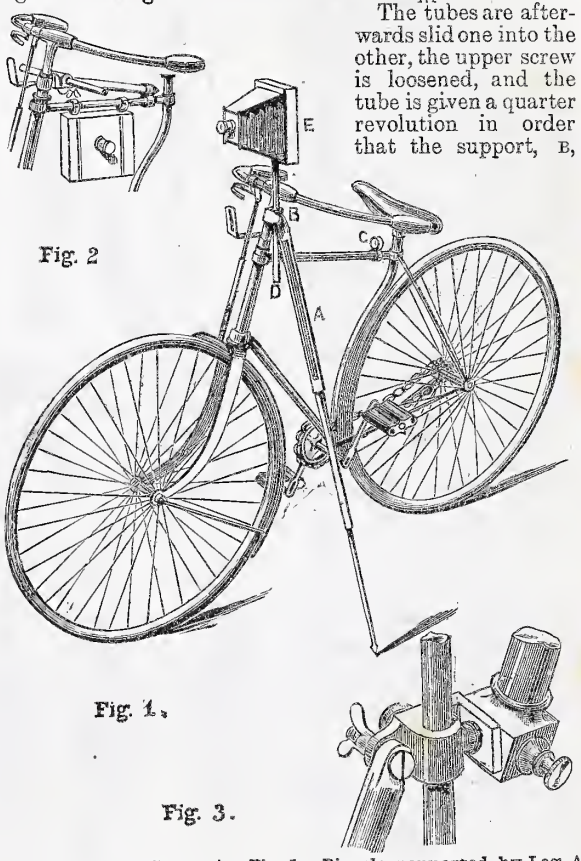


Photo-Bicycle Support. Fig. 1.—Bicycle supported by Leg A. Fig. 2.—Camera fixed to Bicycle for travelling. Fig. 3.—Leg and Steering-Gear Arrangement.

In this motion the socket, D, makes a quarter revolution on the guide bar, and the screw is tightened, and the whole system is then ready for the trip, the leg being in the plane of the bicycle frame and the support, B, being nearly in the plane of the horizontal part of the steering apparatus, so that the wheelman is in no wise discommoded.

Polish.—A fine and lustrous polish for cabinet work can be obtained as follows:—Half a pint of linseed oil, half a pint of old ale, the white of an egg, one ounce of spirits of wine, one ounce of spirits of salt. Shake well before using. A little to be applied to the face of a soft linen pad and lightly rubbed for a minute or two over the article to be restored, which should be first dusted off with an old silk handkerchief. The polish will keep any length of time if well corked.

EXPERIMENTS WITH INDUCTION COILS.

BY G. E. BONNEY.

INTRODUCTION—LIST OF EXPERIMENTS THAT MAY BE PERFORMED WITH AN INDUCTION COIL—VACUUM TUBES—GEISSLER OR GASSIOT TUBES.—EXPERIMENTS WITH VACUUM TUBES: THE ELECTRIC EGG—AN ARTIFICIAL AURORA BOREALIS.

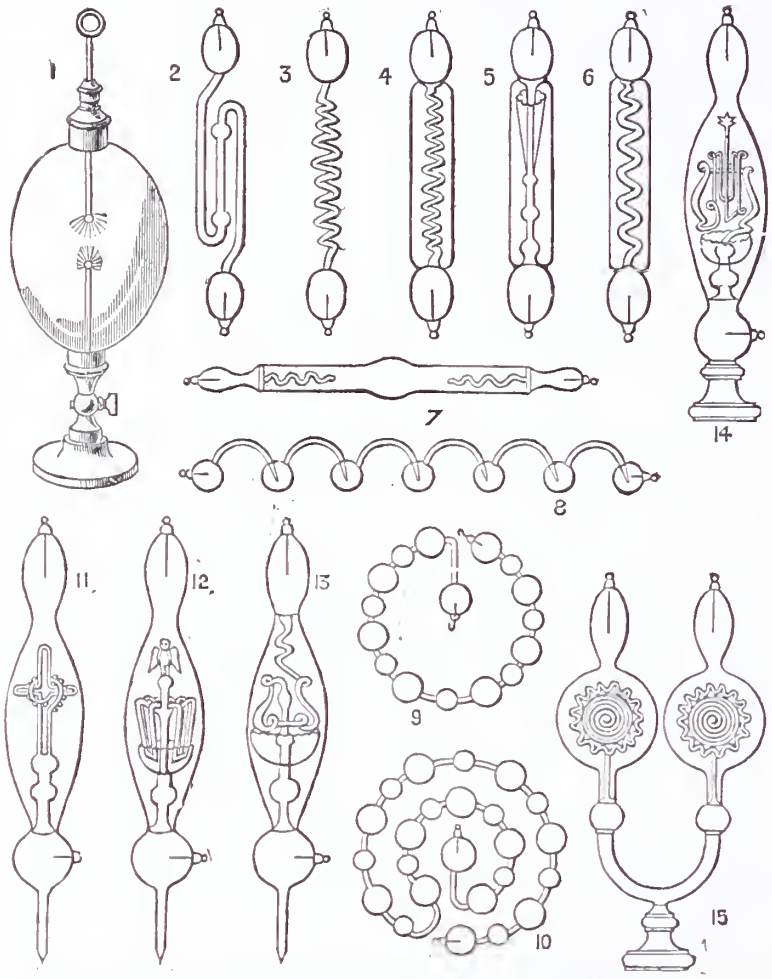
Introduction.—A large number of interesting experiments may be performed with spark induction coils of even small dimensions, and many a pleasant evening may be spent in such instructive amusement. Having constructed a coil as directed in the series on Induction Coils, published in WORK, Vol. IV., pp. 2, 54, 117, 148, 212, 342, and 484, we shall naturally wish to use it for some purpose, and in the papers following this I will endeavour to show how a coil may be used. Among the uses to which the induced current from a coil may be put, I may mention the following: 1. Luminous effects in vacuum tubes; 2. Decomposition of water and other liquids in U glass tubes; 3. Electric writing; 4. Charging Leyden jars; 5. Burning iron wire; 6. Burning leaf metal; 7. Exploding fuses; 8. Perforating cards; 9. Lighting gas jets; 10. Lighting a freshly extinguished candle; 11. Lighting spotted jars, flashing panes, etc.; 12. Production of ozone. In addition to these, there are several other amusing and interesting experiments which may be performed on the stream of sparks from a large spark coil. Some of these will be detailed as we proceed.

Vacuum Tubes.—As a large number of interesting experiments may be performed in a darkened room with a spark induction coil and a few vacuum tubes, it will be advisable to become acquainted with these instruments before we detail the experiments to be performed with them. Vacuum tubes, are tubes of thin glass more or less exhausted of air, and fitted with suitable appliances for connecting them in circuit with the secondary terminals of a spark coil. They also receive the names of Geissler or Gassiot tubes, after the names of their makers or those investigators who used them for the first time. The honour of their invention is generally conceded to M. Geissler, of Bonn, who was the first to perform experiments with Ruhmkorff coils and sealed glass tubes.

A common and very useful form of Geissler's tube is shown at Fig. 1, and sometimes known by the name of the "Electric Egg," because of its shape. It consists of an egg-shaped bulb of thin glass, open at both ends, the lower end being cemented into the hollow stem of a suitable stand, made of polished wood or of brass, the stem being fitted with a stop-cock, and a platinum-pointed rod projecting into the glass bulb. The upper end of the bulb is cemented into a brass cap carrying a closely-fitted, sliding, platinum-tipped metal rod, to facilitate adjustment of the distance between the two poles of the instrument. Wires from the terminals of the secondary coil are connected to this instrument by twisting their ends around the step and the cap. These instruments cost from 20s. to 40s. each, according to size and quality, but may be improvised at home for a few shillings by using a gas stop-cock, a stand of wood, a cheap glass bulb or a cylinder of glass, and other home-made fittings.

Another common and cheap form of vacuum tube is made to resemble a glass test-tube, closed at both ends by melting the glass around electrodes of platinum wire. From this simple form there has sprung a very large number of varieties, some of which are shown in the annexed figures (2—15). In some of these the spark from the coil is led through a wavy tube enclosed within the main tube; in others the glass workers seem to have vied with each other in contorting the interior tube into a variety of shapes and patterns, made out of various tinted glass. Finding by experiment that the light from an induction coil spark varies in tint with the gases through which it is made to pass, and also with the substances placed in the tubes, the glass-blower's aid has been again evoked in producing various combinations of bulbs, containing a variety of different gases, such as hydrogen, oxygen, nitrogen, iodine, cyanogen, ammonium, and such substances as mercury and powdered salts, which emit phosphorescent effects as the sparks pass through them. The cost of these tubes vary from 2s. for the more simple forms, through various grades of prices, up to 40s. for those of the most intricate construction.

As vacuum tubes demand an exercise of manipulative skill in glass-blowing, and the use of suitable apparatus for exhausting the air, their home manufacture is placed out of the reach of an amateur. This cannot be said, however, of the electric egg previously described, as this may be made at home if care be taken in fitting the stop-cock and sliding-rod, so as to secure a tolerably good vacuum in the bulb when exhausted of air. This may be done by means of a gardener's syringe or similar large syringe, the nozzle of the instrument being fitted to the stem of the bulb when the piston is down, the stop-cock opened and the air sucked out, then the stop-cock closed again before the nozzle is withdrawn. If an air-pump can be employed, it will be better than a syringe for exhausting the bulb of air; in fact, an air-pump must be employed to get the best effects from these tubes.



Induction Coils. Fig. 1.—An Electric Egg. Figs. 2-13.—Varieties of Vacuum Tubes. Figs. 14, 15.—Ornamental Vacuum Tubes.

Experiments with Vacuum Tubes: The Electric Egg.—Having either made or procured an electric egg (Fig. 1), connect two lengths of No. 20 copper wire to the two terminals of the secondary coil, and attach their free ends to the stem of the egg and the end of the sliding-rod on top. This should always be done when the coil is not working, or unpleasant shocks may be experienced, and possible serious results if the coil is a large one. Slide the upper rod down to within striking distance of the lower rod, and send current through the coil. Only the ordinary stream of sparks will be seen to pass between the electrodes. Switch off the battery, disconnect the coil, and partially exhaust the bulb of air. Now connect the coil as before, and set it in action. Instead of a stream of sparks passing between the electrodes as before, there will now appear a brilliant stream of light illumining the inside of the bulb. The positive pole of the bulb will be illumined by a red light and the negative pole by a violet light. If the coil has been furnished with a commutator or a current reverser, a half-turn of this will reverse the current in the coil and reverse the position of the colours in the bulb. The character of the discharge through this bulb will vary with each effort to exhaust it of air, some of the variations being very interesting and instructive.

After trying the effects of different stages of exhaustion from common air, another series of experiments may be tried with injected vapour of alcohol, ether, naphtha, turpentine, etc., the colour of the discharge varying with each change of vapour. The vapours may be easily injected by holding

a sponge, or bit of tow, or a bit of cotton-wool, dipped in the selected liquid, to the opening under the stand, and opening the stop-cock. As the air rushes into the exhausted bulb, it draws some of the vapour with it, and some traces of this will remain after the bulb has been exhausted again. Every attempt at exhaustion will vary the appearance of the light, not only in point of colour, but also in form, as the vapours will assume a more or less stratified form in alternate luminous and dark bands.

By substituting gases for vapours, another series of interesting experiments may be performed, and variations in all the above-named experiments can be made by holding the top of the forefinger to the side of the bulb whilst the current is passing, the light appearing to be influenced by the finger. If a permanent bar magnet is brought near a vacuum tube during an experiment, the luminous discharge will behave as if it felt the magnet's influence, and be bent or turned aside from a straight course by the magnet. By reversing the pole of the bar magnet, the deviation of the luminous ray may be altered at pleasure, and by employing two bar magnets, one part of the ray will appear to be attracted, and the other repelled, by the opposite poles of the magnets.

When the electric egg is charged with vapours or with gases rarefied by exhaustion, the discharge of sparks through it from an induction coil no longer takes the form of a flood of light filling the bulb with its luminous pulsations, revealing the alternating character of the induced current, but is altered to the form of luminous clouds arranged in striæ—that is, as bands and puffs of vapour varying in disposition with the vapours or gases in the bulb, and their rarefied condition. The colour also varies with the gas or vapour introduced. Thus, hydrogen has a white striæ, nitrogen an orange yellow, and carbonic dioxide a greenish tint.

An Artificial Aurora Borealis.—An experiment, illustrating the effects of induced magnetism on an electric discharge, was devised by M. de la Rive for the purpose of demonstrating that the rotary motion of the Aurora Borealis was caused by the influence of terrestrial magnetism. For this purpose he constructed an apparatus resembling the electric egg, with an insulated soft iron rod inserted into its lower end, and brought into contact with one of the poles of an electro-magnet. When the induced current from the secondary of a Ruhmkorff coil was passed through the insulated rod in contact with the electro-magnet, an arc of light formed in the globe of the egg, and rotated slowly around the soft iron rod in a direction easily determined by altering the direction of the induced current, or that of the current passing through the wire wound on the electro-magnet.

To construct a similar apparatus, we shall require a globe of clear glass similar to those in use with paraffin lamps. To the upper part of this globe must be cemented a double stop-cock arrangement, one branch for connection to an air-pump, and the other for the introduction of some liquid, such as alcohol, ether, or turpentine. The lower opening of the globe must then be filled with a soft iron rod and its insulating coating. This rod may be of any diameter from $\frac{3}{8}$ in. to $\frac{3}{4}$ in. It should be long enough to penetrate into the interior of the glass globe to two-thirds of the distance between the openings, and leave half its length outside. Now, respecting the insulation: first warm the rod, and roll it in shellac until it has a thick but smooth coat, thick enough to closely fit into a glass tube the whole length of the rod. Coat this tube with shellac varnish, and fit over it another glass tube. Envelop this tube with several folds of paper steeped in melted paraffin, until a coat $\frac{1}{4}$ in. in thickness has been got on, then well baste the whole with the hot paraffin wax, and make it quite smooth. Over the middle part of this insulated bar, fit a sleeve of thin copper tube long enough to have one inch inside the globe and one inch outside. Cement this into the lower portion of the globe, and fit a collar of brass on the outside with a binding screw for making connection with the coil. From the foregoing details, it will be seen that the thickness of the core and its insulation must be determined by the size of the selected glass globe and the size of its lower opening, since we cannot exactly fix these beforehand, but can adapt the fittings to the glass. The best effects are obtainable, however, from an apparatus in which the globe is over 6 in. in diameter and the iron core from $\frac{3}{4}$ in. to $\frac{7}{8}$ in. in diameter.

To work this apparatus, we shall require an electro-magnet with a core or cores 1 in. in diameter, furnished with a bobbin or bobbins 3 in. in diameter by 4 in. in length, filled with No. 20 silk-covered wire. As only one pole of the electro-magnet will be employed, one core will suffice, but if a horseshoe magnet is obtainable or nearest to hand, it may be used for the purpose. We shall also require a disc of iron $\frac{1}{2}$ in. in thickness, and large enough to cover the pole of the electro-magnet, and form an armature for the same. This armature should be furnished with a set-screw attachment for connecting a wire to it from the secondary of a coil. Lastly, we must have a good spark coil, say, one giving a 2 in. spark or over, and an air-pump to exhaust the globe.

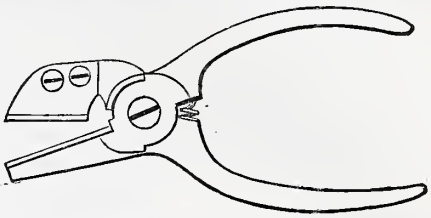
To carry out an experiment with this apparatus: First exhaust the glass globe of air, then introduce two or three drops of ether or turpentine, rarefy the vapour by further exhaustion, connect the wire from the secondary terminals of the coil to the ring of copper or brass beneath the globe, and connect the other wire to the armature of the electro-magnet, then stand the end of the insulated core on this armature, and set the coil in action. A sheaf of light will form inside the globe from the end of the insulated iron bar to the copper sheath or collar covering the part in contact with the globe. Now send a current through the electro-magnet. The streamers of light will all unite on one side of the bar to form an arc of light, and this will slowly rotate around the iron bar. On changing the direction of the current in either the induction coil or the coil of the electro-magnets, the direction of rotation in the arc of light will also change.

Scale in Boilers.—It is estimated that the presence of $\frac{1}{16}$ in. scale in boilers causes a loss of 13 per cent of fuel; $\frac{1}{4}$ in., of 38 per cent.; and $\frac{1}{2}$ in., 60 per cent. It will be wise, therefore, to prevent scale as much as possible.

Tight Screws.—Oftentimes an old screw is in so tight that it cannot be loosened by the screwdriver. The best plan then is to get a piece of bar iron, flat at the end, and make it red hot and place it on the head of the rusty screw, and in two or three minutes it can be drawn with the screwdriver as if it were only a recently inserted screw.

GOOD THINGS.

Pruning Shears.—The illustration herewith is that of a recent article brought out by the Alford and Berkele Company, New York. It is called the Ladies' Favourite Pruning Shears, and is intended as a flower and fruit cutter and rose trimmer. This little tool is very desirable for ladies' and florists' use in the greenhouse and



Ladies' Pruning Shears.

among flowers, possessing lightness and ease of operation. Convenient as a pair of scissors, it is much more effective than heavy pruning shears.

Revolving Top Cabinet.—Among the demands of modern civilisation is a marked desire for economy of space, and wherever this is attained a success has been achieved which is pretty sure to supply a want as well as to meet with recognition. This is all the more sure when uniqueness of idea and ingenuity in construction are, in addition, brought into play. For the reason that much of this sort of thing has been introduced into the artistic piece of furniture patented by Mr. Albert E. Batson, of the well-known firm of fancy cabinet manufacturers, we have no hesitation in describing the revolving top table cabinet, which probably will not fail to interest our readers. The top of the table is pivoted in the frame. Uprights at right angles with the surface of table-top are secured immediately over the

Revolving Liqueur Cabinet.

centre. Cradles or frames (perhaps some may prefer to call them trays) are secured, pivoted, and suspended from the uprights, which trays, cradles, or frames contain the articles that presently and instantly are removed from the surface to within and below the top of the table, the cradles, trays, or frames so suspended retaining at all times the contents in a vertical position, whatever the angle the top may be placed at. Turned upside down, the articles or contents are secure, buried or hidden below and beneath the top (which now forms a table-top and a cover to the contents). Reversing the cover or top, and again the cradles, or trays, or frames with contents are brought over the surface of the top of the table. The use and advantage are obvious—a table strewn with glasses, decanters, and such like is immediately cleared, and a tidy and useful table is at the service of the user by his simply reversing the top; that only requires one hand, and the top is secured automatically.

NOTICE TO READERS.

Next week's Work (No. 195) will contain, among other illustrated papers, the following:—

Art of Plumbing—Joint Making.
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*** The Editor makes this intimation in the hope that readers, having friends interested in any of these subjects, will bring the same to their notice.

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*** Advertisements should reach the Office fourteen days in advance of the date of issue.

WORK correspondents are wanted in every Town.

Amateur and Professional.—The recent competitive exhibition of the Turners' Company, concerning which we have already offered our remarks, forcibly suggested to us the old question of amateur and professional relationship. In the consideration of this question there is much to dwell upon on both sides. In the instance furnished by the Turners' competition, however, there can be but one opinion. The plan of entirely eliminating one class of work from the other has resulted in the questionable advantage of proving of service to neither one side nor the other. There can be no doubt as to the beneficial results which accrue in bringing amateur and professional work together, if not in friendly rivalry, at least in such relationship that the two will admit of comparison, the one with the other. In exhibitions like the recent display by the Turners' Company, it is perfectly legitimate—quite fit and proper—to show one class of work with the other. We have no misgivings whatever upon the issue. The professional work is almost certain to beat the amateur; it usually does, and it is right that it should do so. This fact offers no justification, however, for the Turners' Company, or, for the matter of that, any other body, for dispensing in such competitions with any particular class of work. The purpose of such competitive exhibitions is, we take it, to advance the craft or art itself; therefore, all contributory elements to this end should be considered. The great aim of British craftsmanship is to beat the world, and if, in competitions such as the Turners' Company recently held, lovers of the lathe—whether professional or amateur—are to be parted, then a salient feature and advantage of such competitions is removed. It is a blind policy which permits proceedings of this kind, and we trust that whenever occasion may offer in this or any other direction for friendly comparison between amateur and professional work, that the foresight of the management will be sufficiently keen to permit them to realise the advantages to be gained all round by rendering such competitions as wide as possible in their scope. All that is needed are distinct classes, the work for which should fulfil the conditions of the class for which it is entered. In this great mechanical age, when the desire of every mechanician should be to win a supremacy for British crafts, it is the sheerest folly to esteem lightly any who may be interested in a particular craft, and which it is in the power of all to assist and extend, whether they be concerned with it either as amateur or professional workers.

Aluminium.—The English manufacture of this metal of the future is one of the romances of modern industry. Eight years ago a company was floated who established works at Oldbury, near Birmingham, to work the Webster and Castner patents. The selling price then was 60s. per lb. By these processes a fancy metal was converted into a commercial one by reducing the price considerably, *i.e.*, 20s. per lb., at which price it was hoped to command the market of the world—the cost of manufacture being about 10s. per pound. In these expectations they were doomed to disappointment. No sooner was the cost brought thus low than it was discovered that our American cousins had forestalled us, for by the aid of electricity in the manufacture, the price was brought still lower, the selling price at the present time being little more than 2s. per lb. This has opened up a vast field for it. Not only is it used for fancy articles, jewellery, and table decorations, to which purposes its fineness and flexibility readily adapt itself; it has already been pointed out in "Work World" that Flemish Dragoons have been testing aluminium horseshoes with satisfactory results. Lieutenant W. C. Brown, of the 1st Cavalry (Denver), has sent to the War Department samples of military accoutrements made of this metal, which he claims to be lighter, cleaner, and more durable, and can be supplied at less cost than those of brass as now used. Owing to its non-rusting qualities, its use is advocated for culinary utensils. Experiments are also being made as to its adaptability for sheathing purposes, it being claimed that, should expectations be realised, we may shortly hear of more record breaking by ocean-going steamers. Meantime the English Aluminium Company, finding themselves beaten on their own ground, have turned their attention to the utilisation of bye-products, sodium, and the chemical products made therefrom. Thus in exploiting one metal and bringing it into general use, and cheapening yet another, they place before us a career that is a truly marvellous instance of perseverance rewarded.

Bicycling.—The Sixteenth Annual Stanley Show has come and gone, and all concerned—executive, manufacturers, and bicyclists—are to be congratulated upon the splendid success of the exhibition. Ever since the Stanley Club held its first display in 1877 the movement has grown apace, until this year it quite broke the record, and crowded the Agricultural Hall, Islington, with a collection of all the latest bicycling improvements, the extraordinary extent of which was most apparent when viewed from the galleries of the vast hall. One of the most striking features of the show was the competitive spirit of small makers, affording every evidence that the cycling trade—capable as it is of almost untold development—is not to be left altogether in the hands of the big firms. This is as it should be. The more competition there is the better for the trade and cyclists.

SIMPLE IMITATION STAINED-GLASS HALL LANTERN.

BY E. A. SANDERSON.

It is the opinion of all lovers of the beautiful that stained-glass hall lanterns considerably enhance the appearance of our halls.

Busy men frequently say that change of work is good recreation; and it often happens that, after having devoted both mind and muscle incessantly hitherto on some elaborate piece of work, it comes as an agreeable relief and relaxation to spend an hour or so making some simple and natty article which will also prove of use afterwards.

The lantern may be connected to a gas-bracket, or it may be used with a detachable oil-lamp, as most convenient to the maker's requirements. The original—an illustration of which is given in Fig. 1—has been adapted by the writer to both alternately; and, as a friend remarked on first seeing it illuminated, it looked better than the 15s. one he bought, and willingly would he have exchanged. Is there, then, need for any further inducement?

The cost of the following materials and fittings required for the construction of this lantern comprises the entire expense we need commit ourselves to—if, indeed, we already possess a few transparent oil-colours—namely: Glass, 1s. 3d.; sheet of tin, 4d.; wire, 1d.; collar, burner, and glass chimney for lamp, 6d.; chains, 10d.; smoke-bell, 6d.; brass ornaments for bottom of lantern, 1s. Total, 4s. 6d.

Even this expenditure may be reduced by dispensing with the ornamental knobs; but such a modification in the embellishments would spoil, I fear, to some extent the lantern's appearance. However, this of course is left to the discretion of the would-be lamp-maker.

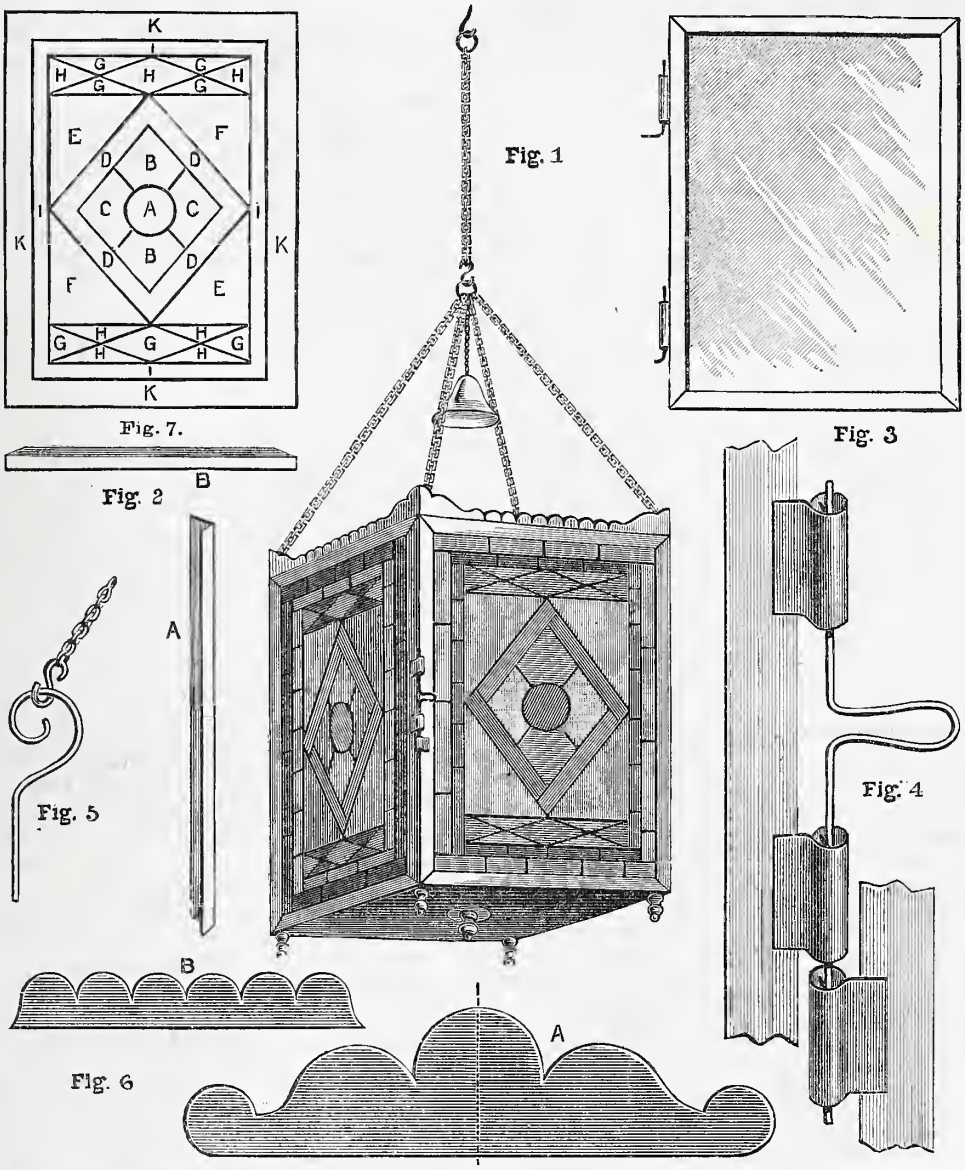
Our first outlay, then, must be to buy a sheet of tin (with which to make the framework of the lantern), and upon it to mark off, with a bradawl or other sharp-pointed tool, four 1 in. strips 13 in. long, which must afterwards be severed with a large pair of scissors or snips. Then lay one of the strips lengthwise upon the edge of the bench or a straight piece of board, allowing ½ in. to lap over, and hammer down this overlapping tin to form a right angle, similar to that shown at A (Fig. 2). The remaining three strips—which, with the one just bent, will form the upright stays of the frame—are to be angled in like manner. The length of the top and bottom pieces, numbering eight in all, should be 9 in. Their only other difference to the former strips is that one wing of each angle must be cut mitre-shape (as shown at B, Fig. 2), so that when four pieces are joined together they will fit properly, and resemble a square tin frame. All joints are to be soldered.

When these 9 in. angled strips have been joined together, we shall have four 13 in. lengths of tin, and two square frames with which to construct the lantern's frame. This may be done in the following manner:—Take one of the tin frames, lay it upon the bench, mitred side underneath, and into each corner fasten the four upright angles (but merely tacking them together until the other end is fixed in position); then, if all is found to be square, each joint should be permanently soldered. We will then have the frame of our lantern complete, minus the door, which latter appendage must be our next consideration.

Four strips of tin, all 1 in. wide, two of them 13 in. and two 9 in. long, are to be cut off the sheet as before, and each doubled in two until a groove is formed, of only sufficient width to allow the glass to slip in. Firmly join three sides of the frame together, but, before fixing on the other end, slip the glass in its place. The four corners of the frame are to be mitred together. It will be advisable to leave the staining part of the business until the last thing, as it can be done as well with the door fixed on the lantern as when off. But before leaving this portion of our work we had better make and fix on the bolt and hinges.

To make the bolt, bend the centre of a piece of 16³ or 18³ wire, 6 in. long, into a kind of loop, as shown in Fig. 4, allowing 2 in. for bending, in order to reduce the length of the bolt when thus made to 4 in.

Now take five pieces of tin, each ¾ in. square, and convert ½ in. of their width into a tube, leaving ¼ in. of tin quite flat, by which they may be attached to the framework, as seen in the diagrams. Three of these tubes are required for fastenings, and two for hinges. First solder two of the fastenings on to the door-frame—one at a distance of 5 in. from the top, and the other that distance from the bottom, thereby providing a space of 1½ in. between the two pieces—taking care that the turned edges come flush with the outer edge of the frame. In Fig. 4 I find that these two fastenings are shown as projecting beyond the edge of the frame. This is incorrect, as the result of such a position would be to prevent the door from closing properly. One of the other tubes should afterwards be soldered on to the frame of the lantern in such a position that it will come exactly under the lower fastening on the door when the latter is shut close, and will also allow the wire bolt to pass freely through. A glance at Fig. 4 will explain matters simply.



Stained-Glass Hall Lantern. Fig. 1.—View of Lantern complete. Fig. 2.—A, Upright Angle for Corners; B, Angle for Top or Bottom Ends. Fig. 3.—Door of Lantern. Fig. 4.—Fastening for Door. Fig. 5.—Chain Hook. Fig. 6.—A, Corner Piece of Ornament; B, Centre Ornament. Fig. 7.—Design for Stained Glass.

The two remaining tubes should now be fastened on to the reverse side of the opposite end of the door—one about 3 in. from the top, and the other that distance from the bottom—to serve as hinges. This done, bend two pieces of wire—the same kind as used for the bolt—both 1¼ in. long, into right angles, ¾ in. by ½ in., and solder the small lengths to the inner part of the lantern-frame, with the ¾ in. lengths (on which the door will hang) pointing upwards. The easiest mode, perhaps, of fastening the wires in their true position is to first slip their long lengths into the tubes on the door, lay the lantern down upon the side opposite to that on which the door is to go, adjust the door in its place, and solder the ½ in. lengths on to the inner side of the frame as they hang. The door should then open and shut easily.

We had better next make the hooks required for attaching the hanging chains to the lantern, using the same kind of wire as hitherto, and, when made, strongly soldering the straight parts into the angle at each top corner of the lantern. An idea of their shape is indicated in Fig. 5.

Our attention may now be turned to the ornamental part of our work. That running round the top of the lantern is made of tin, and consists of corner and centre pieces. To make the corners, draw the design given at A (Fig. 6) full-size on stout cardboard, and cut it out as a pattern; lay it on to a piece of tin, 4 in. by 1 in., and cut the tin to the cardboard shape. Make the remaining three pieces in like manner. Then, when all are finished, find the half of each, bend them at right angles, and afterwards solder them on to the lantern. Now proceed to cut out four tin strips, 5 in. long by ¾ in. wide, divided with a pair of compasses into six half-circles (see B, Fig. 6), and secure them with solder between the corner-pieces.

Glass-staining—or, to speak more correctly, painting—should be the next operation. Tube-colours are preferable for this work, and they should be mixed with white varnish. Those readers who do not consider themselves competent for such artistic work might save themselves the trouble by using the "glacier" transparencies as substitutes. These transparencies would, of course, look well, but, not having used them for this particular purpose myself, I cannot express any confidence that the heat would not cause them to curl off, or otherwise affect them. On the other hand, it will be found by the amateur who employs his own artistic skill that the heat gradually burns the colours into the glass, and imparts a subdued but rich lustre to the various tints, almost rivalling in appearance and utility the genuine stained glass. However, each must decide for himself.

The design need not be elaborate for this article; indeed, consistent with good workmanship, the simpler it is the better it will look. The following instructions will probably be useful to the amateur lamp-maker who intends painting his own glass:—

First set out on a sheet of paper the design full-size, and afterwards trace the outline upon the glass. The two borders, K and I, in the diagram are to be respectively ¾ in. and ½ in. wide, while the top and bottom strips containing the small diamonds, G and H, should be about 1½ in. in width. The remaining space may be filled up with a diamond, having a border of, say, ½ in. width, and in the centre a circle having a diameter of 2 in. This design looks effective, and, with a variety of tints tastefully arranged, will answer for the four sides. The colours should be applied with a fair-size camel-hair brush, and finally stippled with the tip of the second or third finger, in order to obliterate the brush-marks and to produce a softened effect. One coat will be found insufficient; therefore, when the first is hard-dry, apply a second coat of colour, likewise stippling it. The tints to be used and their arrangement must be left to individual taste, but the following combination has a very good appearance, and can be recommended.

The outside border, K, emerald; border marked I, ruby; the small diamonds marked G and H, alternately Prussian (or deep) blue and purple; triangular spaces E and F, yellow and light blue; dark border of large diamond, purple, and light part, emerald; spaces B and C, within the latter, light blue and yellow; circular centre-piece, A, ruby. The tints on two of the sides opposite each other should be arranged alike, but the other two, if different, will have a better effect. For example: Outside border, ruby; inner border, purple; small diamonds, dark blue and ruby; border of large diamond, light blue and yellow; outside triangular spaces, emerald and puce; inner spaces, ditto; circle, Prussian blue.

Lining is the next process, and is accomplished by means of a bevelled straight-edge and a small fitch, the lines being drawn with lead-colour, about ¼ in. wide, on the painted side of the glass. The safest and easiest method of painting a ring round the circle is to cut out a stencil for it. Before fixing in the glass, give the outer side of the tin framework a coat of bronze green. The inside must be kept clean, with the exception of the door; otherwise, the solder will not hold. But the framework of the door, being made on a different principle, should receive a coat of the same colour on both sides.

So soon as the paint is dry, the glass may be fixed in its place—viz., the inside of the frame. The simplest way is to lay the frame on the side in which the glass is to be fixed, and insert the glass in its proper position, painted side down. Then cut four bits of tin about 1 in. square, and bend each piece (allowing for the thickness of the glass) so that one part will lie flat on to the frame, while the other half will be just wide enough to hold the glass firmly. Solder them at each corner of the frame. The ground glass at the bottom of the lantern is best not fixed, but simply resting on the ledge made for it, as it can then be conveniently taken out at any time and cleaned.

The brass ornamental knobs may be easily attached to the glass or tin by means of a preparation called gutta-percha cement. This is a composition, as its name indicates, of gutta-percha and other flexible and adhesive properties; it is made up in cakes, and forms a very valuable cement for any article that does not constantly come into contact with water or great heat. A sufficient amount of the cement to cover the flat end of each knob should be used, and heated until it bubbles, when the brass knob must be pressed firmly against the glass or tin. This cement is obtainable, I believe, of almost any ironmonger or bicycle manufacturer.

Four 12 in. lengths of chain are now required to complete the lantern proper. These should be connected by one end at each corner with small brass hooks, and the other end of each chain to a ring suspended from the ceiling by another piece of chain, the length of which must depend on the height of hall.

Those who wish to make an oil-lamp to stand inside the lantern may do so in the following economical manner:—Get a round tin can possessing a lid (a large condensed-milk tin will do capitally), bore a hole in the centre of the lid large enough to allow the cotton wick to pass through, and afterwards solder the lid on the can. This will answer splendidly as a reservoir. Now we want a collar, burner, and glass chimney, all of which can be bought at any Italian stores for a few pence. Solder the collar over the hole in the lid, screw on the burner (fitted with wick of correct width), slip on the chimney, and the lamp is capable of shedding forth light—if the reservoir contains oil.

Finally, a small brass or glass (the choice is optional) smoke-bell is another requisition. It is required not only to protect the ceiling from discoloration by smoke, but also to serve as a further ornament to the lantern. Hang it over the light by a chain of suitable length.

ELECTROLYTIC ANALYSIS OF SULPHUR IN RED COPPER.

The method generally employed for analysing sulphur in red copper is that of Fresenius, but it is long, difficult, and subject to errors. It is, however, of great importance to fix exactly the amount of sulphuret of copper contained by copper, for these impurities greatly change the physical properties of the metal. A new electrolytic method suggested by M. C. A. Lobry de Bruyn seems more accurate and rapid. According to *L'Industrie Electrique*, twenty-five parts of copper are dissolved in nitric acid, then the solution is electrolysed until twenty parts of copper are deposited. The liquid is then evaporated to expel all the acid, and the electrolysis concluded. During this time the sulphur has been converted into sulphuric acid, which can easily be calculated, there being no longer any copper in the liquid.—*Moniteur Industriel.*

TOOLS OF EGYPTIAN PYRAMID BUILDERS.

Egyptian stone-workers of 4,000 years ago had a surprising acquaintance with what have been considered modern tools. Among the many tools used by the pyramid builders were both solid and tubular drills and straight and circular saws. The drills, like those of to-day, were set with jewels (probably corundum, as the diamond was very scarce), and even lathe tools had such cutting edges. So remarkable was the quality of the tubular drills, and the skill of the workmen, that the cutting marks in hard granite give no indication of wear of the tool, while a cut of a tenth of an inch was made in the hardest rock at each revolution, and a hole through both the hardest and softest material was bored perfectly smooth and uniform throughout. Of the material and method of making the tools nothing is known.

Electrical Accumulator Plates.—A new alloy for this purpose, almost unattackable by acid, is made by adding 22 parts of antimony to 945 parts of melted lead, and, at the moment of pouring into an ingot-mould, introducing 13 parts of mercury. The ingot can be rolled out into thin plates.

HOW TO CONVERT AN ALTAZIMUTH INTO AN EQUATORIAL TELESCOPE STAND.

BY O. BECKERLEGGE.

Apparent Motion of Stars—Axis of Telescope parallel to the Earth's Axis—Altazimuth and Equatorial—Converting the Former into the Latter.

Every young astronomer who has a telescope, mounted so that it allows of vertical and horizontal motions, has realised the difficulty of following a celestial object, inasmuch as its path is always oblique and not parallel to the horizon. In the diagram Fig. 1, Y Z is the horizon, and S T a line perpendicular to the same. Now, it will be apparent to the most inexperienced, that a telescope, mounted with its axis of rotation in this perpendicular manner, as A, would, if caused to revolve, mark out circles in the heavens parallel to the horizon, as 3—4. The star, *a*, in the field of vision, would cross the field in an oblique manner, as shown by the dotted circle, 1. To follow this star the telescope would not only require to be turned on its horizontal axis, but also on its vertical, raising or depressing it, as the object might happen to be east or west of the meridian. To do this with an instrument of low power is not easy, whilst with an instrument of high power it is all but impossible. To follow a star with only one motion an equatorial stand is required.

Everyone, even the most casual observer, has noticed, for example, that the Great Bear, that most conspicuous of all constellations, revolves round a point near to the pole star once in each twenty-four hours. When the constellation is to the north, it is low down in the sky, but climbs higher and higher until it reaches its meridian.

To the uninitiated it has always appeared as though the observer was on a fixed point and the heavenly orbs were whirling around him. But, as even the youngest observer now knows, the motion of the stars is only apparent and not real, the true cause being that the observer is being carried onward by the diurnal motion of the earth, and so his relative position to the fixed stars is continually being altered. The writer witnessed an unusually interesting optical illusion illustrative of this some time since. Riding in a fast train, the line skirted a large field which had been ploughed with the furrows at right angles to the line of motion. The first mental impression as we rushed past, and the furrows, each one in rapid succession, opening out and then appearing in perspective to meet in the vanishing point, was that the observer was stationary, and that the field, like a great wheel with innumerable spokes, was being rapidly revolved on its centre. This, on a magnificent scale, is the optical illusion which so often baffled the early astronomers. They were fixed—so they thought—and the celestial scenery revolved around the pole star.

Having mastered this fact, that the earth revolves, it was comparatively easy to discover that if a line were drawn from the point of observation to the pole star, or, what is the same, a line parallel to the earth's axis, and a telescope were caused to revolve around this line as an axis, it would follow and hold a star in its field of view as long as it was above the horizon. In Fig. 1, S N is the polar axis. If a telescope, as B, is made to revolve regularly around this point once in twenty-four hours, it would cut a circle, as the dotted line, and if a star were in the field of view, as at *b*, it would be retained there through the whole revolution. The dotted circle, 2, shows the path of a star which just dips at one point below the horizon.

A third fact would soon be apparent: that if an observer were stationed at the pole of the earth's axis, the heavenly bodies would appear to revolve in circles parallel to the horizon, and that, on receding from that position towards the equator, the angle included between the pole star, N, point of observation, S, and the horizon, Y, would become more and more acute, until at last the observer would reach a point where the pole star would lie on the horizon, and all stars would rise and set at right angles to it, and the day and night would each be twelve hours long.

We now arrive at the last point I wish to mention in relation to this subject, that is: we must first ascertain the latitude of the point of observation, and make the axis of the telescope to correlate with it; or, in other words, the axis of the telescope must, at all times, be parallel to the earth's axis. We will suppose that we are fixing a telescope, say in Liverpool. On looking at any good atlas we find that Liverpool is 53½° N. This, then, must be the angle of our polar axis. Having mastered these several points, there is little else to do beyond mere mechanical work.

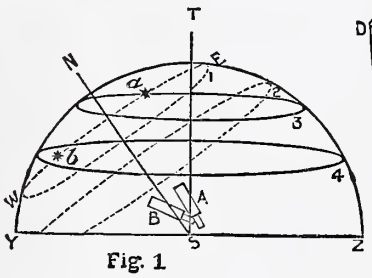


Fig. 1

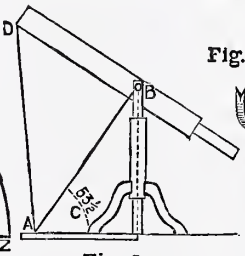


Fig. 2

Fig. 3

Fig. 1.—Diagram of the Heavens—S N, Elevation of the Polar Axis around which the Stars seem to revolve. Fig. 2.—An ordinary Altazimuth Stand adapted as an Equatorial, A B being the Elevation of the Pole, which is equal to the Latitude of the place of observation. Fig. 3.—A Crutch to receive the Trunnions on the Telescope.

But the mechanical labour required for the construction of a good equatorial must be of no mean order. It is not for this class, however, that I am writing this article, but for those whose skill is limited, yet who desire something handier than the Altazimuth. Fig. 2 represents the latter stand adapted or altered to an equatorial. It may be said here that the writer makes no claim to originality; indeed, it might be difficult to determine who was the first to work out the idea. Some years since Lord Lindsay published something on it, but before him two or three other astronomers of great reputation adopted a plan of which his was a modification, and the design I have given is a modification of his, the only point of difference being, that in my design I place the axis in alt coincident with the axis of the telescope, and not underneath, as is generally found in telescopes with Altazimuth mounting. This difference, though at first sight it may appear of little importance, is really of considerable value. It is evident that if the axis of motion is outside the instrument, then the instrument will revolve around it, and not around its own centre; but in any kind of equatorial mount it is absolutely necessary that both major and minor axis of the instrument should be coincident with its optical axis, for if not, no matter what device we may adopt, the object would be continually creeping out of the field of view. I have extended these remarks, perhaps, some people may think, unduly, but they must consider that there are always some readers just starting to learn, and it is those I have in my view, and for whom I write. We will suppose we possess a telescope with a three-legged stand. If the joint for giving altitude is underneath the instrument, then a crutch, as Fig. 3, should be made, either in iron or brass. Y-shaped slots may be cut in the arms of the crutch. Pins must be let into the telescope tube, either screwed or soldered, to act as trunnions to rest in the crutch. Care must be taken that these pins are true with each other. Fix the telescope stand firmly to a small tube or platform, care being taken that the stand is perpendicular to it. Fasten a strong rod of wood to the platform, so that it forms with the stand a right angle. Cut, either in wood or metal, a templet of an angle equal to the latitude of the place of observation, that of Liverpool being 53½°—C, Fig. 2. This must be carried along the rod until a line drawn from A to B shall touch the edge of the templet. At the point A a hole must be bored large enough to take a strong cord. A small eye should be fastened to the telescope tube, as at D, in a line with the O.G. To this a strong cord is fastened, the other end passing through the hole at A. A screw may be placed in the end of the rod to clip the cord, or a cleat may be fastened on the under side of the rod, around which the cord may be secured. Now place the instrument on any suitable stand with the imaginary line, A B, pointing to the pole star. Bring the instrument to bear on any particular star desired, and fix it by the cord, D A. It will now be seen that if moved to right or left it will no longer revolve around either the perpendicular or the horizontal axis, but around an axis that lies in a line from A to B. In other words, it moves on a polar axis, and the circles which the instrument makes will be circles equidistant to the pole star. If our work has been done with care one motion will keep a star fairly well in the field of view. I have, I think, in "Shop" given a very simple method for finding the true north, so need not refer to the matter further. If, however, there is any obscurity on the subject I have written on, I shall be pleased to answer any question, and give what further information I can.

Galvano Plating with Iron and Nickel.—Solution 1, for iron: Take equal parts of pure sulphate of iron and of the sulphate of iron and ammonia, to which is added 1 in 1,000 of sulphate of magnesia. The solution should have a strength of 18° to 20° B. Solution 2, for nickel: To a solution of sulphate of nickel and ammonia, 2 per cent. of sulphate of magnesia and 2 per cent. of boric acid are added, and the solution is then neutralised with carbonate of magnesia. The bath should have a strength of 8° to 10° B.

TRADE: PRESENT AND FUTURE.

**** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

COTTON TRADE.—The great lock-out continues, with no indications of weakness on either side. Several mills have adopted short time, and this has greatly strengthened the masters' position. It is thought that many other concerns will speedily adopt short time, but the operatives rely upon the increased demand for yarn forcing the masters to reopen the mills. Our Rochdale and district correspondent writes:—The Masters' Federation has succeeded in prevailing upon the majority of the mill owners in Rochdale to place their *employés* on short time; consequently, notices have been posted in the mills, stating that the mills will only work twenty-eight hours per week until further notice—this being half-time only. The *employés* are calling a meeting to decide what is to be done as regards the levies under this new regulation, as if they continue to pay the 5s. 6d. per week as before, it will be paying away nearly half of their wages. The question of arbitration has been spoken of again in some quarters, but after the reception which the proposal received before it is not likely the dispute will be settled in this way.

CUTLERY AND SILVER TRADES.—Cutlery trade is dull, while the electro- and silver-plate trade has improved.

SKATE TRADE.—Skate makers are busy with Sheffield-made skates, although vast numbers of cheap imported skates are sold.

PAPER TRADE.—This suffers from the prevalent depression, but more severely than the paper trade is wont to suffer. Many mills are running short time, with no prospect of improvement.

HEAVY TRADES.—Improvement marks the heavy trades of Sheffield. Hematites have declined from 60s. to 54s., according to brand. Railway material is in moderate request.

COAL TRADE.—The Northumberland coal market is easy, best steam coals being from 9s. 3d. to 9s. 6d.; second qualities, 9d. to 1s. per ton lower. Small steam, 3s. 9d. to 4s. per ton. Bunker coals are dull. Gas coals, in large demand from 7s. 6d. to 8s. per ton. Coke is firm.

CHEMICAL TRADE.—The chemical market is flat, with a limited amount of new business.

IRON TRADE.—The Middlesbro' iron market shows an improvement, and shipments continue heavy. The finished iron and steel trades are slack, steel makers being very short of orders; but rail makers continue fairly well employed.

TIMBER TRADE.—Our Hartlepool correspondent writes:—The demand for sawn wood is very brisk, most of the merchants having their hands full of orders. Large timber is being moved from the ponds, especially sawn pitch pine. Norway timber orders are as brisk as ever; also for odd lots of Swedish. There is no doubt there will be a good trade up to Christmas. Pit timber orders are plentiful, especially for Staffordshire and the Midlands. Our Liverpool correspondent writes:—At recent sales mahogany brought from 2¼d. to 2s. 9d. per foot, according to quality; American walnut, 5s. 6d. per cubic foot; American whitewood, 1s. to 1s. 7½d. per cubic foot; satin walnut, 1s. 2½d. to 1s. 5d. per foot; lignum-vitæ, 74¾ tons sold at from £6 5s. to £15 per ton; rosewood, 5 tons sold at from £10 to £11 15s. per ton.

SHIPBUILDING TRADE.—One or two new orders are to hand. Messrs. Laird have obtained an order to build a magnificent yacht, upwards of 200 ft. long, for the American millionaire, Mr. Vanderbilt, and six steam barges are being built by Messrs. R. Gilchrist & Co. for Manchester Ship Canal traffic. It is estimated that removing the sailings of the vessels *City of Paris* and *City of New York* to Southampton will occasion a loss in revenue of £250,000 per annum to this city. The Dock Board have held a meeting to consider the advisability of lengthening the present landing stage on the Mersey with a direct railway connected to it, also the building of another stage for Atlantic passengers and for cattle, etc.; the former to cost £220,000 and the latter £350,000. This having been passed, a Bill is to be promoted in Parliament for the purpose of accomplishing these schemes. This means a good deal of work.

ENGINEERING TRADE.—There is next to nothing doing in the Lancashire engineering trade generally, although here and there stationary engine builders and boiler makers are giving more encouraging reports. The returns for the past months issued by the engineering trade unions show a further increase in the number of unemployed. The Amalgamated Society of Engineers have now nearly 8 per cent. of their members "out." About 4½ per cent. of the members of the Steam Engine Makers' Society are returned as unemployed.

STEEL TRADE.—Ordinary foundry hematites do not fetch more than 56s., while steel billets are readily offered at 87s. 6d. The steel plates for the Watkin Tower are now being supplied at a very low rate. In Cumberland 3,000 steel workers have been discharged, owing to scarcity of orders.

SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

I.—LETTER FROM A CORRESPONDENT.

Turning and the Turners' Company.—CYMRO writes:—"In WORK, No. 183, p. 418, you reminded us as to the Twenty-third Annual Prize Competition of the above Company, which took place in October, when you hoped a good collection of turnery would be exhibited. All your readers would have wished the same success to this institution but for the statements which revealed the serious condition into which this once flourishing concern has been brought. For myself, I have now a full answer to what has been a puzzle to me since the October Exhibition, 1890. To this I paid a visit, thinking to have the satisfying pleasure of seeing the largest and grandest show that could possibly be shown at any one time or place. In this I was greatly disappointed. Upon entering the room—after a great deal of trouble in finding it—thinking it to be a pottery warehouse, I remarked to an official that my errand was to see the Turners' Exhibition, and that I had travelled from Wales for that purpose; I did not want to purchase any flower-pots; would he be kind enough to put me in the way to find it? He assured me I was in the right place. What I thought flower-pots at first glance were vases and urns in terra-cotta, some in the rough, and others in a finished condition. No doubt they were specimens of good workmanship in their class. Also a few exhibits in Derbyshire and Cornish stone of first-class quality and splendid workmanship. At last, in one corner, I came across the lathe work. There were only two exhibitors, one of whom must have sent his work as a joke. But the other, a case of ivory and blackwood—said to be the work of a first-class gentleman amateur—was most exquisitely wrought. The ivory boxes bore ample evidence of the skilful handling of the rose engine and spherical rest, whilst the blackwood box testified to the same artistic manipulation of the medallion machine, having upon its cover a most beautifully worked medallion of Rubens. Such work as this, although few can rise to it, has a wonderful influence upon the amateur of less degree. He may be pleased and satisfied with his own work, but when he sees that of first-class workers, he is stimulated to aim higher, and in this endeavour he accomplishes better results. But what about the blackballing of amateurs? Can it possibly be that they have been weeded out, one by one, down to the last, as the 1890 Exhibition showed, from motives that are best known amongst the managers of the Company themselves? Has a partiality been shown, and preference given, to workers upon lathes and tools of certain makers? If so, then the sooner we 'throw up the sponge' the better, most certainly. The person who has made the tools to cut spirals in separate strands upon his screw-cutting lathe, perhaps, had better keep his work under cover for awhile. He would not only be denied a sixpenny script by the Worshipful Turners' Company, but would be boycotted for daring to make a tool himself. To remedy all this, Mr. Editor, I would suggest you take in hand the formation of a society of all workers, whether amateur or professional. Members to pay a fee for entrance; the first year's expense to be met by subscription or a guarantee fund; afterwards it would be self-supporting. This would meet a great want and, I think, be very acceptable to the tens of thousands who read your valuable paper, WORK."—[Will CYMRO set out the lines of such a society? If it can be worked we shall be pleased to give all the assistance in our power. It is for amateur and professional workers to decide the matter, by writing to us and making the matter known.—ED.]

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Luminous Paint.—E. W. (*Sheffield*).—This useful invention—which, by the way, was first brought into general knowledge through the medium of the last great Paris Exposition—can be purchased through many agents. I give one in London: W. C. Horne, 6, Dowgate Hill, London, E.C. It is retailed at prices and in quantities within the reach of most people. Write the above for particulars, stating your requirements. If you are a regular WORK reader, you will find a description of method of preparing luminous paint on p. 556, Vol. III., No. 139. This I had from a good source, and its perusal will interest you, I think.—F. P.

Boot and Shoe Making.—ERGO.—Many letters are reaching us, asking when these articles commenced. You will find this information below. It is a pity, when series papers of this nature are set going in WORK, that readers and friends of the journal do not make a point of bringing the fact under the notice of strangers interested. It would do incalculable benefit to WORK if every subscriber would, for instance, acquaint his or her bootmaker of these articles from Mr. Greenfield's pen. If friends of WORK would adopt this simple and not costly plan, it would save us a mass of correspondence every day, and materially relieve the columns of "Shop." See Nos. 165, 168, 173, 176, 182, and 187.—ED.

Ebony Stain.—A. R. (*Ashton*).—Refer to "Ebony Stain" in WORK, No. 125, p. 332. The subject is there fully treated. The staining mediums you refer to do not turn the wood black. Their action is to simply darken such woods as mahogany or oak to give a richer appearance or the look of age. Look through the local directory for the address of dealers in pearl in your own neighbourhood. Should you be unable to meet with any, write Joseph Forrester, 1, Summer Hill Terrace, Birmingham; he can supply you in any quantity of genuine pearl. You may be aware that there is an imitation largely used. For this, write the British Xylonite Company, Homerton, London.—LIFEBOAT.

Spirit Varnish.—D. S. R. (*Cambuslang*).—A spirit varnish which, when simply applied by a brush or dipping, will give an appearance of French polish without any further trouble has yet to be found. Some preparation is needed, such as sealing the pores of the wood by "filling in," or giving a few rubbers of French polish. Papers on this subject are in the Editor's hands, and may, doubtless, appear in due time. Personally, I can meet with satisfactory results with a varnish made as follows: Rectified naphtha, 1 gallon; shellac, 2 lb.; gum benzoin, ½ lb.; gum sandarach, ½ lb.; gum thus, ½ lb.; resin, ¼ lb. The varnish you refer to as used by the Germans contains gum elemi, which gives a bright but very soft varnish, hence it is a gum but little used in this country.—LIFEBOAT.

Patent.—J. R. (*New Brompton*).—There is nothing new in your idea for the position of a portable light. Miners have carried their candles thus from time out of mind, and workmen in more delicate crafts—sculptors, for instance—used to do so when candles remained the only source of light. But to the use of gas in this manner, the fact that the necessary supply pipe would hamper the free movements of the worker has always been an obstacle; so also has the minor point that the heat generated by the burner might cause inconvenience. Are we to understand that you have invented an apparatus by which both these difficulties are overcome? If so, you have, undoubtedly, a proper subject for a patent; but whether such a patent would prove profitable is another question, and one which it is not possible to answer. It appears to us, however, that an electric light, with a small portable battery, would be better suited to the purpose than gas, if it could be produced at a sufficiently low price. As to the professional character of the patent agent named, or his charges, it is not for us to express an opinion; but if you wish to get your provisional protection economically, buy the form at the Post Office, and make out the specification yourself. You have full instructions how to proceed in WORK.—C. C. C.

Browning Gun Barrels.—J. L. (*Wexford*).—Brown stain, applied with a brush and allowed to dry on, is of no real service for these, owing to its liability to wear off with constant handling. The correct way, by eating into the surface by means of acids, though more tedious in its application, is far and away the best in the long run. The simplest method is to apply chloride of antimony, first made of a thin, creamy consistency by mixing with olive oil. The barrel should be slightly heated, the mixture applied, and allowed to remain on till the requisite brown is produced. The polish is brought up again by friction—rubbing with a piece of hard wood. Sometimes a coat of shellac varnish is now applied, and again polished. A more tedious affair, but adopted by some of the first-class establishments, and known as "military browning," is as follows: Tincture of steel, 7 oz.; spirits of nitre, 6 oz.; spirits of wine, 4 oz.; nitric acid, 2½ oz.; blue-stone, 1 oz.; rain-water, 24 oz. The blue-stone must be dissolved in the water first, the nitric acid put in last, and the whole well shaken, which will turn a nice green. The barrels must be perfectly free from grease. First day: Coat and stand in the drying room for the night; not less than 90° of heat. Boil off next morning; scratch off, and continue the same daily. You will find four or five coats sufficient. Change the water every morning (if possible, boil off in rain-water). *The barrels must be perfectly cold when coated.* Should you, on the score of cheapness, require a brown stain to apply with a brush, write us again; we shall be pleased to assist.—LIFEBOAT.

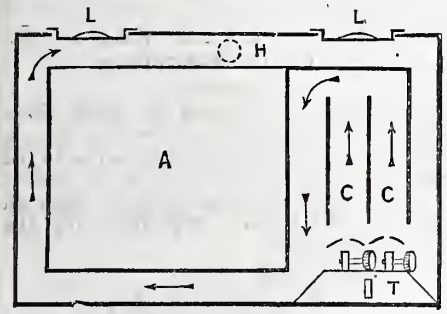
Turners' Company Competitions.—A. E. (*Birmingham*).—Write to the Clerk of the Company, London, E.C.

Mail-cart Wheels.—A. G. (*Pulborough*).—I have made several inquiries in London, and have come to the conclusion that, if I were wanting above, I should certainly send to Victor Cycle Co., Grimsby, for them; and advise you to do the same.—E. D.

Metal Beadings, etc.—A. L. W. (*Aberystwyth*).—I have made inquiries, and find that these ornamental mounts are chiefly imported. The only firm I have been able to discover who deals in them is S. M. McEwan, who deals in dyed woods, veneers, marqueterie, etc., 282, Old Street, St. Luke's, E.C.—B. A. B.

Aerated Waters.—H. G. (*Leith*).—Haywood & Tyler, Whitecross Street, E.C.; and Barnet & Forster, Forston Street, Shepherdess Walk, N., are both good makers; and will, no doubt, furnish you with all the particulars you require.—J. C. K.

Paraffin Cooking Stove.—D. J. S. (*Roehampton*).—Your idea and sketch for above are not at all bad, and would, if properly constructed, answer very well. I send you a sketch of a different design, which, perhaps, you may like better, being more compact and not so top-heavy. I see from your sketches that you understand what you want, so my explanations will only need to be brief. A is the oven, contained within an outer case, as suggested by you; T is the oil-tank, with two 4½ in. burners, which you will find sufficient to heat a 12 in. square oven; C, C are the chimneys of same, but, instead of allowing the heat to disperse at the top in the usual way, stop it off so that it is directed in the course shown by the arrows. A few small holes

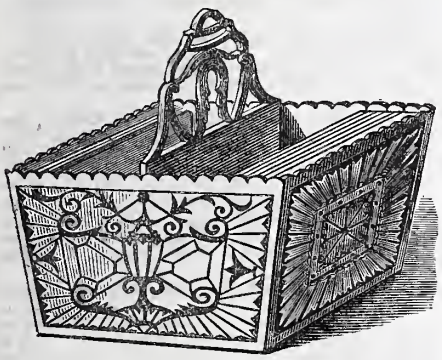


Plan of Paraffin Cooking Stove.

might be punched near the chimneys to help heat the right-hand hole of the top plate. A hole at H—to which you might rivet on a flange and about 2 ft. of 2 in. pipe—would assist in drawing the heat round. L, L are covers, which must be left there when the oven is in use without saucepans on the top. With regard to thickness of material, I advise you to use 24 gauge soft steel, which you can get at any ironmonger's. The sides will not require lagging if you stand the stove out of the reach of draughts. I am sorry that I cannot give you any advice respecting the making of a wooden dough-mixing machine to dispense with yeast. Perhaps some other contributor will oblige.—R. A.

Green-houses and Summer-houses.—DULL.—These are exempt from assessment. DULL and his brother should appeal.—OVERSEER.

Music Holder.—JAY TEE.—I hope that this design will suit you. Probably you do not need details of construction; if you do, however, let us know. With regard to your query respecting your desire to be supplied, on payment, with a full-sized drawing, I think I may say that you and other readers would experience little difficulty by making your wants known in WORK. I have several times been applied to, privately and through WORK and other journals, for full-sized (working) drawings of various pieces of furniture I have designed; and I daresay other contributors have had similar applications. In my case, however, I am generally too much occupied with original work to give much



Music Holder.

attention to these requests. But, in your case, if no reader comes forward with due willingness, I will undertake the job for you if you write me through the Editor, enclosing a stamped letter to me in one addressed to the Editor. Perhaps the Editor might see some utility in a suggestion I now make: That a department be started for supplying, at proper fees, working drawings of selected designs from WORK, any capable readers having their addresses retained for this purpose, to whom application may be made.—J. S.—[Before deciding this matter, I should like my readers' and contributors' views.—ED.]

Quarter Horse-power Engine.—E. C. (*St. John's Wood*).—Articles appeared in WORK, Nos. 106, 110, 121, 125, 131, 136, 141, 145, 149.

Coach-makers' Routers.—G. W. (*Devizes*).—I would advise you to buy your routers instead of making them. Send to Mr. George Buck, toolmaker, 242, Tottenham Court Road, London, from whom you could get routers and other coach-makers' tools.—W. P.

Cutting Machines.—G. A. M. (*Nottingham*).—I am sorry I have been unable to answer this query sooner, as I know of a machine which would just suit. It is called the "Advance," a small cutting machine, 16 in. knife. Full particulars can be had by applying to W. C. Horne, 2, White Horse Alley, Cowcross Street, London, E.C. If G. A. M. will do this, and mention where he got his information, I am sure he will be well suited.—G. C.

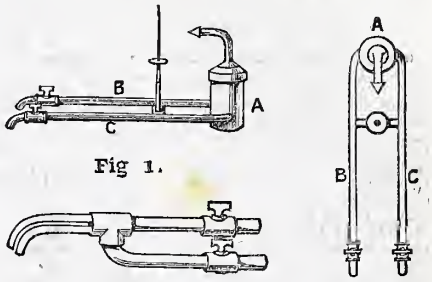
Leakage of Gas.—W. H. C. (*Homerton*).—In the first place, I should thoroughly examine the brackets and fittings to see if the leakage was in them; first, by carefully smelling, and then, if you are not quite sure, by means of a lighted match or candle, being particular about the joint behind the wooden block and the wall; twenty per cent. of gas escapes are found to be either in the fittings or at the joint of the fittings and pipe. Perhaps you only smell the escape when the gas is alight, which would almost go to prove that the defect is in the bracket somewhere between the tap and burner. Anyway, give the fittings a good testing before going further. If, after having done this, you do not discover it, you must trace the pipes from the various fittings up to the ceiling, or down to the floor, or whichever way they run, slitting the paper behind the pipe here and there, and carefully smelling every inch of pipe. Do not apply a light to the pipe covered with paper unless you feel almost sure you have found the exact position, and then only for a second, blowing it out directly it lights, to make sure you are right, and that the gas really does escape there. If you have still not found it, you must now take up the floor boards directly over the pipes (which, by the way, should be *screwed*, and not *nailed*, down), and carefully smell every possible inch of the pipes; and if you think you have found it, test it with a light, always bearing in mind never to apply a light recklessly to find an escape of gas; never attempt to discover a *large* escape of gas with a light, or in a room that has been shut up whilst the gas has been escaping some time; and do not apply a light to a *small* escape of gas if it is in such a position that it cannot be got at readily; and lastly, always be sure that the stop-cock at the meter works properly, so that you can have it turned off at once in the case of a mishap. You must continue in this way to examine thoroughly every piece of gas pipe in the house until you find it. But after examining the fittings and pipes that are not hidden, and before pulling the place to pieces, go to your "tell-tale," the gas meter: that will soon let you know if there is an escape or not, for it sometimes happens that someone has let the gas escape at the burner from some cause or other, and has omitted to mention it. Turn all the gas off in the house, and turn the stop-cock full on at the meter; watch the small hand at the top, or unit circle, of the index, and if in an hour or two the hand has not moved, you may know that there is no escape in the pipes between the meter and the taps on the fittings, and the leakage, if any, must be in the fittings when the burners are lit; but if the hand moves ever so little, you may know there is an escape somewhere, and be it ever so small find it out, for you must bear in mind that that small escape is continually going on, and comes to something considerable in a quarter. I think I have given you sufficient information to enable you to find the small escape you mention, and a little yellow soap rubbed in will stop it until you can do it properly with white-lead, or call in a gas-fitter.—E. D.

Blind.—FACTORY LAD.—Blind laths can be bought at most timber yards, especially those that have saw mills in connection. I do not know Manchester, but blind laths, ready planed, ought not to cost more than 12s. per 100 ft. super, which is less than ¼d. per ft. run. This is for painted work; perfect laths, suitable for stained and varnished work, cost rather more. If you read the article on "Venetian Blinds" (No. 110, page 86, Vol. III. of WORK) you may get a hint or two. You cannot easily get paint off Venetian blinds, and probably if you did you would find the laths not clean enough to varnish; they are so frequently prepared with size colour. The colour used for green blinds is made of mineral green, turpentine, varnish, and white lead. It is not now so popular as it used to be, on account of the poisonous character of the colour, which, however, is too much imprisoned to do any harm. If you wish to use it you will do best to buy it ready mixed, under the title of varnish green; it costs about 1s. per lb., and is to be thinned with turps only. The colour may be made lighter by the addition of white lead, which must be mixed with turps *before* adding to the varnish green. The varnish is composed of resin, or partly of it, and sold as turpentine varnish.—B. A. B.

Resistance of Electric Lamps.—SOLDER.—The resistance of Edison-Swan electric lamps varies with the length and diameter of the carbon filaments. Even 16 c.-p. lamps may have a varying resistance of from 30 to 200 ohms. The hot resistance of a carbon filament may be put down as one-half of that of a cold filament. The voltage of current needed to properly light a lamp is generally marked in figures on the neck of each lamp. You will find a table of the safe carrying capacity of wires in the *Electrician*, "Electrical Trades Directory" for 1892, in my book on Induction Coils, and in WORK, No. 138, Vol. III., p. 541.—G. E. B.

Brass Files.—SOLDER.—The teeth of files for brass are cut finer than those for filing iron. Finely-cut files are sometimes named "brass files."—G. E. B.

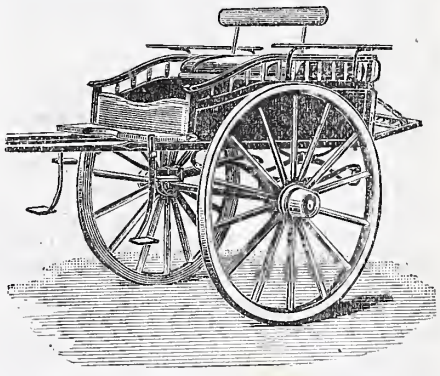
Oxyhydrogen Blowpipe.—C. R. (*West Kensington*).—You did not state in your letter whether you wanted the oxyhydrogen blowpipe for lantern or for brazing, etc. If the former, see the sketch Fig. 1. It consists of a reservoir, A, made from brass pipe of 1 in. diameter, 2 in. long, to which a circle of sheet brass is brazed to form a bottom. The upper part of the reservoir is packed with thin iron wires cut to a length of 1¼ in., and on top screws a cap fitted with a piece of bent ¼ in. tube, on which is screwed a nozzle having a fine bore. Two tubes of ¼ in. brass are fitted to the reservoir, and are bent



Figs. 1 and 2.—Oxyhydrogen Blowpipe for Lantern. Fig. 3.—Ditto for Brazing.

in such a way that they run parallel. These tubes are 10 in. long, and each one is fitted with a cock, so as to regulate the flow of the gases, and a bent tube is fitted to each cock. The arrangement for holding the lime is made to slide upon B and C. The safety of the blowpipe depends upon packing the reservoir well with iron wires, as these prevent the flame passing down the tubes and thus causing an explosion. The oxyhydrogen blowpipe for brazing is seen at Fig 3. I may say that, for this purpose, gas is almost always used in place of hydrogen. It is practically the same as the blowpipe shown at p. 250, No. 172, Vol. IV., but the brass pipe should not be more than ¼ in. internal diameter; the inner tube for oxygen about $\frac{1}{16}$ in. internal diameter, and should reach to the mouth of the outer tube. It can then be filed down, if required.—H. B. S.

Whitechapel Cart.—D. M. (*Aboyne*).—This question, "How to make a Whitechapel cart body, and hang it, so that, with four riders, those on back seat may sit upright, with sketch," involves two branches of cart making—body and carriage—with its ironwork details of proportional measurement of parts and adjustment to act properly. It would require as much as a whole number of WORK to explain all, even briefly, to do justice to your questions. In "Shop" columns you will find forthcoming replies bearing on the main aspect of your question in answer to other inquirers. To aid you is a sketch



Whitechapel Cart.

of a sticked Whitechapel cart body. The bottom sides are 3 in. by 2 in. for very light-framed body; the pillars, 1½ in. thick; stiles between pillars, 1½ in. square; side rails, 3 in. by 1½ in. The seat, to shift back, may run on rollers let into four corners, and a pin of iron to pass through seat, each side, into holes in the projecting seat side-rails, on which the front seat moves. This should be 1 in. above the level of back seat, to slide over it. The hind riders sitting without stooping or being tilted back is a matter of shaft hanging. This will be explained in detail in a future number of WORK; but to guide you now, for a 15-hand horse, with 4 ft. 6 in. high wheels, be sure to have shafts that rise, from the horizontal level of body bottom to the tug-bearing, 16 in.; not a fraction less. And when your cart is

mounted, and the shafts are held up to 4 ft. 2 in. at the tug without riders, the cart body will be about 4 in. lower in front than at the back. To look at it thus, it will show as no Whitechapel or any other cart in England looks; but carts are not used empty, as they are sold in coachmakers' shops (made to sell), but for use, with two, three, or four riders in them. Put in four riders, and the sinking down of the springs 4 in., and with them, the back ends of the shafts, brings the body to a true level and horizontal line of seats, so that hind riders sit so as to ride in comfort, without risk of being slid off into the road. The axle, fixed by scroll-irons as deep in front as behind, should be 24 in. forward of a vertical line of hind-bar.—J. C. K.

Camera Obscura.—R. F. (*South Hornsey*).—The lines upon which a camera obscura is constructed are remarkably simple, and consist of little else than a lens, a mirror, and a translucent screen, on which the image is thrown, all enclosed in a suitable box. If a permanent building is required, the screen is replaced by a whitened table, upon which the image reflected by the mirror is cast, the building itself constituting the box or camera; the lens and mirror are fixed in a small revolving turret, to which movement is given in a similar manner to that of an ordinary window-blind roller, except that the movement is horizontal instead of vertical, by means of cords conveniently placed inside the camera or dark room. This revolving movement is not absolutely necessary, but has the advantage of adding a pleasant variety to the picture. If the position of the camera is raised above the surrounding buildings, etc., a veritable panorama is then shown on the table with excellent effect. The table is an ordinary flat-topped table covered with white paper, or, what is better, coated with about half an inch thickness of plaster-of-Paris, made perfectly level and sand-papered to a smooth surface. It goes without saying that the room itself must be perfectly dark, no light being admitted except that passing through the lens to form the picture. Any good single achromatic lens will answer perfectly—one of long focus, as the image will then be of more important dimensions. The mirror must have a true surface, and if made of *thin* patent plate is preferable to the usual thick plate, which is apt to give blurred images; but glass silvered on the reflecting surface, such as the reversing mirror used for photographic purposes, is best of all.—E. D.

Horsehair Loom.—J. W. (*Dundee*).—"Spon's Encyclopedia," Part 18, price 2s., is chiefly devoted to the subject of hair manufacturers: perhaps this might be of service to J. W. Or possibly some reader of WORK can tell him about looms for horsehair weaving.—LIFEBOAT.

Electrical Engineering.—R. F. (*Hounslow*).—I see that R. F. wishes his son to qualify as an engineer and electrician. Now, there is but one way to qualify as an engineer, if you ever wish to be acknowledged as such by the Inst. C.E.: and that is, to serve articles of three or five years' duration under one of its members, for which a premium is and always has been paid of 500 or 300 guineas respectively. There are many members at the present day who make electricity a speciality, but I should be very sorry to be responsible for having given six or seven names that *I* thought were "solid and respectable;" the degree M.I.C.E. would be *carte blanche* for all that is required. As to subsequent employment after the term of articles, that always depends upon the conduct of the pupil himself during his apprenticeship; and I may add that it would certainly be his fault if he were sent adrift. But how your correspondent's son would get on with an injured *right* hand I fail to see, seeing that it is usual always to serve at least the first eighteen months in the drawing office. I am afraid he would find it a great detriment to tracing, drawing, etc., or even to taking out quantities.—J. B.

Cold Brazing.—FAITHFUL READER.—Here is a recipe for cold brazing:—Melt 10 dwt. of tin in a small crucible, and add in the following order, as the tin melts, bismuth 1 dwt., fine silver 8 dwt., platinum foil 1 dwt. When all is melted and mixed together, pour into a mould; reduce this to a powder, and reserve till required. To use the solder, prepare the article by cleaning and scraping the same as if for ordinary soldering; tin the surfaces to be united with the following flux: 1 part metallic sodium to 50 parts mercury; get this prepared by a chemist, and keep in a closely stoppered bottle. Mix three parts of the solder filings before mentioned with one part of mercury till reduced to a paste; smear it on the surfaces to be united, and press firmly together; it will soon set hard. This method is only suitable for articles that cannot be brazed with a fire, and will not stand much knocking about.—R. A.

Birdcage Making.—CANARY.—I do not know of a book published on birdcage making. There are many books on cage-birds and how to keep them. If CANARY will get Nos. 54 and 108 of WORK, I think he will find all he wants.—F. H.—[A novelty in this way will shortly appear.—ED.]

Twisted Pillar.—C. B. B. (*Westbury-on-Trym*).—To answer this would be to advertise a particular turner, and I am quite ignorant of Bristol turners, any of whom ought to be able to do the work mentioned. C. B. B. should ask the turner who usually does his turning, as he, being a cabinet-maker, must often need turning work done. Not having full particulars, no instructions can be given as to the twisted pillar required; but twisted work may be described as carving on the lathe, and after the ordinary turned parts are done, and the twisted parts turned to a cylindrical form, a piece of paper, like a riband, may be twisted round the work at the proper inclination and the spaces cut with a saw; then gouge, rasp, and glass-paper, using the lathe with a backward and forward movement, with a very slight movement of treadle and fly-wheel.—B. A. B.

III.—QUESTIONS SUBMITTED TO READERS.

**** The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Dough-mixing Machine.—HYGIENE writes:—"Would a fellow-reader describe a wooden dough-mixing machine that would incorporate the air, to make bread without yeast, soda, etc.? It should be for hand power, and for a quantity of 1 lb. or 2 lb. at a time."

Piano Stool Screw.—W. J. W. (*Heckmondwike*) writes:—"Will any reader kindly tell me where I can obtain Brooke's Patent Adjustable Screw for pianoforte stool? I have seen one which came from Germany."

Insurance of Tools.—CONSTANT READER writes:—"Could any subscriber inform me as to insurance of wood-workers' tools' offices, and terms?"

Blade Polishing.—ELECTRO writes:—"Would some kind reader inform me how to polish pocket-knife blades, and especially how to make buffs for the polishing lathe? I use fine emery, also putty powder with oxalic acid, and it does fairly well."

Monogram.—E. W. B. (*Manchester*) writes:—"I shall be greatly obliged if some kind reader would furnish me with a monogram of the letters 'E. W. B.'"

Furniture Diagrams.—E. C. N. (*Islington*) writes:—"Can any kind reader kindly guide me to a work on diagrams and measurements of furniture?"

Enamel for Lathe.—E. J. C. (*Charlton, S.E.*) writes:—"Will some reader tell me where to purchase good black enamel for lathe—one that will not dissolve with oil?"

Monogram.—J. H. P. (*Castlemartin*) writes:—"I should be much obliged if some reader would give me the monogram 'J. H. P.' in a form suitable for carving in wood in the centre of a stool."

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Monogram.—T. B. P. (*Winlaton*) writes:—"I beg to submit monogram, 'S. S. G. C.,' in answer to

"S. S. G. C." Monogram.

H. T. W. (*Cardiff*). (See No. 170, p. 222). Should this design not suit H. T. W., I shall be pleased to design another."

Asphalte Paths.—W. W. W. (*Wembley*) writes to W. R. (*St. Albans*):—"Ashes with pitch and tar do not do so well as coarse gravel. The usual method, after preparing the path and making it the proper rounded shape to allow the wet to run off, is to boil up gas tar with a little pitch in it in a large iron pot, and then mix the fine chippings that are sold for paths, or good gravel will do, with the hot tar and spread on the path to, say, 2 in. thick or more; then roll flat and sand it slightly to keep the roller from sticking. Care must be taken that the contents of pot do not catch fire. If they do, the only way to put it out is to cover top of pot with a slate or something that will do this as quickly as possible, and same may be kept handy in case of need."

Pyrotechny.—M. (*Bishop Auckland*) writes to C. A. J. (*Manchester*) (see No. 183, p. 430):—"You will find 'Firework Making for Amateurs,' by Upcott Gill, 170, Strand, a suitable book."

Ventriloquists' Dolls.—W. C. (52, *Commercial Road, Peckham*) writes to BURGY:—"I can supply him with the dolls he requires. The price would be 30s. the pair."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only awaiting space in SHOP, upon which there is great pressure:—J. B. (*Old Charlton*); J. T. S. (*Strangeways*); W. L. (*Middlesboro'*); T. S. A. (*Grantham*); CEMENT; J. H. W. (*Hulme*); W. C. (*Heckmondwike*); C. C. (*Durham County*); YOUNG ENGINEER; A. A. (*Christchurch*); E. MOO. (*Newcastle*); L. W. L. (*Newcastle-on-Tyne*); W. T. H. (*Paddington*); T. H. (*Blackburn*); G. S. (*Montreal, Canada*); D. MCS. (*Glasgow*); H. J. O. (*Stockport*); D. C. (*Godalming*); J. P. H. (*Aberdeen*); A. R. (*Scorrier*); W. S. K. (*Tunbridge Wells*); W. P. (*Cheshire*); W. H. C. (*Plumstead*); F. H. (*Hull*); J. E. B. (*Chesterton*); WHITESMITH; BOOTS; PRACTICAL; H. D. (*Leeds*); J. H. (*Stockton-on-Tees*); CONSTANT READER; A. W. J. (*Evesham*); J. K. (*Newcastle*); T. W. L.; F. W. B. (*Huddersfield*); LEYBOR; T. E. (*Creeton, N.B.*); REV. R. B. R. (*Dorchester*). J. F. S. (*Salop*); D. B. C. (*Bedford Park*); C. W. (*Conway*); CONSTANT READER (*Penzance*); W. R. (*Tunbridge Wells*); X. Y. Z. (*Derby*); YOUNG SAWYER; C. R. (*Nottingham*); X. X. (*Dundee*); J. H. (*Wellington*); LAVENDER; W. W. (*Brierly Hill*); G. R. T. (*Newcastle-on-Tyne*); W. H. B. (*West Hartlepool*); J. M. (*Belfast*); J. M. (*Glasgow*); F. R. (*Isle of Wight*); M. L. (*Naples*); C. F. M. (*Bolton*); TENANT.

"WORK" PRIZE SCHEME.

FIFTH COMPETITION.

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All manuscripts intended for the "Electricity Suggestion" Competition must be addressed to the Editor of WORK, c/o Cassell & Co., Ld., Ludgate Hill, London, E.C. They must reach him on or before Saturday, December 17th, endorsed, "Electricity Suggestion" Competition.

***** For conditions and rules see previous numbers.

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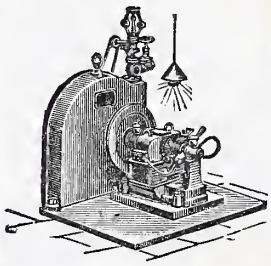

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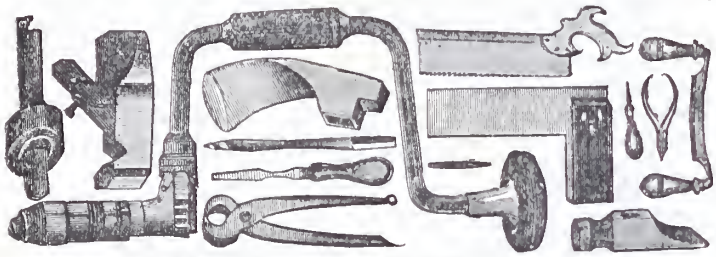

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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VOL. IV.—No. 195.] SATURDAY, DECEMBER 10, 1892. [PRICE ONE PENNY.

WORK WORLD.

SKYTOGEN is a paper substitute for calico and leather in bookbinding and fancy goods. It is soft and leather-like to the touch, does not scratch so easily as leather, and is not readily soiled as is calico.

* *

Cycle sections have fallen off considerably. The great variety of sections for tires has caused Sheffield makers of cycle material some expense and anxiety, but the demand for the coming season will be met.

* *

An electric snow-sweeper, with steel brush at either end, has been used in several towns in the United States with complete effect. It is an electric motor car that drives the steel brush, from enclosed gears, at a normal speed of 1,200 revolutions per minute.

* *

Digging for petroleum or "earth oil" engages two hundred families in Upper Burmah. The future, however, does not present bright prospects if native methods only are retained, as they only enable a depth of 310 feet to be reached, and many of the wells have reached this depth already.

* *

There is to be a line up the volcano of Popocatepetl. Sulphur and natural ice are wanted for the City of Mexico. Thus a railway is proposed to be worked by electric motors. The quality of the Popocatepetl sulphur is excellent, and, if mined in large quantities, will find a ready market in the United States.

* *

An anomalous condition of things prevails in the hematite market. While the West coast makers consider the lowest price has been reached at which they can make a profit, and decline to quote lower than 57s. delivered in Sheffield, North-Eastern makers, on the other hand, offer hematites at about 53s. per ton.

* *

A new manufacture is glass sheet, with wire netting embedded in it, for use in roofs and other situations in which the fall of broken glass is a source of danger. It is also to be used for footlights and windows, thick glass, with heavy steel wire netting, being made for burglar and missile-proof purposes where light is required.

Wood concrete of a novel character is now being made in Germany. It consists of chips, shavings, and clean mill waste of plain or fancy woods, which can be stained to requirements before use. These are mixed with casein, calcined limestone, glycerine, sodium silicate, and linseed oil. The dry composition is hard and solid, and can be sawn, planed, and polished.

* *

In yet another method of extracting aluminium which has been elaborated, the aluminium oxide is extracted from pure clay and dissolved. The solution is treated with an electric current, which deposits the metal —almost pure—on brass plates, from which it is removed in the form of a silvery impalpable powder, which is subsequently melted into ingots.

* *

The number of men and boys employed on the Manchester Ship Canal, from November, 1887, to November 18, 1892, has been 10,500 per annum. The list of killed or dying from injuries received on the works has reached 130—an average of 26 a year; the array of permanently disabled is 165, and those partially injured, 997. The total number of accidents of all kinds has been 1,292. * *

For experiments in electrical communication, a shore wire, a mile long, has been erected on the Welsh coast, a little to the south of Cardiff, and a receiving wire on the island of Flat Holme in the Bristol Channel. The shore line was furnished with a powerful generator, and the island line with a sounder, and words despatched on to the mainland wire were distinctly heard on the island, the wires acting by induction. The wires are parallel, and the distance between them is about three miles.

* *

A new method of measuring, at a distance, the rate of rising of a river after a fall of rain has been devised. An organ pipe of square section is inverted with its open end in the water, which then acts as a stopper to it. It is sounded by a bellows driven by a very small water-wheel. The note varies with the water level, and is conveyed by a micro-telephone to a town station, where a duplicate organ pipe is placed in a tank; this is raised or lowered to give the same note as that coming through the telephone, and thus the rises and falls of the river level can be measured at the tank.

In the new small arms factory at Herstal, the mechanical transmission of power from the engine to the machine tools by belts or ropes is abandoned in favour of electrical transmission. A 500 horse-power dynamo is fitted on the shaft of the engine, which is 460 horse-power. The current generated by this dynamo is used for driving small motors varying in size from 3 to 37 horse-power. The main dynamo had to be specially designed to run at the lower speed of sixty revolutions per minute. The armature is about 16 ft. in diameter, and acts also as a fly-wheel to the engine. The machine develops 2,400 ampères at 125 volts.

* *

The longest telephone line ever constructed, exceeding by at least 450 miles that in operation between Paris and Marseilles, extends between New York and Chicago. The line is constructed of No. 8 hard-drawn copper wire, weighing 435 lb. to the mile, the total length being 950 miles. It is strung upon poles, the utmost care, of course, being paid to insulation and the use of cables has been avoided wherever possible. The two wires forming the circuit are run on what is called the balance principle—that is, the wire from New York passes on the north side for a short distance, then crosses to the south side, then back to the north side again, this arrangement being adopted in order to avoid induction.

* *

A gas of very high illuminating power is secured by injecting oil into red-hot retorts by means of steam, the oil used being a heavy hydro-carbon. Results obtained by this process compare with coal as follows:—

	Cb. Ft. Gas per Ton.	*Candle-power.*
West Lowthian oil ·840 sp. gr.	24,922	60·15
,, ,, ·890 ,,	23,573	55·29
,, ,, ·870 ,,	24,383	56·26
,, ,, ·870 ,,	24,396	57·65
Westfield oil (crude)	16,755	49·03
Walkinshaw oil ·653 sp. gr.	19,464	40·23
Boghead coal	14,900	42·19
Cairntable coal (1872)	11,294	35·75
Haywood coal (1884)	11,360	32·12
Lesmahagow, Auchenheath coal (1882)	13,201	34·52

Each result shows how vastly superior some heavy oils are than coal for the production of illuminating gas, not only for quantity of gas yielded, but also in the candle-power of the gas

PRACTICAL PAPERS ON PLUMBING.

BY R. A.

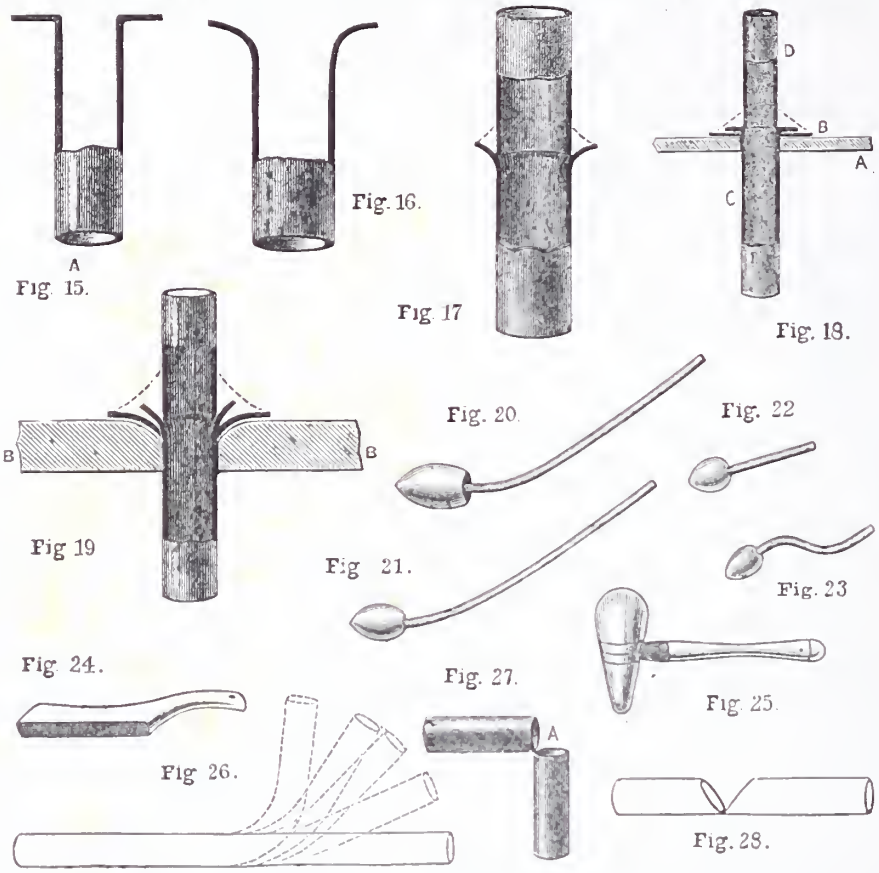
JOINT MAKING (*concluded*) — THE TAFT JOINT, BLOCK JOINT, FLANGE JOINT — GENERAL REMARKS ON JOINTS — PIPE BENDING EXPLAINED AND DESCRIBED.

Taft Joints.—These are not much in favour with skilled plumbers, but are often made nevertheless by others not so well up in the trade. They are very much decried by some, but if properly constructed they are a strong, useful joint. The method of operation is to taft back the edge of the lower pipe from 1 in. to 1¼ in., according to the size of the pipe, and here is where many spoil the joint. Figs. 15A and 16 show bad and good tafting; in Fig. 15A you will notice that the pipe is flanged back quite sharp and square. It is thus rendered very weak at the angle, and liable to break off there if there should be any weight or expansion and contraction of the pipe; but if made with an easy curve, as shown at Fig. 16, the joint when completed (see Fig. 17) is a very good one. It is probably the easiest of all wiped joints to make. After tafting back the pipe, shave the inside, soil the top pipe 4 or 5 in., and shave the end 1¼ in.; place in position, "touch" round, and either pour or splash on the solder, and when sufficiently plastic wipe as before described.

Flange Joint.—This is mostly made where a pipe comes through a floor (see Fig. 18). To make this joint, first cut a lead collar or flange 3 in. or 4 in. larger in diameter than the pipe that is to pass through it; cut a hole the exact size of the pipe, and slip it over it, then cut the pipe off so that it stands up ¾ in. or 1 in. above the flange. This is best done with a tenon saw and piece of board the requisite thickness of the stand-up that you want. Next drive the turnpin in to swell the pipe out a little, and then work the pipe down on the collar; prepare and make the joint as described in taft joint. In Fig. 18, A represents the floor, B the lead collar or flange, C the lower pipe, D the upper pipe, and the dotted lines the wiped soldering. This form of joint is mostly used for small pipes.

Block Joint (Fig. 19). — Although this appears similar to the flange joint, yet it is differently fitted, and is much stronger. B B is a section of the wood block through which the pipe passes, which is fixed in the wall to support the pipe. This block is dished out as shown, and the lead flange, with a hole cut in it, that will just admit the pipe, is dressed down into it; the pipe is then passed up through the block and flange, and the turnpin driven in as previously mentioned to open out the pipe. Now, instead of dressing it sharply back on the flange, it is left as shown in the sketch, so that the solder will run underneath as well as above the tafting, thus forming a very strong substantial joint. Of course it will be noted that the outside of the pipe that is tafted back will require to be shaved and "touched" as well as the inner part. It is also advisable to "tin" the lead flange before putting in place, to ensure more perfect cohesion between the parts. This class of joint is mostly used when soil or vent pipes are fixed in the interior of dwellings, in a chase or cutting left in the wall for that purpose. These are the principal joints used in plumbing practice, and when proficiency in making these various joints has been attained, the groundwork of plumbing may be said to have been learned. Much argument is sometimes heard as to which is the strongest, a blown or copper bit joint, or a wiped joint. Well, though the former joints are very good and useful joints when in their proper place, yet no sensible man would contend that a wiped joint was not superior in strength; if not, how is it that so many water companies will have no others made on their service pipes? The fact is that no other soldered joint will stand an equal amount of pressure or rough usage, or will stand the expansion and contraction of the pipes like wiped joints will. This is due to the well-known fact that plumbers' solder approaches very much nearer to the composition of the pipe to be jointed than does the solder used with copper bits or blowpipes; it is also tougher and more tenacious. These are a few of the reasons why wiped soldered joints are preferable for good plumbing work; others could be adduced, but these I think will suffice.

Pipe Bending.—The art of bending lead pipes, especially those of large diameter, was not very extensively practised till within the last thirty or forty years, and there are many plumbers at the present day who cannot bend a piece of 4 in. or 5 in. soil pipe successfully. And at the same time it is a fact that pipes of this kind and size can be bent successfully to any required degree of angle, and that without diminishing their size or thickness in any part; some practice, of course, is requisite before this degree of skill can be attained. I will now describe the process, and by care and strict attention to details a successful job may be made by anyone conversant with the use of tools. The only tools required for bending large size light pipe, say from 3½ in. to 6 in. in diameter, are a plumbers' mallet, dresser, and some dummies. These dummies are simply long pieces of pipe or iron rod with a lump of lead run on the end. They are illustrated at Figs. 20 and 21; short ones, Figs. 22 and 23, are also required when the bend is near the end of the pipe. The dresser and mallet are shown in Figs. 24 and 25. To bend a piece of 4 in. pipe (which we will take as our example) is a two-handed job. The pipe should be first heated in the place where the bend is to be; this may be done in various ways. Some plumbers put some lighted shavings down the pipe and pull them out when it is sufficiently hot; but I prefer to use a blowlamp, as the heat can then be directed more definitely to the place where it is wanted. The pipe should be just hot enough to make a fizzing noise when a splash or two of water is dropped upon it. Next place the pipe on the floor on a bag of shavings or something similar; take a couple of pieces of stout carpet in your hands, and let your mate pull up the pipe a little bit, you holding it firmly in the bend, and shape it as well as you can. Do not let it be pulled up too much at once; just sufficient to dent it across the throat of the bend. Fig. 26 shows a straight piece of pipe, and the dotted lines the various stages of bending to get it to a right angle, or square bend, which is the farthest that pipe of this description is required to be bent. After pulling up, and whilst the pipe is still hot, take one of the long dummies and lightly dummy up the part that is dented in, taking care not to strike the back of the pipe, or it will make it thin at that part. Give the sides a rap with the dresser where they are pressed out. When you have got the pipe fairly into a round shape, it must be warmed again, and the pulling-up process repeated. This time let your mate



Practical Plumbing. Figs. 15 A and 16.—Sectional Views of bad and good Tafting. Fig. 17.—Section of Taft Joint. Fig. 18.—Section of Flange Joint. Fig. 19.—Section of Block Joint. Figs. 20 to 23.—Dummies. Fig. 24.—Dresser. Fig. 25.—Bossing Mallet. Fig. 26.—Diagram showing Stages of Bending. Figs. 27 and 28.—Diagrams illustrating Theory of Bending.

hold up the dummy inside and dress the sides into shape, giving the blows a direction towards the back of the bend, so as to thicken the lead at that part, as it is thinner there the more it is bent, unless this is done. I will explain this presently. Repeat these processes till the bend is brought to the desired shape, then with the joint use of mallet, dresser, and dummy remove all marks as far as possible, and the bend is completed. Should the bend be near the end of the pipe, a piece of wood called a mandrel must be inserted at the end to afford a leverage to pull up by. It should enter the pipe about 6 in., and should just fit it. The diagrams Figs. 27 and 28 will explain what I meant by saying that the lead would be thin at the back of the bend, unless it was assisted by bringing lead from the throat, or inside part of the bend. Fig. 27 shows a piece of pipe cut nearly through and then bent at a right angle. It will be seen that there is a vacant space at A. Fig. 28 shows a piece of pipe with a V-shaped piece cut out; this, if pulled up together, will form an angle similar to Fig. 27, but with no vacant space, and the piece cut out would, as near as possible, fit in at A (Fig. 27). It will thus be seen that in making a bend there is much superfluous metal in the throat that must be worked round to the back to supply the deficiency there, caused by the stretching of the metal at that part. This can be done by careful and well-directed blows, making the bend an equal thickness throughout. A badly made bend is thin at the back; a bend that is thin can easily be detected by giving a blow in different places, and with equal force (light blows of course), and noting the part that dents the easiest.

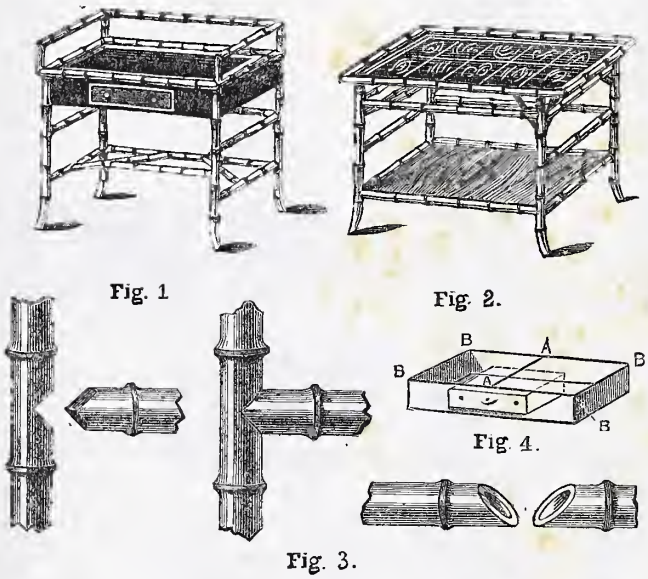
Bending Small Pipes. — The method just described of bending soil or funnel pipes will not be suitable for small bore pipe such as is used for water service, overflows, etc. Strong lead service pipe, up to 1 in., can be easily bent by pulling round, if the bend is not made too sharp, and the plumber should always make his bends as easy as possible. When a sharp bend has to be made in a long piece of pipe, it is best to cut the pipe near to where the bend is to be made, then when pulling round, if the throat contracts, it can be worked out to its proper size by means of what is called a bolt or tommy (see Fig. 11, p. 578). These are made of iron or steel, with the ends well rounded and quite smooth.

Bending with Water or Sand.—Some plumbers adopt these methods for bending small pipes. In the former method the water should be poured in *hot*, and the ends plugged tightly or flattened close, and the soldering-iron run over the ends to keep the water from bursting out when the pressure of bending comes on it. In bending with sand, the sand may either be put in hot, or the pipe can be heated in the place where the bend is required. After filling, one end should be plugged, then the sand rammed in as tightly as possible till the pipe is nearly full, and then plug or close the other end. In bending pipes they should not be bent over anything sharp, but they should be "humoured" as much as possible. The great point to be aimed at is to keep the pipe full size at the bend, otherwise its effectiveness is reduced.

BAMBOO FURNITURE: A WRITING-DESK AND TEA-TABLE.

BY C. S. V.

Introduction.—In placing before the readers of WORK these designs for bamboo working, I do not think any apology will be needed for what I might call introducing the subject—one which all can turn to. Bamboo furniture is in itself very artistic, and is much seen in lately furnished houses, more especially in drawing-rooms where there is an appearance of Eastern art, by the many coloured silks and highly-tinted fans, and other ornamentations that abound; and if strongly and carefully made, will be found very durable indeed, as well as handsome, and, I am sure, will repay anyone the trouble expended thereon. The two designs given are very simple, and to the ordinary amateur should not be difficult, as anyone with a knowledge of carpentry and the use of tools should be able easily to construct them.



Bamboo Furniture. Fig. 1.—Bamboo Writing-table. Fig. 2.—Bamboo Card-table. Fig. 3.—Plans, showing Joints in Bamboo and Mode of fixing same. Fig. 4.—Plan of Drawer in Fig. 1.

I will now give a few hints enabling anyone to make either one or the other of these designs.

Heights.—The most convenient measurements for the writing-desk will be as follows:—Height (exclusive of outside railing) 2 ft. 6 in., the depth 2 ft., and the length 3 ft. 2 in.; and for the tea-table: height 2 ft. 7 in., length 3 ft., and depth 2 ft.

Construction.—Fig. 1 shows a view of the desk complete and finished; but we had better first commence by making Fig. 4, which is the skeleton of the top part, and which consists of a simple tray cut for a drawer to be inserted. I may add that two drawers would look as well as one, and would be equally easy to make. A small bit of wood dividing the tray, and running from A to A, will be required so that they keep their position. We shall then require a nice bit of wood—say, walnut—well stained and polished, to go over the top, and to run from B B. The edges had better be rounded and polished and well finished-off, so as to add to its beauty. Next we shall get our bamboos and arrange them as Fig. 1, fastening the legs by small screws on to Fig. 4, at the top of each corner; and by running bars across, and fastening them by screws and joints as Fig. 3, we shall make the whole very secure. The bamboos round the sides of the desk will be required to be neatly fastened, as also the rail; and this can be done by running small screws and nails under the sides of the canes. With regard to the table, the top can be fitted with tiles or plain or carved wood; and the construction is similar to that of the desk.

In conclusion, if the desk or table is stained and varnished a dark colour, and carefully done, I have no doubt it will be a success. Information as to bending bamboos, and where they may be bought, can be turned up in the back numbers of WORK. And the number of firms who sell bamboos who advertise, or should do so, in WORK, disposes of the question, Where to buy the bamboo?

HINTS TO USERS OF MILLING CUTTERS.

BY N. MACLEAN.

BEFORE setting the cutter to work on any material, first ascertain the number of revolutions the milling-machine spindle is making per minute, then multiply number of revolutions by circumference of cutter in feet, which will give cutting speed in feet per minute. This should be approximately as follows:—On cast iron, 60 feet per minute; on wrought iron, 48 feet per minute; on steel, 36 feet per minute; on brass, 120 feet per minute. The above rule relates to cutters of 6 in. diameter and upwards.

If there is not any great depth of material to be cut away, the feed per minute should be about:—On cast iron, 1⅛ in. per minute; on wrought iron, 1 in. per minute; on steel, ½ in. per minute; on brass, 2⅝ in. per minute. When working on cast iron, a very easy way to ascertain how many revolutions the spindle should make with cutters 6 in. in diameter and upwards is to divide 240 by the diameter of cutter, which gives the proper number of revolutions the spindle should make; thus:—A cutter 8 in. diameter $\frac{240}{8} = 30$ revolutions per minute. Do not use blunt cutters; have them re-ground as soon as the teeth become dull.

ENAMELLING PRINTS WITHOUT GELATINE OR COLLODION.

MIX oxgall and alcohol in equal parts without frequent agitation, and allow to stand two days; finally filter the resulting solution. Place the albumenised print in close contact with a glass plate coated with the above mixture. Drying will be complete in about one hour. The print can then be removed by peeling, and will be found to be highly enamelled. To mount the print without loss of gloss, affix a sheet of paper to the back of the print while it is on the plate. The outside of the paper is then coated with gum or dextrine. When detached and pressed down upon a mount with a thoroughly damp surface, the print will be permanently mounted, and yet possess all its high finish. It should be thoroughly rubbed down and passed through a cold burnisher, with the print in contact with a zinc plate without flaw of any kind.

HOW TO VENTILATE A ROOM.

BY E. DICKER.

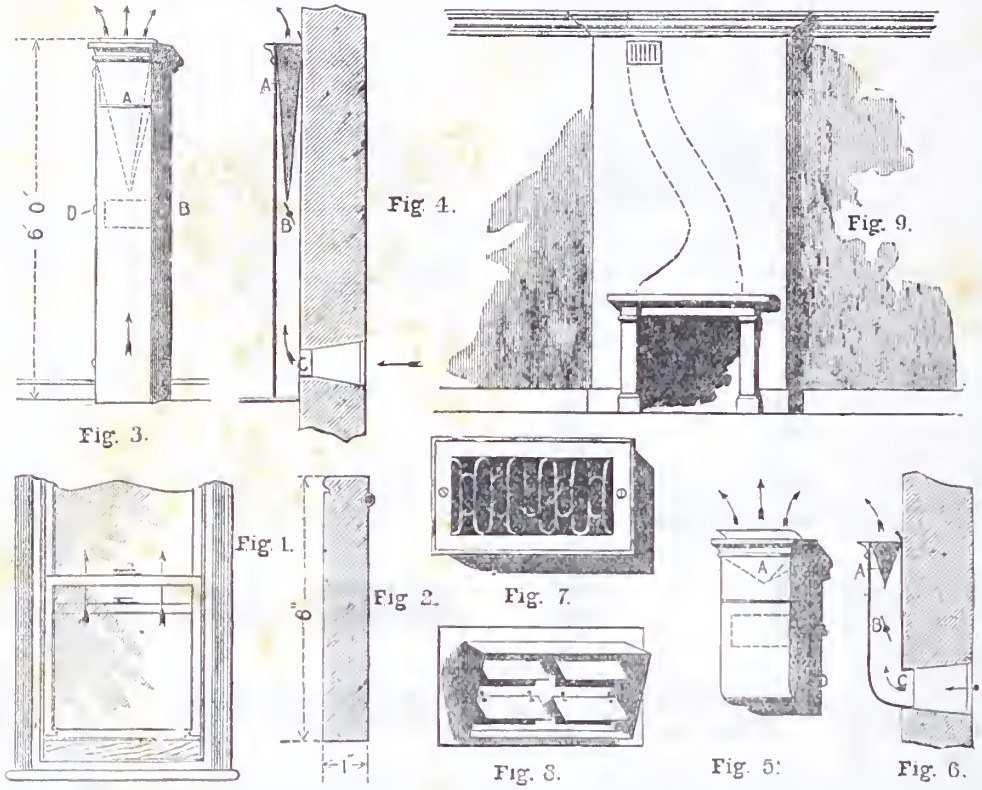
Introduction. — Hardly any other subject has occupied the attention of scientific men to a greater extent than ventilation. It is a well-known fact that every room should be supplied with a steady flow of fresh air in order to secure the health of its occupants, and to do this without draught is often a very difficult matter, as so much depends upon size, situation, and construction. The object of this article is to give a method by which the ventilation of nearly all ordinary rooms can be greatly improved. It is a very simple matter to admit fresh air to a room by opening a window, but what is the result? — a draught, especially in cold weather. So we will first consider the various methods of admitting fresh air without a draught, and afterwards the means of getting rid of the heated or otherwise vitiated air, bearing in mind that one of the principal considerations of these articles is economy, and following that, the wish of most of the readers of these pages for a *modus operandi* that they can carry out themselves.

Fresh Air Inlets. — Figs. 1 and 2 show what is known as a "Sanitary Rail." It consists of a piece of wood about 6 in. wide, fitting in tightly between the side sash beads and on top of the bead of the inside of window-sill, secured by dowels at bottom and two ordinary blind bolts on the top, that bolt into the beads on either side. This enables it to be readily removed for the purpose of cleaning the windows, etc. Now, by raising the sash about 5 in. a current of fresh air is admitted between the meeting bars of the upper and lower sashes in the direction shown by arrows. The meeting bars of an ordinary sash being above 6 ft. from the floor, and the space between the two sashes forming a short shaft, the air is directed upwards, so that nobody in the room feels any inconvenience. Fig. 2 shows the sectional end of the rail, with a piece of indiarubber piping inserted and glued in a hollow groove, against which the face of the bottom sash slides, and thus prevents a draught at this point. I generally put a similar piece along the bottom of the rail, to make a good joint down on to the bead.

The above is the simplest and cheapest form of fresh air inlet, but it is open to the objections that it does not sufficiently direct the current upwards; also, that it lets in smuts and blacks, etc., as well as fresh air.

Figs. 3, 4, 5, and 6 are elevations, and sections of what are known as "inlet air tubes," and can be made either of zinc or wood. This consists of a tube from 2 ft. to 6 ft. long, with a valve, as shown at B, to regulate the quantity of air, and a filter, A, made of coarse canvas or muslin stretched on a wire frame and dropped into the tube from the top, and made removable, so as to enable it to be dusted about once a week. This entirely prevents any dust, etc., getting into the room, and tends to break up the current and diffuse the air more generally. The back part of the tube is carried up a little higher, and bent slightly forward to throw the air away from the wall and prevent its being marked; an opening is formed at the bottom of the back of the tube, as high up as the skirting is deep, with a flange as shown at C, to make a good joint to the opening.

To fix these tubes, it is necessary to cut a hole through the wall, communicating with the open air. This hole should be at least about 3 in. by 9 in., and be made a little larger outside than inside. To cut this hole, first determine by examining both inside and outside the wall the most convenient spot for cutting, taking into consideration the appearance, etc., it will present when finished. The best place is just above the wood skirting, if this is practicable, and the farthest point away from the fireplace. Commence by cutting a small hole right through the wall about the centre of the hole when finished, taking great care not to burst the plaster away when cutting from the outside, or the brickwork when cutting from the inside, and from this small hole work all round carefully until it is the size required. A terra-cotta or iron air brick should be fixed on the outside of hole, and the inside roughly rendered with cement or mortar, so as to present no obstruction to the current of air. To fix the tube inside, small ears are formed on the sides, as shown at D, Figs. 3 and 5, if the tube is made in zinc, but if it is made in wood, looking-glass plates should be used. The flange, C, is then passed into the hole, and the tube simply screwed to the wall; the inside tube should be fixed before the air bricks outside, so as to enable you to make good round the flange, and thus prevent draught. Sometimes a water-trough is inserted at the bottom of the hole through the wall, to catch the blacks and other impurities, but in our case it is hardly necessary. The action of the "inlet tube" is as follows:— The fresh air enters through the opening in the wall near the floor level, and by means of the vertical tube is caused to take an upward direction, owing to its natural pressure, and the extra velocity it attains in passing through a long narrow channel. It continues upward as a direct column of air, equal to the area of the tube, for several feet above it, spreading over the upper part of the room, and then getting warmed, passes away through the outlet in the chimney, which we shall speak of later on.



How to Ventilate a Room. Figs. 1 and 2.—Sanitary Rail. Figs. 3, 4, 5, and 6.—Inlet Ventilators—A. Air Filter; B, Valve; C, Flange; D, Ears for fixing. Figs. 7 and 8.—Mica Flap Outlet Ventilators. Fig. 9.—Sketch showing supposed direction of Flue and position of Outlet Ventilator.

Figs. 5 and 6 are elevation and section of a shorter tube, but being shorter, the air does not gain such a velocity as it does with a longer one; these shorter tubes are generally used when it is found impossible to make the hole through the wall at the skirting level.

We now come to the outlet ventilator (see Figs. 7 and 8); and although the one I am about to explain is open to some objections, it is almost the only form that is suitable for an ordinary room, where no thought has been given to the ventilation of the various rooms in the building of the house.

It consists of an iron frame, hung in which there are four or more mica flaps or valves. These flaps are light, rigid, and incorrodible, and are so sensitive that they open with the slightest appreciable outward current into the chimney flue (to which they communicate), and immediately close against down draughts, and effectually prevent the smoke entering the room. There is an ornamental iron front that screws on to the body of the ventilator, this front being also very useful in covering up any damage done to the plastering round the hole in cutting into the flue. Sometimes these iron fronts consist of an ornamental "hit and miss" ventilator, and are worked with cords and pulleys, so as to close the outlet when necessary, and prevent the noise of the flaps flapping against the iron frame.

These "mica flap" (outlet) ventilators, as they are called, are sometimes made with the mica flaps hanging perpendicularly down and always open, unless there is a downward current, which downward or

backward current at once closes them for the time the down current lasts. Some are made with the flaps resting on the iron frame continually, until there is an outward current to open them. This latter method is not to be recommended, as I and many others have found in practice that the fact of them resting on the iron frame when there is not a good current of air, or the room is not in use, they get stuck, as it were, to the frame, and refuse to work when required.

These outlet ventilators should be fixed as near to the ceiling of the room as the cornice or other obstacle will allow, and the only difficulty is to find the exact position of the flue near the ceiling. This does not present much difficulty to the practical man, but with an amateur it is very different; but I will endeavour to explain how it can be done with a little care and disregard of soot.

First look carefully up the chimney, and see if you can see the direction the flue takes; be very careful in this, as the flue, if properly built, sometimes takes just the opposite direction it appears to directly after leaving the fireplace opening. (See Fig. 9.) In some flues you can see the sky on looking up; and although this is exactly what you should not see in a properly constructed flue, it makes the finding of the position of the flue on the face of the chimney crest a very simple matter.

If you cannot exactly determine the direction of the flue even with a light, pass a stiff cane so far up the flue as just to reach the ceiling level, and get someone to wriggle it about whilst you listen, with your ear to the wall or the chimney breast near the ceiling, and in nine cases out of ten you can easily locate the spot where the flue is.

Having determined the position of the flue, make a small hole through the brickwork, about 6 in. below the cornice, into the centre of the flue as near as you can guess. Now that you have made sure you *are* in the right spot, take the ornamental front off the ventilator, and mark out on the wall the exact outside size of the body with the flaps attached, and working from the centre, gradually make the hole the size required, being very careful not to damage the plaster and paper round the opening. When the hole is cut, put the body of the ventilator into its place, wedging it in position with small pieces of slate, and make good round it with plaster, and screw on the front with a little painters' putty between the two frames, to prevent the smoke coming through any joint there may be. If this operation has been performed properly there is no occasion for any appearance of dirt or damage round the ventilator.

I should have cautioned you to close the register of the stove before commencing to cut through the wall; the pieces of brick, etc., can be readily removed afterwards by carefully opening the register and inserting your arm into the flue and taking the rubbish out.

The size of ventilator for an ordinary room in a ten-roomed house should not be less than 9 in. by 7 in., and the inlet about 9 in. by 4 in. The cost of a 9 in. by 7 in. outlet mica flap ventilator is about 8s., and a zinc inlet ventilator 9 in. by 4 in., 6 ft. high, about 15s.

Iron castings that are to receive a coat of paint should be first well rubbed with a piece of common coke, and then painted, when they will present a much better appearance.

AN ELECTRIC HAMMER.

BY G. E. BONNEY.

Introduction — Electro-Magnets — Magnetic Shell—Hollow Electro-Magnets, or Solenoids—The Action of a Solenoid applied in the Construction of an Electric Hammer—Parts of the Electric Hammer—The Legs, or Frame of the Hammer — The Cylinder, or Bobbin.

Introduction.—The little toy described and illustrated herewith is made and sold for 12s. 6d. by Mr. G. Bowron. It is intended to practically illustrate the magnetic action of an electric current in a solenoid. It may not be generally known that a solenoid is a hollow electro-magnet. If we take a piece of iron, and wind around it some insulated wire, then send a current of electricity through the wire, the current will induce in the iron a magnetic effect, and convert it into a magnet whilst electricity is passing through the wire. Such an arrangement is named an electro-magnet, because the magnetism of the iron core is dependent upon the electric current passing through the wire wound over the iron, and ceases when the current is stopped. This magnetic influence is always present in and near a conductor of electricity, whether wound around iron or any other metal, or not wound on any metal at all. The presence of iron merely demonstrates the existence of magnetism, because iron is easily magnetised. If we pass an electric conductor through a piece of cardboard placed in a horizontal position, and sprinkle a few iron filings on the upper surface of the card, near the conducting wire, the filings will arrange themselves in lines radiating from the wire, as the spokes of a wheel radiate from its centre. These become more distinct when the card is gently tapped or shaken. This shows that a conductor of electricity is always surrounded with a shell or halo of magnetism, and this has been named the magnetic shell of the conductor. Now, if we wind the wire around a bobbin of wood, and place this over the iron core, as in making a magnet for an electric bell, we get the same magnetic effects in the core as when we wound the wire direct on the iron. Remove the iron core from the bobbin of wire, and the coil still remains an electro-magnet, but is now named a solenoid, because it is a hollow electro-magnet without an iron core. It has now a core of air, capable of being magnetised, and this core will attract to itself a piece of iron brought within the sphere of its magnetic influence. If, therefore, we connect the wire of the coil to a source of electricity, and place the tip of the abstracted iron core to the opening of the bobbin, the magnetised core of air will attract to itself the iron core, and suck this into the bobbin. If a strong current of electricity is sent through the wire, the core will be strongly magnetised, and the iron will be drawn into the bobbin with some amount of force. This sucking action of the current is shown in the toy under consideration, where the piston of the hammer is drawn into the cylinder when a sufficiently strong electric current is sent through the wire.

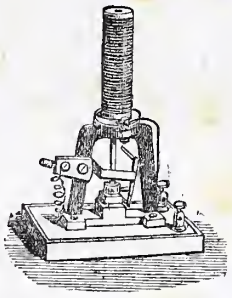


Fig. 1.—Bowron's Electric Hammer.

Parts of the Electric Hammer. — This little hammer may be regarded as a model of a Nasmyth steam hammer, and is therefore made up of the following parts:—(1) The legs or frame. (2) The cylinder. (3) The piston of the hammer. (4) The hammer head. (5) The block or anvil, and its base. (6) The regulating gear, or, in this case, the make and break arrangement. I shall first describe Mr. Bowron's toy as illustrated at Fig. 1, and then suggest, under each head, how the various parts may be modified to suit the requirements, skill, and pockets of amateur makers. In this way I hope to meet the wants and wishes of all my readers.

The Legs, or Frame of the Hammer.—This, together with the base and block of anvil, and also the cylinder, is formed of one piece of cast brass (obtainable for 1s. 9d. by post) in Mr. Bowron's novelty. The dimensions of this are as follows:—Height of frame, $2\frac{1}{4}$ in.; legs, $2\frac{1}{8}$ in. by $\frac{5}{16}$ in. by $\frac{1}{8}$ in.; feet, 1 in. by $\frac{1}{2}$ in. by $\frac{3}{16}$ in.; base, including feet of legs, $2\frac{5}{8}$ in. by $\frac{1}{2}$ in. by $\frac{3}{16}$ in.; anvil block, $\frac{5}{8}$ in. by $\frac{1}{2}$ in. by $\frac{1}{2}$ in. Cylinder—length, $2\frac{7}{8}$ in.; diameter of bottom flange, 1 in., thickness, $\frac{1}{8}$ in.; diameter of top flange, $\frac{11}{16}$ in., thickness, $\frac{1}{16}$ in.; diameter of body, $\frac{3}{8}$ in. A lug $\frac{5}{8}$ in. by $\frac{1}{2}$ in. is cast on the right leg of the frame, halfway up, to form a support for the regulating gear.

The legs and frame may be made of sheet brass, cut to the form of Fig. 2, and bent on the dotted lines to the required shape, or may be of very stout sheet zinc or iron. The centre disc of this will form a support for the flange of the cylinder, or bobbin, and a guide for the piston. The hole for the piston should be square or rectangular, to prevent the piston from turning round. The feet can be bent outwards after they have been cut, and screw-holes drilled in them. The base and anvil may be made separately.

The Cylinder, or Bobbin.—This may be made separately of brass, or of zinc, or of boxwood, ebony, ebonite, or ivory, or of papier-mâché. The length should be about 3 in., the diameter of lower flange 1 in., thickness of flange $\frac{1}{8}$ in., diameter of body $\frac{3}{8}$ in., bore for piston $\frac{1}{2}$ in. The cylinder must be bored true and smooth. If this is not done, the piston will stick in it sometimes. Holes must be drilled in the lower flange to correspond with the holes in the disc of the supporting frame, and be bolted to this with two small bolts. The cylinder should be wound with No. 22 silk-covered wire in two layers if the hammer is to be worked with two bichromate cells, or with four layers if it is intended to be worked with four Leclanché cells. The commencing end of the wire should pass through a hole in the lower flange, and the bared clean end be secured under the head of one of the bolts in contact with the metal disc beneath. The finish end will pass down by one of the legs under the wooden support of the hammer and be secured to a binding screw in front.

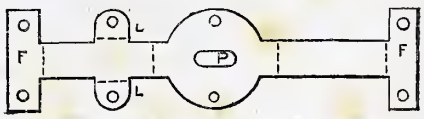


Fig. 2.—Shape of Frame cut out of Sheet Brass—F, F, Feet; L, L, Lugs to support Regulating Gear; P, Piston Guide.

To desulphurate indiarubber or gutta-percha, treat these substances with iron shavings and sulphuric acid, diluted, before boiling them in the alkaline lye.

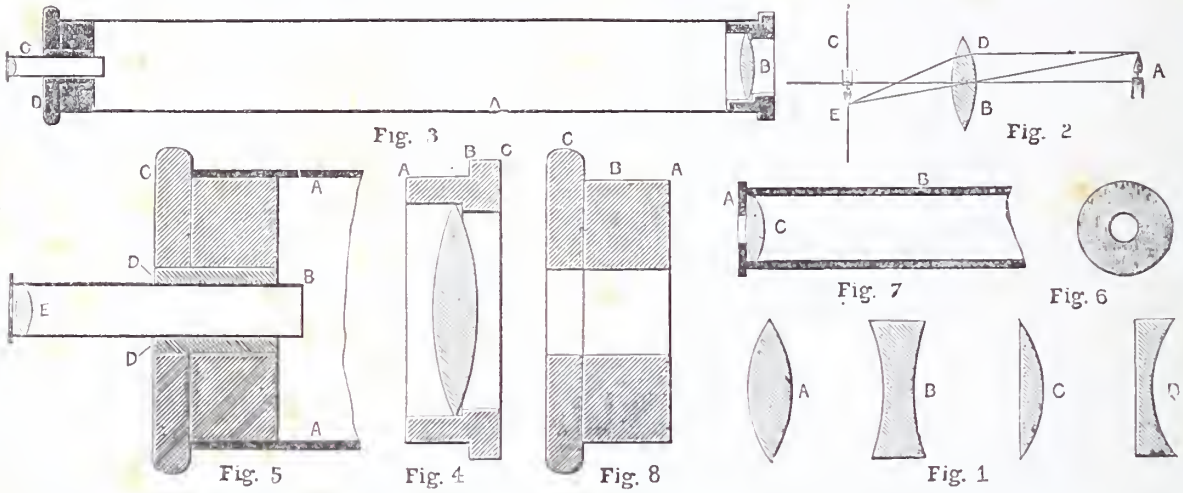
THE ASTRONOMICAL TELESCOPE, AND HOW TO MAKE IT.

BY ROBERT W. COLE.

INTRODUCTION—KINDS OF LENSES—PRODUCTION OF IMAGE BY LENS—PARTS OF TELESCOPE—MAKING TUBE—SEAT FOR FIELD-LENS—FITTING LENS INTO SEAT—EYE-LENS—FITTING EYE-LENS INTO TUBE—MAGNIFYING POWER OF TELESCOPE—USING TELESCOPE.

MANY of us have often been told by books and other sources of information of the many wonders with which the deep vault of the sky teems. On looking towards the sky on a fine night, we see it studded with countless hosts of stars—some large, some small, and others so minute that they can hardly be seen at all. On some nights we see the moon wending her way through the midst of the stars, gradually increasing from the crescent to the full moon and then diminishing back again to a crescent; or, if we happen to be very lucky in selecting the time of observation, we may see one of the larger planets, or, possibly, a comet. Many of those objects—especially the moon—if viewed through a telescope, reveal their hidden beauties to the enchanted observer, and show the vast foundations on which our universe is constructed. The moon, if viewed through a telescope, will show its mountains and valleys, its seas and plains, and even the shadows cast upon the plains by the mountains; and, if the telescope is very powerful, it will also show the minute details of its surface. The planets will reveal their spherical shape and their attendant moons. Saturn will show his magnificent system of rings, his belted surface, and his moons; Mars will show his surface divided into oceans and continents, and his snow-capped poles; Jupiter will show his four moons, his belted surface, and his orange-shaped form; and Venus will only appear as a crescent. A telescope directed to the Milky Way, or to any of the star groups, will reveal a multitude of stars invisible to the unaided eye, and will make known the fact that certain stars which appear to the naked eye to be single really consist of two, which revolve round one another.

In order to understand the principle upon which the astronomical telescope gives an enlarged view of an object viewed through it, we must, first of all, examine the optical properties of those round pieces of glass which are known as lenses. Four of the most generally used kinds of these are represented in section by Fig. 1, where A is a double-convex, B a double-concave, C a plano-convex, and D a plano-concave lens. A straight line passing through the centre of a lens is called its axis, and a ray of light, on passing through a lens, has the property of being refracted or bent back. If a bundle of rays of light pass through a double-convex or a plano-convex lens, they are bent inwards, but if they pass through a double-concave or a plano-concave lens, they are bent outwards. Both of the two convex lenses have also the property of throwing on to a screen an inverted image of a luminous object placed in front of them: for instance, if a lighted candle is placed at a short distance from one side of a double-convex lens, an image of the candle will be thrown on to a screen placed on the other side of the lens. The manner in which this takes place is represented by Fig. 2, where A is the candle, B the double-convex lens, and C the screen. A ray, starting from the top of the flame of the candle, travels straight on to the top of the lens at D, is refracted on passing through it, and falls on to the screen at E. Another ray, starting from the top of the flame of the candle, strikes against the centre of the surface of the lens, and, by a law of optics, passes straight through it without being refracted at all, and falls on the screen at E, where it forms, together with the former ray, an image of the top of the flame. In the same manner, images of all the other points of the candle and its flame are made on the screen, and thus the whole image is formed. These properties, and the additional property that an object when viewed through a plano-convex or double-convex lens is magnified, are made use of in the construction of the telescope.



Astronomical Telescope. Fig. 1.—Four kinds of Lenses—A, Double-convex Lens; B, Double-concave Lens; C, Plano-convex Lens; D, Plano-concave Lens. Fig. 2.—Showing manner in which Image of Candle is thrown on Screen by Double-convex Lens—A, Candle; B, Lens; C, Screen. Fig. 3.—A, Tube; B, Field-lens; C, Draw-tube; D, Circular Piece of Wood which fits Draw-tube into End of Telescope. Fig. 4.—Seat of Field-lens. Fig. 5.—Sectional View of Arrangement for fitting Tube containing Eye-lens into the Telescope Tube—A, Portion of Tube; B, Small Tube containing Eye-lens; C, Circular Piece of Wood; D, Cork; E, Eye-lens. Fig. 6.—Disc of Brass placed at one End of Tube containing Eye-lens. Fig. 7.—Section of Tube containing Eye-lens—A, Disc of Brass; B, Brass Tube; C, Lens. Fig. 8.—Sectional View of Circular Piece of Wood (C, Fig. 5).

Having gone through this preliminary explanation, we will now turn our attention to the construction of the telescope. An astronomical telescope, in its simplest form, consists of two lenses, a large one and a small one, fixed at a considerable distance apart from one another in a tube, the large lens—which is nearest to the object to be viewed—being called the field-lens, and the other one the eye-lens. The field-lens is fixed permanently in its place, but the eye-lens is fastened into a short brass tube which is made to slide up and down in the large tube. Fig. 3 is a section of the telescope, showing the two lenses and draw-tube fitted in their places; A is the tube, B the field-lens, and D is a piece of wood which fills up the other end of the tube, and which contains the draw-tube, C, at one end of which the eye-lens is fixed. The first things to be obtained are the lenses. Go to an optician, and buy a double-convex lens of 36 in. focal length and $3\frac{1}{2}$ in. in diameter; also a small double-convex lens $\frac{1}{2}$ in. in diameter and of 1 in. focal length. These will cost about three shillings the two; and, since it is rather difficult to get a lens the focal length of which is exactly 36 in., one whose focal length is nearly this amount will do equally well. Now get a tube 4 in. in diameter and 36 in. long. This may be made of brass, iron, or paper, and must be painted inside with dead-black varnish. If made of iron, you can easily get it made by a blacksmith, and if made of paper, you can make it by wrapping sheets of paper round a smooth wooden cylinder and pasting them together. The tube having been either bought or successfully made, you must make a seat for the field-lens—that is, some contrivance which will fix it in its proper place at one end of the tube. A sectional view of the seat, and the lens fitted into it, is shown in Fig. 4. From A to B its diameter is equal to the interual diameter of the tube, and from B to C its diameter is slightly greater than the external diameter of the tube. The distance from A to B is about 1 in., and that from B to C is $\frac{1}{2}$ in. It must be turned on a lathe out of boxwood or some other wood, and, as is shown in the illustration, must have a projecting collar turned inside it, and its greatest internal diameter must be just large enough for the field-lens to fit easily inside it. If you do not possess a lathe, you can easily get a professional wood-turner to make the seat for you. Now lay the seat on a table with the end, A (see Fig. 4), upwards. Then take the field-lens, carefully polish it with a piece of soft rag, and place it inside the seat so that it rests on the projecting collar. Go to a watchmaker, and get a piece of pliant clock-spring about $\frac{1}{2}$ in. wide, cut off a piece of it long enough to go round the seat about $1\frac{1}{4}$ times, bend it into the form of a circle, and place it inside the seat so that it presses against its sides and holds the lens firmly against the collar, which projects inside. This is all that we need do for the present to the field-lens, so we will now set it on one side, and proceed to make the contrivance for fitting the eye-lens into its tube and making it slide up and down. These are represented in section by Fig. 5, where A is a portion of the tube, C is a piece of wood turned upon a lathe, and having a hole about 1 in. in

diameter bored through its centre, and a flange ¼ in. wide projecting round its circumference, and D is a large cork fitted into this hole, through which a hole is bored in which a small tube, B, about 3 in. long, slides. We will begin with making the small tube, B. Procure a piece of brass tube about 3 in. long and ½ in. in diameter, and solder at one end of it a piece of circular sheet-brass, having a small hole about ¼ in. in diameter bored through its centre. This piece of circular sheet-brass is shown in Fig. 6, and is also shown, fitted on the brass tube, in Fig. 7, where it is represented by A, the brass tube by B, and the lens by C. Care must be taken in soldering the piece of sheet-brass on to the tube that the hole in its centre is exactly over the centre of the tube. The lens can then be dropped into the tube, and can be secured in its place by a piece of clock-spring in exactly the same manner in which the field-lens was treated, care being taken during the operation that the lens is not at all chipped or cracked, or otherwise its utility will be impaired.

We may now see about making the turned piece of wood, C (see Fig. 5). As in the case of the seat of the field-lens, you must get a professional wood-turner to make this for you, if you do not happen to possess a lathe. From A to B (see Fig. 8) it is 1 in. wide, and is sufficiently large in diameter to fit tightly inside the tube. From B to C it is about ½ in. larger in diameter and ¼ in. wide. Through its centre a hole 1 in. in diameter is drilled, care being taken that this hole is of the same diameter throughout. A good cork is fitted into the hole, and a hole bored through its centre, large enough for the tube to fit tightly into it. The hole must be bored through the cork by means of certain instruments called cork-borers. These—which are used in chemical operations, and which consist of a piece of brass tube having one end made very sharp and a knob at the other—can be obtained in sets at any chemist's shop, and usually cost about a shilling the set. Select a cork-borer of the right size, hold the cork between the forefinger and thumb of your left hand, and press the sharpened end of the cork-borer against its centre with your right hand, and gradually press it forward, at the same time turning it round, when you will find that it will easily cut into the cork. When you have cut about halfway through the cork, take the cork-borer out, and treat the other side of the cork in the same manner, making the two holes meet, when you will have cut a small cylinder of cork out of the hole of the same diameter as the cork-borer. When you have made the hole, see if the tube will fit into it. If it fits in too tightly, file the hole slightly all round, then glue the cork inside the hole in the circular piece of wood; fit the small piece of tube into the hole in the cork; place the circular piece of wood in its position at the end of the tube so that the flange presses against the edge of the tube all round, and secure it by a small screw passed through it and the large tube. Then, in a similar manner, fix the seat, which contains the other lens, at the other end of the tube by passing a small screw through it and the tube. The tube must now be coated with some kind of paint; if constructed of paper, black varnish will do very well, but if of sheet-iron or brass, black or dark-blue enamel paint would be more suitable. When the tube is being painted, the lenses and their seats had better be taken out, in case they get damaged. The construction of the telescope will now be complete; and, in conclusion, I will say a few words with regard to the method of using it, and its magnifying power.

The magnifying power of this kind of telescope—for there are other kinds besides the one which I have already described—is equal to the focal length of the field-lens divided by the focal length of the eye-lens. As the reader will undoubtedly remember, the focal length of the field-lens was 36 in., and that of the eye-lens was 1 in.; therefore, the magnifying power of the telescope is 36 in. It will be obvious from this that the magnifying power of the telescope may be increased by diminishing the focal length of the eye-lens and increasing that of the field-lens. This is what is usually done, and it may be done to a slight extent in the present case. Another small brass tube may be made of the same size as that which has already been fitted into the hole in the cork, but containing a lens having a focal length of ½ in., and thus, by using this tube instead of the other one, the magnifying power of the telescope will be doubled. The magnifying power can be diminished by making another small tube containing a lens of 2 in. focus. As inexpensive lenses are usually not of very good quality, they will not stand a very high magnifying power, and the image, consequently, becomes blurred: for instance, the image seen in the present telescope, when its magnifying power is 72 in., is much more indistinct than the one which is seen when its magnifying power is only 36 in. It is only when achromatic lenses, which are very expensive, are employed in telescopes that the image which is obtained by employing high magnifying power is perfectly distinct. A better method of increasing the magnifying power is to employ a field-lens of greater focal length; but, since field-lens and eye-lens must be placed at a distance apart equal to their focal lengths added together, this method requires a very long and, consequently, inconvenient tube to contain the lenses. But if the reader requires a telescope of higher magnifying power, I should recommend him to employ a field-lens of 72 in. focal length rather than an eye-lens of ½ in. focal length.

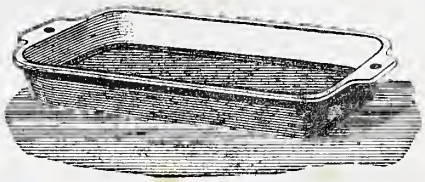
As the field of view of a telescope decreases with the increase of magnifying power, it is best to enlarge the diameter of the field-lens when the magnifying power is increased.

To use the telescope, direct it at some very distant object, and draw out or push in the small tube until the object is quite clear and distinct. The telescope will now be focussed, and will not need refocussing, except in the case of people who are short-sighted, to observe the heavenly bodies. When you wish to observe the stars, moon, etc., rub the outside of the field-lens with a soft handkerchief, to remove any specks of dust which may have settled on it, incline it against a post, fence, or some other convenient object to steady it, and point it towards the body which you wish to see through it. The moon is one of the most interesting of astronomical objects, and shows its craters best if observed when it is in quadrature—that is to say, when only half of it is visible.

Fine-ground flint glass may be turned to good account for grinding in safety valves, feed-check valves, and the like, when they become warm and commence to leak. Many prefer it to using flour emery.

DRIP PAN.

This pan—an American novelty—is made of a single piece, with no wire handles nor with wire beaded into the edge to stiffen it. The material is drawn into shape by means of dies, and is finished with a flanged edge and projecting handles at the ends. The flanged edge enables the housewife or cook to lift the pan easily and safely



Drip Pan.

from the oven. Pans of this form of construction possess great advantages over the old style pan made of common stove-pipe iron, such as the absence of lapped corners, seams, and wire beading, which collect and retain grease and filth of all kinds; also the superior quality of the metal prevents pans made of it from warping and twisting.

NEW INSULATOR.

Ivory is an excellent insulator, but very expensive. A substance has been manufactured in America, with the elements of ivory, as a substitute:—Lime, 100 parts; water, 300 parts; solution of phosphoric acid (density, 1·05), 75 parts; chalk, 16 parts; alum, 5 parts; magnesia, 1·5 part; gelatine, 15 parts.

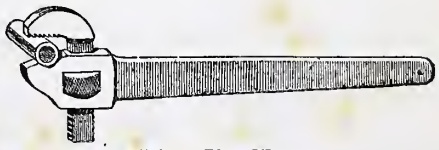
Thus tribasic phosphate of lime is obtained, carbonate of lime, magnesia, alum, gelatine, and albumen.

This is the method followed:—Quicklime is partially hydrated, then treated with a solution of phosphoric acid. While making this mixture, small additions are made of chalk, magnesia, alum, and, finally, gelatine and albumen, dissolved in water. The mass should be as homogeneous as possible. It is allowed to repose for twenty-four hours, so that the phosphoric acid may have full effect on the lime. Then, being very plastic, it can be shaped as required, and dried in a stove with ventilator at 150° C. during a short time.

After a month the objects are quite dry, and present the appearance of ivory, with its hardness and insulating power.

PIPE WRENCH.

The illustration herewith shows the Billings Pipe Wrench. The advantages claimed for this wrench over similar tools are simplicity of design, few parts, excellent workmanship and finish. A special feature alluded to is



Billings Pipe Wrench.

that, whether the size of pipe be large or small for which it is adjusted, the angle of the jaws remains the same. Total length, 14 in. The wrench is made to take pipe from ¼ in. to 1½ in.

NOTICE TO READERS.

NEXT week's WORK (No. 196) will contain, among other illustrated papers, the following:—

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- CHEMICAL APPARATUS, AND HOW TO MAKE IT.
- HUNG SASH LIGHTS ALTERED TO PIVOT LIGHTS.
- PRESERVATION OF MINERALOGICAL SPECIMENS.
- BLACK DYE FOR PEAR WOOD.
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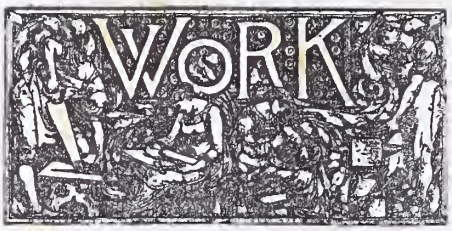

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WORK correspondents are wanted in every Town.

TEMPERING SPRINGS.—Many amateurs find considerable difficulty in tempering springs, and this frequently arises from not beginning at the beginning—that is, with the forging itself. The forging should be done with low heats and light blows, and the steel should not be hammered when cold. Care should be taken not to make hammer marks while forging, for although such marks may be worked out, they interfere with the homogeneity of the metal. Many failures of apparently good springs could be doubtless traced to this cause. After the spring has been hammered to size, it is advisable to lightly hammer it for a short time when it is nearly cold, but do not strike hard. This light hammering toughens the steel and improves the quality of the spring. The outside skin seems better adapted to spring work, when the surface is hammered up, than when it is ground or filed. After hammering, the spring may be polished with fine emery. The spring should not be put on an emery wheel, however, as this would remove the "hammer" skin. If it is necessary to partly shape the spring by grinding, this should be done at an early stage of the work, so that the skin may subsequently be restored as much as possible. When ready for hardening, the work may be heated, either by holding the spring over a clear fire with a small pair of tongs, keeping the spring high up so that it will heat slowly; or by heating a large piece of iron and laying the spring upon that until it acquires the requisite temperature. A modification of the latter method consists in heating some lead red-hot in a ladle, and placing the spring in that; but the spring should first be heated black hot. When the spring is uniformly heated to a light red, plunge it into cool—but not ice-cold—water. The spring should be put endwise or straight into the water, for if the flat side first touches the water distortion will ensue. After hardening, polish the steel with emery cloth; then put a few drops of oil on a piece of paper, light it, and hold it under the spring until every part is covered with a coating of smoke. Then hold the spring above the forge fire until the smoke is uniformly burnt off, taking care that the burning off proceeds equally over the surface of the spring, which may then be placed in the ashes to cool, after which it will be ready for work.

CRAFT OR PROFESSION?—Some of our well-informed daily papers have been calling attention lately to the overcrowded condition of the labour market generally and of some professions in particular. The matter is undoubtedly one of importance—especially to the world of family men who have before them the solution of that difficult problem contained in the not altogether disposed of question, "What shall we do with our boys?" We are told that the professions are going from bad to worse—one particularised being distinguished by wig and gown. To train for the profession of barrister is, it appears, scarcely worth the proverbial candle—since it is difficult to get back in brief-money even the sums paid for such preliminary necessaries as "articles," so crowded has this particular branch of legal occupation become. Added to this, the prizes to be gained are getting fewer and less worth having—which, if it means that people are growing less litigious, or that competition is producing a healthy effect upon the extravagant fees of fashionable counsel, affords ground for a modicum of satisfaction to those who may not be contemplating a legal career. Doubtless a great wave of change is passing over not the trades merely—as many restrict it to—but the professions of this country. With improved methods of living, ever-advancing education, and higher and higher culture, there must be changes even in professions which may tend perhaps to almost obliterate what may be at the present time most remunerative sources of income. Whether the first to feel the new condition will be that profession the members of which are recognised as gentlemen whose occupation consists in practising at the "bar," is difficult to predict. Most likely not. We are tending more and more to arbitration in all matters, and national disputes and the piques of emperors may some day be settled without the annihilating processes adopted by modern armies and navies. Wordy warfare will take the place of *mitrailleuse* and steel ordnance, when—on the principle of the survival of the fittest—the lawyers will be more than ever needed. We cannot all be lawyers, however, and the same newspapers have pointed to crafts for our boys. One selected is the art of plumbing—a very good and profitable business when thoroughly acquired, as a correspondent in *The Daily Telegraph* has recently asserted. This, with many other trades which could be enumerated, would unquestionably far oftener present a profitable occupation for even superior boys, could parents but be induced to overcome the silly prejudice about a "profession" for their sons. Of course, there would be something incongruous in the sight of the Eton boy "devilling," as it were, for a journeyman plumber. We are not, however, thinking of this element, but rather of the wide range of middle-class boys who, without money or interest, are almost hopelessly handicapped when facing the world from a middle-class school. If they are all to be clerks, the prospect is a decidedly gloomy one for them. After all, parents might do worse than return to the good old idea and give their sons a trade. Thus equipped, well-educated, and with a little money, they will have no difficulty in making their way in America or the Colonies.

THE ART OF STAIRCASING.

BY GEORGE F. CHILD.

Open-string Staircase.

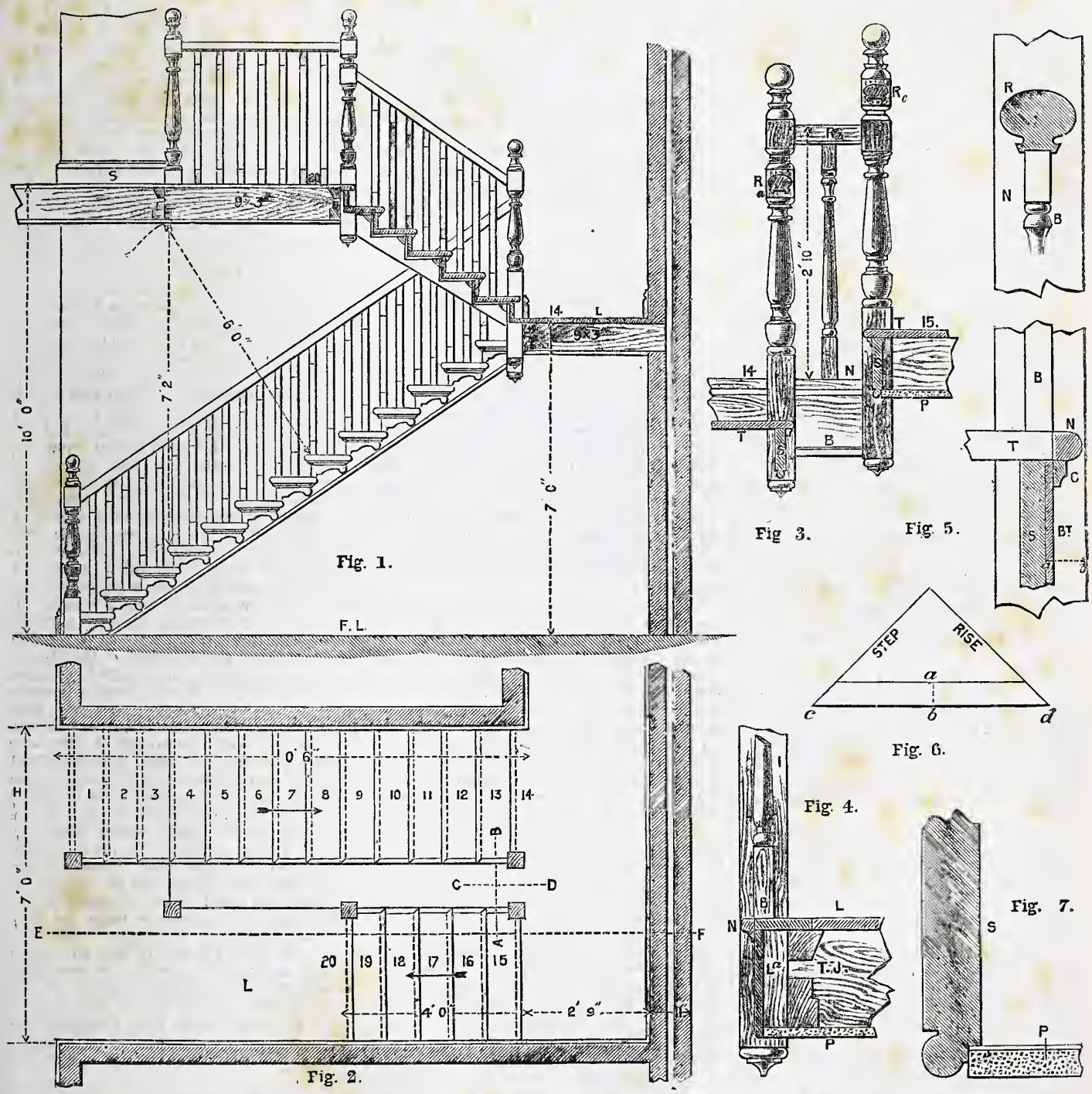
Introduction—Setting out the Plan—Setting out the Elevation—Two Newels on Landing—Section on Landing — Position of Strings on Newels—Setting out the Cut-strings—Pitch-board—Head Room.

Introduction.—In all staircases previously examined the *outer string* has been the same as the *wall string*—that is to say, that the board has merely been *housed* out to a depth of ⅜ in., into which the "treads and risers" are inserted. Now, however, we propose describing a staircase of a superior class, the outer string being "cut" or notched out to receive each step, the *nosing* being returned across the face of the string, which gives the stairs a handsome appearance. It will be noticed that the width of the space into which the stairs are to be fixed is 7 ft. Now, by allowing 3 ft. each for both top and bottom flights, we can employ two newels on the landing in place of one, which greatly adds to the general effect.

Setting out the Plan.—We find from the plan (Fig. 2) that the hall, H, passes the foot of our staircase at right angles, with a passage exactly above it on the first floor. Also on the first landing we have a doorway passing into adjoining rooms (as seen). This will, of course, limit our "going" to the distance between the two walls. As we want an easy stairs, we find on dividing out the "going" that the number of steps it is proposed to employ will allow no space for an easement on the strings; we therefore have to work a special moulding, which will be described hereafter.

Setting out the Elevation.—At Fig. 1 we have the sectional elevation, which is taken on E F (Fig. 2). This elevation can be set out as all preceding examples, the difference being in the two newels on the first landing and the open string.

Two Newels on Landing.—To set out the newels for the "turner" will require some



Staircasing. Fig. 1.—Sectional Elevation—F L, Floor Level; L, Landing; S, Skirting. Fig. 2.—Plan, 1 to 14 inclusive, Steps of Bottom Flight; 15 to 20, Steps of Top Flight; L, Landing; H, Hall; A B, C D, and E F, Section Lines. Fig. 3.—Section on A B (Fig. 2)—14, Landing; 15, Step; S, S, Strings; T, T, Treads; N, Nosing; P, Plaster; B, Bead; R, R, R, Rails; *a* and *c*, Rails on one Pitch; *b*, Rail on one Landing. Fig. 4.—Section on C D (Fig. 2)—L, Landing; T J, Trimmer-joist; P. Plaster; B, Baluster; N, Nosing; L*a*, Lining. Fig. 5.—Details for setting out Position of String on Newels—S, String; N, Newel; R, Rail; B, B, Baluster; B , Bracket; T, Tread; N, Nosing; C, Cove; *a b*, Distance from Edge of Newel to String. Fig. 6.—Pitch-board—*a b*, Distance equal to Width of Carriage-pieces; *c d*, Edge for Guide. Fig. 7.—S, Section of String; P. Plaster.

little attention, as upon this depends the appearance of the newels when in position.

The bottom newel requires no special explanation, it being set out as all others previously described. The next upwards—that is, on the top of the long string—will require a little more care, it having, in addition to the bottom "handrail," to take one on the landing also.

Before setting this out, it will be necessary to mortise it for the string, also marking the height (2 ft. 7 in.) of the long rail. Now mortise newel No. 3—that is, the one at the bottom of the "top or return flight"—at the same time drawing the lines to denote the height of the *top* rail.

Having proceeded thus far, we have to attend to the rail on the landing. This will be more readily understood by an examination of Fig. 3. The newel on the *left-hand* side represents the one on the top of the long or bottom flight; S shows the string-board, T the tread immediately under the landing, and 14 the landing itself.

The newel on the *right-hand* side, of course, being the bottom one of the top flight, S is the string, and 15 the first step upwards. This will be seen by reference to Fig. 2.

The rail R*a* is the bottom one, and R*c* the top. Having obtained this, we have to decide upon the height for the rail R*b* on the landing.

It has been before explained that rails on the *level* should be higher than those on the *pitch;* but the distance between the newels being so small, no regard should be paid to this rule in this instance, as to place the rail at a height of 3 ft. 2 in. from the landing would oblige us to make the square an unsightly size. By making R*b* 2 ft. 10 in. from landing, we are able to obtain several turned members between the rail, which all will allow is an improvement.

It may be remarked that the square *under* the landing is much greater on one newel than the other. We are bound to have a long square on the bottom newel to take the string, S, but this necessity does not exist upon the top newel. It is therefore kept about 1 in. below the bead, B—that is to say, the square portion—the turned drop being about $2\frac{1}{2}$ in. long. I have omitted to state that Fig. 3 is a section taken across A B (Fig. 2).

Section on Landing.—Fig. 4 shows a section of the landing taken on C D (Fig. 2); T J is the trimmer-joist; L the landing; L*a* the lining, which is blocked out from the joist; B the baluster, which is let into the floor-board; N is the nosing, which is worked to the same section as the nosings on the steps, and nailed on the edge of the flooring, as seen.

Position of Strings on Newels.—Before mortising the newels for the strings, it will be necessary to decide upon the size of the balusters to be used. For stairs of this class they should never be less than $1\frac{3}{4}$ in. square, although they are made in sizes ranging from $1\frac{1}{4}$ in. to $2\frac{1}{4}$ in. square.

We will suppose that $1\frac{3}{4}$ in. balusters are to be used, this being the average size. This being the case, we draw a portion of the newel *full size* (see Fig. 5). Now draw the baluster, B, in the *centre* of the newel. In a line with the *outer* edge of baluster draw the line B*t*, and from this line the thickness of the bracket, which is $\frac{3}{8}$ in. Now, this bracket (as will be explained later on) being nailed upon the face of the string, it follows that the string itself (S) should be set off on the *inside* of the bracket. Having done this, the distance from *a* to *b* will give us the position of the tenon, which should always be cut with a *bare face.*

Setting out the Cut-strings.—In setting out the "cut" or "notched" strings, we have to bear in mind the fact that the treads are fixed on the *top* of the portion cut out to receive them. Now, as we have always before set out the strings for the *top* of the tread, we must allow the thickness ($1\frac{1}{4}$ in.) *below* this line and to which it is cut. There is also a portion of the riser equal to the thickness of bracket in *front* of the *notch,* which also must be taken into account. Details of this and all other important parts will be given in the next paper.

Pitch-board.—This cut-string should be set out from the bottom edge. The pitch-board (Fig. 6) having been set out, the distance from *a* to *b* should be made equal to the depth of carriage-piece and plaster, and the guide screwed on the edge, *c d.* This being done, proceed to set out as before. Fig. 7 shows part section of string, rebated to receive the plaster, P, the carriage-piece being above.

Head Room.—In Fig. 1 the curve struck with a radius of 6 ft. gives the position of the trimmer on landing. This has been described before, and is only mentioned to recall it to mind.

SWEDISH WEAVING.

BY COUNTESS HAMILTON AND MISS CLIVE BAYLEY.

Introduction.

In the present rage for technical handiworks, there are very few which are specially adapted to women. There are two, however, which were in high repute among our ancestors, and which might, with much advantage, be revived amongst us, both on account of the utility of the employment, and also because of their attraction as picturesque and pleasant occupations. Poets have sung of the spinning-wheel and of the loom, and artists have also chosen, on more than one occasion, to depict women employed in these handicrafts.

Spinning is already well known in England, and there are homes in which the wheel is not a mere adornment, kept in sacred uselessness, but the whirr may be heard in many a lady's boudoir, and flax and wool are alike in request for its use. But it would, doubtless, be still more in fashion were there any means of working up the hanks of material spun into useful stuff. It would be well if the ancient art of hand-weaving could be restored in this country, so that the two industries might follow each other in their natural sequence.

Sweden is the country which, perhaps, stands highest in Europe as regards home industry, and the Handarbetets Vänner, or the Society for the Promotion of Manual Work, has, during the last twenty years, laboured with much success for the revival of these arts. It takes the same position in that country as does the somewhat more recently founded Society of Home Arts and Industries, or perhaps, more correctly speaking, the South Kensington Royal School of Art Needlework in our own country. The Swedish Society upholds a very high standard of excellence, both in execution and in design. It allows no designs to be used by its weavers or in its schools but those which are really Swedish, in order to maintain the national characteristic of the art, and a pure and not a mixed style, which would ruin the distinctive nature of the work. The old art of weaving, as practised among the peasantry, was very nearly superseded by the more mechanical forms introduced by machine-weaving. The Handarbetets Vänner stepped in, and saved the national work from oblivion and neglect, and now loyally maintains, as we have said, the ancient and national style in all its integrity.

When the matter was first mooted it was in the southern provinces of Sweden that the Society found the richest store of woven work. In this part of the country the population was thicker, and the resources too, in the way of materials necessary for the art, were plentiful in these, the most fertile, districts of Sweden. Here the peasants wove not merely the ordinary stuffs for clothing, but also ornamental cloths and draperies for their rooms. Bed-covers, chair-covers, carpets, are all woven and used for great occasions, such as weddings, funerals, christenings, and for festivals such as Christmas. At other times they are locked away in dower chests, carefully preserved, and are handed down from generation to generation as heirlooms. Thus, antique patterns are still retained among the peasantry, and from them have been adopted by the patriotic Society, which numbers, amid its supporters, the members of the most aristocratic families of the country. Such relics of ancient days are now highly prized and bought by the aristocracy, and treasured as artistic hangings and draperies. They are, in fact, admirably suited for use in libraries, smoking-rooms, and large halls arranged as sitting-rooms. It was also the custom in olden times for the tenants to bring part of their rents in materials which they had woven, and on rent day long settles were placed round the walls of the castle hall, and the ells of material woven were measured off as they were spread upon these settles; hence it is that many of the old-fashioned pieces of weaving, now so much valued, are in long narrow strips. It was also the fashion to weave into these, and other pieces of drapery, records of events, insignia, initials, and other mementoes which related to family or national events. It was, it appears, the custom in every land to make "woven pictures, as did the daughters of the Huns." In Finland, which was subjugated in former days by Sweden, and which was only made over to Russia a century ago, the long narrow strips, when made in coarse weaving, are used as mats, the boards of the floor showing between each strip. The practice of weaving has, in consequence of the energetic action of this Society, become so universal in Sweden that the loom is now to be found in almost every house, from the cottage to the castle. We are therefore encouraged to hope that these articles may spread the knowledge of the art in England, and enable those who are familiar with plain hand-weaving to learn the high art work which it illustrates. We may also hope that the art is not so wholly foreign to England as might at first sight appear, for we have come across an old Swedish folk-song in which reference is made to some "sisters from England," one of whom "sat to the treadles with heed" while the other "threaded her needle and reed."

The following articles will show, *first,* what apparatus is required; *secondly,* how to prepare it; *thirdly,* how to use it in the different styles of plain and art weaving.

LABOUR AND CAPITAL MEN.

THOMAS BURT, M.P.

Mr. Thomas Burt, the Northumberland miners' representative, is, perhaps, the plainest man in the House of Commons—plain and unassuming in appearance, plain and unassuming, also, in speech and manner. He still clings to his Northumbrian dialect, though he has now been a member of Parliament for eighteen years, and will tell you that a better day is in store for labour "for sartin," but that "I doan't know" whether it will be through a legislative eight-hour day.

Though Mr. Burt be thus plain, and though he have little of the brilliance that surrounds newer figures in the field of labour politics, he is yet surpassed by no man in the highest attribute that can invest the human mind. That attribute is honesty. Honesty of purpose pervades plain Thomas Burt's whole being. So much is this the case, that even his opponents cannot raise the slightest whisper of suspicion against him.

He is a poor man—so poor, indeed, that while Parliament is sitting he leaves his wife and family at home in the north, and is content with the accommodation of a single bedroom in London. The Reform Club supplies him with a rendezvous for meeting friends and callers. To such a man it cannot be said that money is no object. Yet when bad times came on the miners he was the first to propose a reduction of £100 a year on his salary as the General Secretary of the Northumberland Miners' Union.

Again, only lately, after he had been chosen by Mr. Gladstone to fill the office of Parliamentary Secretary to the Board of Trade, an office with the comparatively small salary of £1,200 a year attached to it, he offered to relinquish the salary he receives from the miners now that he was in receipt of Government pay. "The offer of office made to him," he further said, "was a compliment to labour, but no honour and no emolument which could be held out to him would persuade him to leave the labour movement on which he had set his heart, and which he would continue to work for. His ideal was that competition would be succeeded by co-operation, and that was what he looked to for the solution of the labour problem." The Northumberland miners will be well advised if they reject Mr. Burt's generous offer and retain the services of so true a friend to the cause of labour in general, and of mining labour in particular.

Mr. Burt's career has no doubt been a most remarkable one. He began with every worldly possibility of ending in the obscurity of a coal-mine. He descended the shaft at the early age of ten, and he continued to go up and down the shaft daily for eighteen years. These eighteen years were marked by hard physical toil, the monotony being broken with a few short hours—far too short for the indomitable youth—over books. The present Secretary to the Board of Trade in the greatest commercial country in the world is an entirely self-educated man, and curiously enough, as he has never been slow to acknowledge, the book of all others that lent him the greatest aid in his self-imposed task was "Cassell's Popular Educator."

After eighteen years, however, Thomas began "to see of the travail of his soul," and when he was twenty-eight he was appointed General Secretary of the Miners' National Union, with a salary of £1 7s. 6d., increased to £2 per week. This union comprises the miners of Northumberland, Durham, and Cleveland, and co-operates with the Miners' National Federation in all that concerns the mining industry in general. His election as secretary was in 1865, and nine years later, in 1874, he was returned to Parliament for Morpeth, a constituency which he has not ceased to represent since. During the twenty-seven years of Mr. Burt's secretaryship two general strikes occurred, both being against reductions in wages proposed by the employers. The first was in 1876. The men proposed arbitration, when the employers rejected it, and the men were ultimately obliged to accept the reduction. The next was the seventeen weeks' strike of 1886. Again the miners were defeated and had to accept a reduction of 12½ per cent. Thus Mr. Burt's experience of strikes has led him to be rather wary. He is, with such experience and knowing the untold suffering they entail, opposed to them. At the same time he is inclined to think that if workmen never resisted the encroachments of the employers, their position would be worse than it is now. It is positively futile, he thinks, to call a strike in a falling market. Every possibility of conciliation should be exhausted before recourse be had to striking; and he is of opinion that as the unions become better organised, and the men become aware of the resistless power perfect organisation will give them, strikes will become less frequent than now. The unions will then be burdened with a keen sense of responsibility which will prevent the arbitrary use of their power.

Mr. Thomas Burt, M.P.

(From a Photograph by A. & G. Taylor, Newcastle-on-Tyne.)

Such is a skeleton outline of Mr. Burt's career, and such is his opinion on strikes. As regards his views upon the labour question in its entirety, he is well known to look upon a legislative eight-hour day as an impossible solution. He opposed the Eight Hours (Mines) Bill that was introduced into the last Parliament, because, firstly, his constituents were opposed to it; secondly, where eight-hour Acts have been passed, as in some American States and in Australia, they are a dead letter; and thirdly, he cannot see how the carrying out of such an Act is practicable. Show him a policy that will ameliorate the hard lot of the workman, which he knows too well, and he will support that policy. Meanwhile he believes that grown-up men, by combination, can themselves far more effectively control and adjust the conditions under which they labour than can the most drastic Parliamentary measures. We have, at the beginning of our sketch, quoted from Mr. Burt's own lips words which show the direction he looks to for redemption. That direction is towards co-operation. Such is the opinion of a man who has climbed from the bottom of a mine up to a seat in the Government of this great Empire. That opinion is worth tons of rhetoric, and weighs far more with the sober-minded worker than the fiery oratory that the masses are too often fed with.

TRADE: PRESENT AND FUTURE.

*** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

Building Trade.—There are good signs of work for all in the future, but at present all branches are dull.

Surgical Instrument Trade.—Surgical instrument makers are having a good time, every Sheffield firm being full of orders.

Cotton Trade.—Our Rochdale and district correspondent writes:—The cotton crisis, as it is now familiarly called, is in about the same condition as in the last report. The notices of short time have been posted in the mills.

Engineering Trade.—In the Lancashire engineering trade boiler makers have rather more work on hand than recently, but prices are cut very low. Locomotive builders are not securing any new orders of any weight, and several stationary engine builders have not been so slack for many years. Our Aberdeen correspondent writes: — Marine engineering is in a very unsatisfactory condition.

Iron Trade.—Low prices and small transactions continue the rule in the Lancashire market. For local and district brands of pig iron 44s. is being quoted for forge, and 45s. 6d. for foundry, purposes. In the finished iron trade prices have fallen slightly, but only very few inquiries are coming forward.

Metal Market.—A moderate amount of business is being done in the Lancashire metal market, and quotations are as follows: Solid-drawn brass boiler tubes, 6d.; ditto surface-condensed tubes, 7d.; solid-drawn copper tubes, 7d.; brazed copper gas and steam tubes, 7¼d.; brazed gas tubes, 7d.; brass wire, 5¾d.; copper wire, 7d.; rolled brass, 5½d.; sheet brass, 6½d.; and sheet copper, £3 per ton.

Shipbuilding Trade.—This is almost at a standstill in Aberdeen, and one of the largest yards is working a short day of six and a half hours.

Granite Trade.—In Aberdeen the building and granite trades flourish.

Ironplate Trade.—The ironplate trade has for years past been declining in Birmingham, Wolverhampton, and Bilston, and has slowly, but surely, drifted into the Lye and Cradley district, where large factories have been built up and apparently cheaper labour—mostly female—is obtainable. Some masters declare it is from 50 to 100 per cent. cheaper, thus enabling them to compete unfairly with the Midland town manufacturers; who have, consequently, given notice to their *employés* that the 10 per cent. bonus given some years ago will, after the 3rd of December, be withdrawn. This the men will strenuously resist.

Railway Carriage Trade.—An order of the value of £10,000 has been placed with the Oldbury Railway Carriage Company for carriages for Indian railways.

Cable and Chain Trade.—Government contracts for five years for the supply of mooring-chains, mooring-gear, and ordinary cables have been placed with Messrs. H. P. Parkes & Co., of Tipton and the Round Oak Ironworks. This means that thousands of tons of steady work will be turned out, the value of the orders being about £80,000.

Sheffield Trade.—In the staple trades of Sheffield there is little change to note. The silver trade is below the average; files dull; rolling mills, tilts, and forges are not busy, and cutlery is slack.

SHOP:

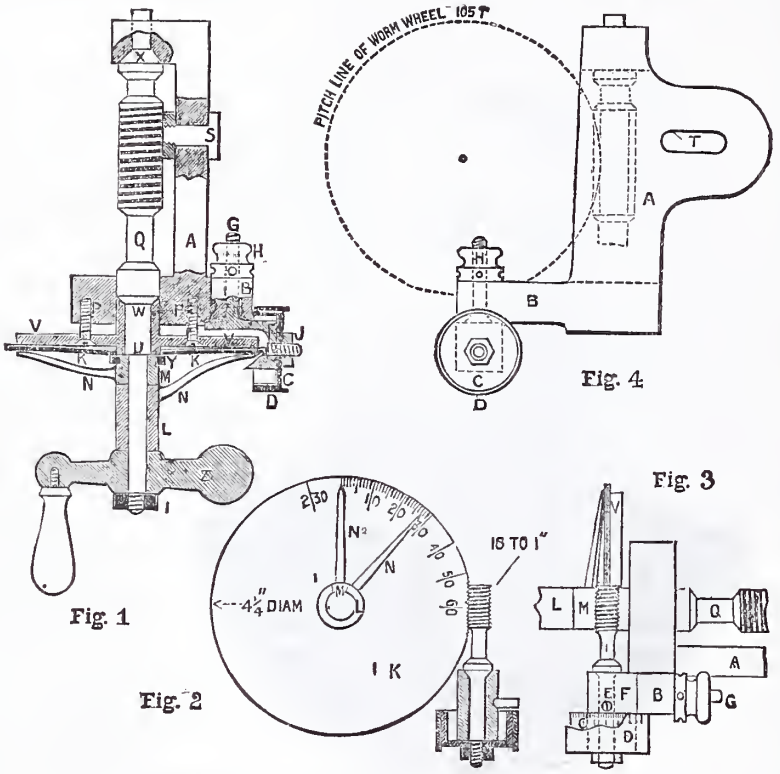
A Corner for Those who Want to Talk It.

**** In consequence of the great pressure upon the "Shop" columns of* Work, *contributors are requested to be brief and concise in all future questions and replies.*

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of Work *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given.*

I.—Letter from a Correspondent.

Lathe.—W. H. C. (*Orillia, Ont.*) writes:—"I have been a subscriber (through a London friend) to the English journal, Work, from the commencement, and have been much instructed by the articles you, dear Mr. F. A. M., have contributed to that paper on lathe matters, and wish, from here, to tender you my thanks for same. I am a lathe 'crank,' as they say in this country, and have a No. 5 Barnes lathe to operate with, and run it, with other shop tools, with a 5 horse-power steam engine; and although I am only an amateur machinist, still I take a great deal of pleasure out of my little workshop, especially in the winter season, when architecture is at a standstill. This place is only a small town, and there is no other person beside myself that has anything like the shop rigging I am possessed of, so I am shut off from the privilege of coming in contact with others of like tastes in a mechanical way, so that any help got through the trade papers is very acceptable to me in my mechanical exile. My main reason in writing to you at this time is for some information in regard to a 'front slide' lathe after the style of the 'Price' type. I want to build a lathe after that pattern as far as the principle of the front sliding carriage is concerned. What I would like to have you do for me is to furnish some rough sketches of the method of constructing the front slide and the elevating slide-rest; and if you can help me to an understanding of what is required to make the figure effective, after the style of the Price lathe or after any improvement that may have occurred to your practical mind, I shall be very thankful for the service, and would be willing to pay any charge in connection with the matter. As to the rest of the lathe, my plans are matured, and I am aiming at something 'extra' fine in the lathe line. May I count on your good nature to help me? Among the many things you gave in Work was a tangent screw-dividing apparatus, which interested me very much. As an outcome of a study of your scheme, I have constructed what I consider a very fine dividing rig for my own lathe on somewhat independent lines, and find it all that can be desired for the purpose. I have made a drawing of the rig, and enclose it for perusal. The variations from your scheme were adopted in order to avoid making so many dividing collars and to try to obtain an apparatus that would practically divide any number of divisions in the circle without having to change anything in the device, and for cheapness. Referring to the drawings, Fig. 1 is a horizontal section, in which A is the casting, with lugs for the bearings of the worm, Q. The worm is passed through front bearing, and centres against side shake by cone-part, X; a similar cone-part, W, acts to prevent side and end shake at the front bearing. V is a disc-and-thimble-piece for a bearing for worm-shaft, and is confined to casting, A, by screws, P, P; K is a brass swaged dial mounted loosely on hub of shaft at U. M is a collar with pointer, N, attached thereto, and L is a similar but longer collar with its pointer; Y is a washer shouldered about M. The ball handle, Z, and nut, I, act to tighten up on the collars, M, L, and washer, Y, to hold them rigid to the position that may be arranged for the pointers. The use of the pointers is to count by for whole and part turns, the pointers being set to suit any required division, and move with the shaft. The dial, K, is graduated into two hundred and forty parts, and its edge is cut with the same number of teeth, as shown in part. B is an arm of the casting, A, carrying a small micrometer screw-shaft bearing, F, held to arm, B, by screw, G, and capstan-nut, H, so that F may swivel on B to allow worm, J, to readily mesh with K. Rigid with J is a reading-flanged collar, C, divided into one thousand parts, to read in connection with the station point, E; D is a slip-collar, to be used when absolute correctness of division in certain cases is desired. The worm-wheel that goes on the mandrel of the lathe has one hundred and five teeth, and was cut by myself with great care, the same being in halves and corrected, as you have advised. The casting, A, is secured to the arm that carries the change-gears by a bolt, S, in connection with a slot, T, as in Fig. 4, which allows the worm to mesh with the worm-wheel. The working of the apparatus is effected as follows: Suppose the awkward division 13 is wanted; then, as the product of 105 × 240 gives 25,200, we find we shall have to make eight whole turns of the worm and eighteen parts of the dial divisions as well; and then there is a remainder of 6 to divide into thirteen parts. This we dispose of by the secondary or micrometer worm, I, and treat the fraction decimally and obtain a movement of forty-six parts, graduated on C. This is done for each division, and the resulting error is only two parts short on the micrometer, or one-fifth part of one of the divisions on the dial, K. It is to be understood that the movement of the dial by the micrometer is independent of the pointers, M, L, and the operator imperceptibly follows up the extra movement of the dial as he uses the pointers. The use of the second pointer is for automatically counting the odd number of parts on the dial. In our case of thirteen we set the pointers eighteen divisions of the dial apart, and then, if we call N² the zero pointer, we turn eight turns, see where the second pointer, N, is, and make the extra or odd part movement by bringing the zero pointer over the position occupied by the second one, after which we turn the micrometer collar, C, forty-six parts, which completes one step, or a division of the required number. The worm-wheel number of teeth and the dial number of division combine to give a very large number of straight working divisions. If we want to be very 'pernickity,' we could divide a collar, D, into thirteen parts by the process just explained, and move six parts thereof on the micrometer in place of the forty-six parts of the hundred, as in the other way, and he as near mathematically right as possible; and so on for any case of division. I trust the foregoing will be of interest to you. Degrees are got by simply turning seventy parts of the dial, K. I have done some nice graduating for verniers for reading to one minute without any trouble, and I am somewhat proud of my dividing rig. As a proof that I am not merely playing with my lathe, etc., I may say that I invented and made the typewriter with which this letter is written. Some of the letters are not clear for want of cleaning, which kindly allow for."—[F. A. M. writes on the above:—"My notions on the lathe with front and vertical slide can be had for 4d. by anyone who will obtain Nos. 1122 and 1124 of *The English Mechanic*; I need not, therefore, send you any sketches. I congratulate you on your ingenious modification of the dividing apparatus given in No. 14 of Work. The details are nicely worked out, but I am bound to say I do not think it quite satisfactory, and the example given of thirteen divisions very well illustrates the weak point. You pursue that unlucky one-thirteenth through two worm-wheels, and still, to get the exact division, you must divide a collar into thirteen parts. In a case of this kind it will not do to have the divisions *nearly* right, especially as, in wheel cutting, you may have to go round two or three times. I do not think it the best plan to have *two* worms and wheels; the second one makes the motion too slow. I would rather prefer to have on K a series of division plates, as on the dividing head of the milling machine; or to have the first worm-shaft turned by a set of change-gears with a click, as in the ordinary dividing engines. By these methods there would, probably, be less chance of a miscount. However, if you have invented and made a typewriter, you must be a better mechanic than I am, who have never attempted such a thing."—[W. H. C. writes:—"I fear you have not grasped the true 'inwardness' of my dividing apparatus, for I can assure you the difficulties you think exist while using the rig are purely imaginary. Several machinists have seen the rig and think it is a first-class device for originating any desired division of the circle. I daresay you have failed to observe that the wheel, or dial, K, is loose on its bearing, and is used to deal with the fraction remaining after dividing as near as allowable by primary dividend (25,200), and in place of an undesirable number of turns of the secondary worm, J. The fact is said worm is never turned a whole revolution, for the reason that one of the divisions on K is equal to a revolution of worm J. The error in dividing for 13 is only 1 in 1,260,000, which is as close as workmanship will permit with theoretical exactness, I should presume. I send along a sample of the unlucky number dividing, and, although it was not done with a jig for guiding the drill, I think you will have some difficulty finding the first and the last hole drilled. I have never needed to divide by an extra collar to suit the division in hand, and this sample was divided by the fixed decimal collar, C, as is my usual custom for eliminating the fraction when the dividend of primary worm-wheel and dial is prime to the number to be divided."]



Tangent Screw and Micrometer Dividing Apparatus for Lathes. Fig. 1.—Horizontal Section. Fig. 2.—Graduated Dial. Fig. 3.—Showing Slip on Collar for exact Division. Fig. 4.—Fixing and Meshing of Worm-wheel.

II.—Questions Answered by Editor and Staff.

Sale for Painted China Plaques and Tiles.—Neptune.—The market for such things is, at the present day, flooded with the work of lady painters, who are contented with small gains, and this would be against you, unless your skill is exceptional. Perhaps your most promising plan would be to bring specimens of your work to London, to look out in the Directory such firms as seem likely, and to go round and show them what you can do. Possibly Howell & James, Regent Street, might be worth trying, or the great furnishing and decorating houses, such as Oetzmann's, Hampstead Road, or Maple's, Tottenham Court Road.—M. M.

Private Installation of Electric Light.—P. E. C. (*Bromsgrove*).—The cost of a private installation of electric light, equalling from 16 to 20 lamps of 16 c.-p., will be from £200 to £300. If you have a dynamo, gas-engine, and ordinary fittings to your lamps, and work the lamps direct from the dynamo, the plant will cost about £200. Some skill will be required to work this plant. If you add a set of accumulators, and have better fittings, in the form of a few handsome electroliers, shades, globes, ornamental brackets, etc., the cost will run up from £250 to £300, which may or may not include engine shed, and shed for accumulators, but will include cost of fixing and starting. The cost of maintenance afterwards will depend upon the source of power. With gas it will be considerably higher than the cost of gaslight. With steam it will be less. With water or with spare steam, the cost will be very much less than gas at 4s. 3d. per thousand. An installation with accumulators is very easily managed. A similar installation in a gentleman's house at Croydon is run by an intelligent page boy. Messrs. Cathcart, Peto & Radford, Hatton Garden, can lay down for you such an installation.—G. E. B.

Pantograph.—A. G. (*St. Albans*).—See Work, No. 187.

Incubator.—J. M. (*Edenfield*).—The copper flue is 6 in. long and 1¾ in. in diameter. The tray is 4½ in. at top, 3½ in. at bottom, and 1¼ in. deep. It is fixed to flue with the top of tray ½ in. below top of flue. The space between top of flue and radiator is ¾ in., and the radiator is 2½ in. in diameter.—Leghorn.

Lady's Workbox.—W. E. (*Notting Hill*).—It seems that, after all, the initials J. E. (*Notting Hill*) were correct, and not intended for yours, although the coincidence is curious. You will find, too, that F. J. has replied, giving a drawing, to your former query, in issue for October 22nd (No. 188). All, then,

which I need say is in relation to your query as to where to obtain the satin or silk for the interior of the box. Most drapers would supply you, and you will be wise to obtain the assistance of a lady relative or friend thereunto. Wadding or cotton-wool (sold by chemists, etc.) is generally allowed to intervene between the wood lids and the silk covering, the ends of the latter being glued out of sight by means of an extra covering in the shape of cardboard, or paper, or silk.—J. S.

Bamboo Working.—W. E. R. (*No Address*).—An article upon this, which clears away many of the beginner's difficulties, is in Vol. I., p. 518 (No. 33), and numberless "wrinkles" upon it have since been in "Shop;" so that, with the article given in the present issue, the amateur bamboo worker will find much to help him in this publication. W. E. R. is thanked for his suggestions.—M. M.

Bamboo Working.—W. J. (*South Wales*) is referred to the above answer to W. E. R. As to the places where bamboo may be procured, he is referred to Vol. I., p. 221 (No. 14), and elsewhere in "Shop."—M. M.

Fret-saw on Sewing Machine.—AMATEUR.—You have made a very nice drawing of the sewing-machine stand, but your wheel is too small and light to give you satisfaction if you used it for fret-sawing, and it is too small for anything but a watchmaker's lathe. I have made a fret-sawing machine on a sewing machine, but my wheel is 12 in. in diameter; yet, even here, you do not get power enough: your legs and ankles get cramped, and you feel you cannot use the strength you have. I think you should have a 15 in. wheel at least, weighing not less than 25 lb.—F. A. M.

Electric Bell.—W. C. (*No Address*).—You can procure the castings, etc., from Mr. N. Collins, 59, Church Street, Newcastle-on-Tyne. You can purchase ordinary bell parts from Messrs. King, Mendham & Co., Western Electrical Works, Bristol.—J. T.

Old Oak Dresser.—CONSTANT READER OF "WORK."—I doubt whether a drawing of your dresser would be of sufficient general interest for publication in WORK. It appears, by the sketch you sent, to be Late Seventeenth Century style.—F. J.

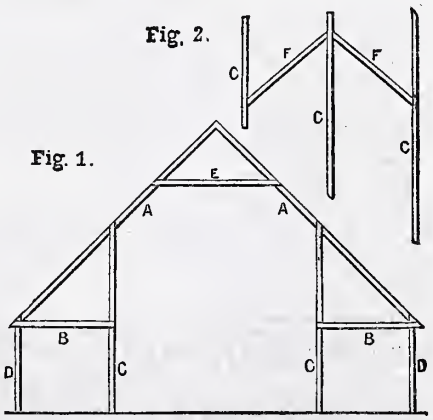
Kitchen Range.—ANXIOUS.—If you have not set a range, you had better get a bricklayer to set one for you, and get him to explain the method to you, as, if improperly set, you will soon hear of it afterwards. Speaking generally, a chamber lined with fire-brick is formed under the oven, with an opening from the fire. A flue is carried up the side, and returned across the metal hollow top, on which a damper is fixed, and a small vertical flue carried up and sloped into chimney flue. The boiler is set in a similar manner. If it is a kitchener or close range, the ironmonger will supply a plan of the flues. The brickwork should be set with fine joints, and neatly cut and fitted together.—M.

Framed Door Jambs.—NEWEL.—Framed door jambs are made in the same way as doors—that is, as far as the framing together or mortising and tenoning is concerned. The rails generally carry round the same lines as the rails of the door. Of course, there are no mullions, as the total width of the jambs is generally the thickness of the wall, including the plastering on either side; and, taking 1 ft. 5 in. as the average thickness of walls in a building that requires "framed jamb linings," it will be seen that, after deducting the width of the stiles, it only leaves just room for panels. The ordinary jamb linings go right through the depth of the brick opening, and on one side of the wall have their edges rebated to receive the door, the edges on the other side of the wall being similarly rebated to correspond; so that you must allow your stiles to be the thickness of the door wider than you wish to show when the door is closed. The head or soffit is framed in the same manner. The length of soffit is generally divided into two panels by a mullion following the line of the mullion of the door (if there is one). The soffit is grooved to receive the tongues formed on the top of the jambs (as in ordinary window or door linings). The soffit is then nailed down on to the jambs, and a shutting piece is temporarily nailed in the door rebates to keep the jambs parallel, and a brace fixed across the top angles to keep it square whilst being fixed. In fixing the linings, scribe the bottoms down on to the floor, so that the soffit is level and the right height in the rebate for the door, taking particular care that the uprights are upright. Now offer the frame in its place, and measure the thickness of cradling or backing required to make up between the wood bricks, joints, or other fixing material and the wood frame. Put the frame on one side, and fix the cradling perfectly straight, square, etc. etc., and then put the jambs in their places, and secure them to the cradling. Some joiners cut long folding wedges between the back of the jambs and the fixing bricks, and gently drive them or slacken them until they are just right. This makes a very good job, especially if you fix the top and bottom of the frame first and the centre afterwards.—E. D.

Tire Cement.—SPLICE.—Having never made indiarubber cement, I am not in a position to reply to this query from personal knowledge. The best I can do is to give a recipe from "Spon" to make rubber cement, as follows:—"Cut pure rubber into the thinnest possible slices, then cut these with scissors into the finest possible shreds. Get a wide-mouthed bottle, and fill about one-tenth full of the cut rubber; add benzine—pure, and free from oil—about three-fourths full; shake frequently, and in a few days it will assume the consistence of honey. If rubber remains undissolved, add more benzine. If solution is too thin, add more rubber. In using, smear the surfaces to be united with the solution, and let them stand for an hour or so; then unite, and press firmly together."—A. S. P.

Tooth-cutting Machine.—A YOUNG CLOCKMAKER.—Write to Grimshaw & Baxter, 33, Goswell Road, London, for catalogue, in which you will find a drawing of a machine for cutting wheels. It is far too elaborate an affair for any but a very skilful mechanic to attempt.—J.

Cow House.—NEEDY ONE.—Your cow house, as you have sketched it, is a very large building, and I cannot, by any means, understand why you require a space of 26 ft. by 40 ft. in which to store 16 tons of hay. There is plenty of room for nearly 100 tons! But it is not my duty to find fault with your needs, but to give advice; so I tender it. I will reply to your questions in the same order as you asked them. (1) As you say you do not wish to use any intermediate rafters, it is useless for me to give any size for them. The principal should be about 16 in. by 4 in., and they will require to be 30 ft. long, as the pitch should be about as I have shown it in Fig. 1; otherwise, you will not keep the wet out. (2) Battens should be about 3½ in. by 2 in., placed edge up on the principal rafters, not cutting the rafters or battens in any way. (3) The ties should be whole trees not less than 6 in. in diameter, mortised through the inner posts, and the outside posts mortised up through them and also through principal rafters. (4) For the inner posts you should use whole trees from 7 in. to 9 in. in diameter, either bolting the principal rafters to the top of each, or cutting a tenon on top of post to fit in a corresponding mortise in rafter. The outside posts will do a



Cow House. Fig. 1.—Pitch. Fig. 2.—Bracing of Posts. A, Principal Rafters; B, Tie-beams; C, Inner Posts; D, Outer Posts; E, Collar; F, Braces.

trifle less—say, 6 in. in diameter—and must be tenoned up through tie-beam and rafters, as stated above. (5) I do not know of any hooks likely to be of use to you in buildings like this, but I will have a search, and if I find any which I think are suitable, I will let you know where to obtain them, and also the prices. You must brace the inner posts lengthways, as shown in Fig. 2, bracing each way alternately; otherwise, you will find yourself and cows buried in the ruins some day. It is also necessary that a small collar be put on as in Fig. 1. I should not think that would be in the way if placed as high up as I have drawn it. I am afraid you will think it a rather gigantic task to use the size timber which I have given; but, as I take it, timber is cheap with you, and the sizes are not overdone in the least. I should be very pleased to have a few weeks' work at the wages you mention in your letter, and should not mind roughing it a little.—CHOPSTICK.

Rust in Boiler.—OPIFEX.—The only way is, I think, to keep the boiler filled with water when not in use. This is the practice in steam boilers for engines: an analogous case.—J.

Organ Blower.—NO NAME.—W. H. Bailey & Co., Albion Works, Salford, Manchester, make a small organ blower, suitable for a chamber organ, at £6 6s. It is illustrated in their price list. Some day I will describe one in WORK, but at present am too fully occupied with pre-arranged subjects.—J.

Protecting Iron-work from Rust.—A. H. (*Bradford*).—By means of Barff's process, which forms a film of magnetic oxide on the bright surface. It is effected by heating the iron to redness, and passing superheated steam over it.—J.

Steam-engine.—H. H. (*Stony Stratford*).—The idea is a very useful and practical one, and one which I shall be pleased to take up in due course.—J.

Mangle Springs.—A. N. (*London, N.E.*).—Rubber will do very well, but not better than steel. Its range of elasticity is not so great as that of steel. I do not think I should alter present arrangements. If the steel springs do not act quite as you wish, you can have them re-tempered to a different grade of elasticity.—J.

Model Steamboat.—*No Name* (*Crown Hotel*).—I hope to reply at length to your query at a future time, in an article or two.—J.

Bent Iron.—J. B. (*Newcastle-on-Tyne*).—You can get the strips of W. Whiteley, Bayswater, W., and of Gawthorp, 16, Long Acre, W.C.—J.

Bent Iron.—H. L. D. (*Leicester*).—You can get flat-headed rivets of any of the model makers, but will have to make the cup-headed ones yourself.—J.

Re-waxing Brass Name-plate.—NOVICE.—I fear there is nothing left for you but to entirely re-wax your plate. You should have worked with the graver only, then the wax would have remained in the cuts. You must patiently pick out all the old wax, and roughen the bottom of the cuts. Next pound up your sealing-wax into a fine powder, and lay in the cuts sufficient powder to fill them, pressing well down with a flat piece of iron or steel. Now gently warm the plate; if you have an oven large enough for the plate, that will do as well as anything. Failing that, stand the plate upon two bricks, and burn waste paper under it until the wax begins to melt, and press the wax into the cuts with the piece of iron alluded to before. Be careful not to allow the wax to boil, as that will cause small air-holes to develop in the wax. Afterwards clean off in the usual manner.—N. M.

Papier-mâché Work.—LINSEED should write to Thornby & Son, oil and colour merchants, Snow Hill, Birmingham, who will supply him with a proper oil and a proper black japan. For the purposes of the latter Brunswick black is useless, as it never hardens properly; and it may be that in the oil used (which certainly ought not to conduct itself in the manner mentioned in LINSEED'S letter) a proportion of driers is mixed.—S. W.

Painting Screen.—H. E. S. (*Chatham*).—I see no reason why sateen should not be a very good ground for your purpose. To prevent the colours running, you must before painting "satisfy" the material, so far as the painting will extend, with size of some sort. Those who paint on sateen use, I believe, simply white of egg. When the ground is sized no especial medium is required. Whether you can gild on this I am in no position to say. If you think of using much gold, perhaps you will do better to have linen or calico, and size with isinglass, or if the work is on such a scale as to make cost of material an object, size with dissolved Russian glue. On these sizes you can gild with confidence.—S. W.

Varnish for Painted Sign.—E. R. (*Limavady*).—Ordinary carriage varnish is generally used by sign-painters, and would be all that would be needed if the situation is *inland*. But if the action of *sea air* has to be guarded against, a varnish prepared by dissolving gum in oil would be desirable. In this latter case, apply to a firm which supplies ship painters for the transparent varnish used by them over the paintings on white wood in saloon fittings.—S. W.

Reeds on Organs in lieu of Pipes.—F. D. (*Dunstable*).—Your suggestion of using harmonium reeds instead of Bourdon pipes is not practicable, as reeds will not keep in tune with pipes. Papers on Organ Building are already commenced in WORK.—W. M.

Wire Egg Holder.—J. G. (*Crosshouse*).—Do not trouble with your idea. Many better things are on the market.

Invention for Producing Ovals, etc.—W. H. (*Arbroath*).—It would be impossible to advise you as to your invention for producing ovals, etc., without seeing the machine, and knowing more fully its capabilities and scope. The prints you have sent as specimens are very nicely and cleanly done, as far as they go. But all these have been produced by other means, chiefly by the aid of the rose-engine and the various chucks. The work itself is too simple for hanknote engraving and kindred work, and I cannot designate any other occupation which would be likely to afford employment for such an invention. Having proved your competency in making such a machine, might you not go further in the same direction, taking in certain modern ideas, and consolidating them with your own invention? The main thing to be first considered is to make the machine strong enough to cut soft steel, and to provide for a more irregular outline—not circular only, but elliptical and general geometrical outlines. Next, you would have to consider how you could make the patterns less simple and more difficult to imitate. To bring this about, a multiplicity of movements are brought into use—viz., longitudinal, transverse, elliptical, excentrical, and cycloidal, all of which can be accommodated in one machine. I take it that your machine is built in the vertical position with horizontal movements, which is certainly the most approved fashion for constructing such modern lathes; and should you require further information on this subject, I shall be pleased to reply in "Shop."—N. M.

Enamelling Photos.—W. M. (*Bray, Co. Wicklow*).—The enamelling of photos is so different from the enamelling of jewellery that I do not feel at all sure of the details. I therefore suggest that you write to Oeffelein & Co., 51, Berners Street, London, W., and make inquiry as to the cost, etc. etc., of what you require. If W. M. is really bent on trying his hand, I think some of the photographic manuals give details—Capt. Abney's, for example. The enamelling I am speaking of is that in which the photo is to be burnt into a vitreous base. I am not referring to the so-called enamelling of photos on cards, which is produced by some kind of glaze or

varnish. There will be a short article in WORK soon on the furnaces, etc., used in enamelling, that may help you to understand the great need of practice and skill to obtain a successful result.—H. S. G.

Coloured Lights for Tableau.—NOVICE.—Whether limelight or oil lamp should be used will depend partly on the size of the room and also on cost. If the room or groups are large, and cost of no consequence, I should certainly recommend a biunial limelight; if, however, the other conditions exist, then a pair of good four- or five-wick lanterns will serve the purpose. When the coloured glass slides are in position, dissolve with a slow effect, not instaataneous, so that one tint shall blend and slowly fade into the other. Do not dissolve with violent contrasts.—O. B.

Model Lighthouse.—CORNISHMAN proposes making a model of the Eddystone Lighthouse in wood, with the lantern 2 in. in diameter and 2¾ in. high, and inquires where he can procure a glass globe for the purpose. Now, I canaot see exactly how or where he can get a *globe* of this size and form, and if he could, it would be of no service to him; but he can get a small glass shade with a dome-shaped or circular top, such as arc used for covering delicate objects. Knowing Penzance well, I venture to say he can get any size he requires. CORNISHMAN, however, proposes to do what is far more difficult—the "globe" is to be ventilated by four or five ¼ in. holes. How does he propose to do it? That ventilation will be necessary is a fact, if CORNISHMAN does what he further proposes: "What sort of a lamp can I uso to burn in it, as I wish to light it up from the inside of the lantern? Where can I get the lamp?" I am sorry, in a general way, to dishearten any budding genius, but I am afraid my countryman is attempting to do the impossible. The only thing that I can suggest is that he should procure a tiny electric lamp, such as is used in scarf-pins. This can be fixed in the lantern, with two wires leading from it through the woodwork, the electricity being supplied by two or three cells of the Bunsen type. A lamp of this size will be quite large enough to be in proportion to the lantern, aad will not require ventilating. With reference to the question of using knotting for the knots in elm, I would say knotting is only uscd on wood which contains resinous knots, such as pine; consequently, it is not needed in elm.—O. B.

Phonograph.—ANXIOUS.—I am sorry that I canaot help ANXIOUS with his instrument. If he had been more explicit in his letter—if he had stated where he thought the fault lay—I might have helped him. I can only refer him to the details already givea in WORK. If he has made the instrumeat to the instructions, the next point will be to carefully adjust the needle, and work away until he gets it right. He must not think that I am unwilling to help him, but he must try and give me something to work upon. His letter is too meagre for anything.—W. D.

Phonograph.—A. B. (*Herts*).—See above reply to ANXIOUS. I cannot make anything of your letter. Try and locate the fault, and write again. The tin-foil can be purchased at a chemist's.—W. D.

Varnish for White Wood.—G. W. R. (*Cheam*).—Ordinary white hard spirit varnish, such as can be bought at any respectable oil or drysaltery stores, at not less than 1s. per pint, should be suitable for this. Should you prefer to make a varnish yourself, take 6 oz. white shellac, 2 oz. pale resin, 1 oz. benzoin, and 1 pint methylated spirits. The gums to be finely crushed and spread out on paper for a few hours in a warm room or sunshine. To dry the shellac—a necessary proceeding, owing to its being kept under water—carefully strain before using, and apply with a camel-hair brush in a warm room free from dust.—LIFEBOAT.

Pinna.—W. P. (*Ballynafid*).—I cannot tell you where you can purchase pinna, and, ia fact, I do not think it is in the market. There are about thirty species to be found on the British coasts, but they are not all silk spinners. You might write to one of the firms in Dublin who supply fishing material on this point.—F. C.

Steam-engine Cylinders.—R. C. (*Skipton*).—There is no necessity for any steam-engine cylinder to be made of brass, whether oscillating or otherwise. The reason why brass is used for models is that it is more easily worked than cast iron. For the size you mention, brass would be preferable. You should write to "The Model Dockyard," Fleet Street, London, E.C., for price; all kinds of models—complete and in parts—are to be purchased there, either rough or bored and turned.—F. C.

White Clay.—E. F. F. and B. E. E.—You can procure the clay from Messrs. Doulton & Co., Lambeth Pottery. You may also be able to get the colours and glaze at the same place, but I am not sure. If not, you can procure them from a wholesale chemist, or through a local chemist. If you want eolours for painting, you can procure them from Messrs. Hancock & Son, Worcester, but as you are comparatively near the potteries, by making inquiries you might procure what you want from there.—M.

Boat Making.—J. W. W. (*Heckmondwike*).—Articles on Model Boat Making for Boys appeared in WORK, Nos. 160, 166, and 171.

Drawing Office Work.—COMPASSES.—Articles oa Drawing Office Work appeared in WORK, Nos. 158, 162, 166, and 171.

III.—QUESTIONS SUBMITTED TO READERS.

**** The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Speaking Tube.—H. L. P. (*Montrose*) will be glad of the address of the Homacoustic Speaking Tube Company.

Monogram.—T. L. E. (*Cardiff*) writes:—"I should esteem it a great favour if any reader would kindly submit a monogram for the three letters T. L. E."

Tinware Japan.—GULIELMUS writes:—"Can any reader inform me how to japan tinware—carriage lamps, for example—so that it will not finger-mark nor chip off?"

Plaques.—J. B. (*Lincoln*) is ia possession of a pair of terra-cotta plaques which he is desirous of painting, and which he finds absorbs the paint as soon as it is placed upon them, and thus interferes with the shading. Will any reader inform him how to preveut them from doing so?

Monogram.—BECK writes:—"Would some kind reader give me monograms for 'H. Y.' and 'J. B.'?"

Weaving.—A READER OF "WORK" writes:—"Will any kiad reader tell me where I can get full particulars of the Jacquard Weaviug Machiue?"

Mat Machine.—CONSTANT READER writes:—"Being a regular reader of WORK, I would be much obliged for aay information as to a machine for the working of mats or hearthrugs out of strips of old cloth, using a piece of light canvas as a foundation. Any information from your many readers will be thaakfully received."

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Saw Belt.—HEBBLETHWAITE BROS. (*Huddersfield*) write to SUBSCRIBER (see No. 184, p. 446), that "they can probably supply a belt that will drive a circular saw without difficulty."

Water Wheel.—W. A. H. (*Redhill*) writes to DYNAMO (see No. 179, p. 366):—"The best thing you can do is to send one stamp for price-list of dynamos and motors, etc., to Mr. W. Wells, Tooviesworth, Crawley, Sussex, who is the best maker of them. As to water power, send two stamps for list to Mr. P. Pitman, Withington, Manchester, who is the maker of the 'Demon' water motor."

White Wood Articles.—F. C. (*No Address*) writes:—"A. M. R. (*Golden Square*) (see No. 186, p. 478) can get white wood articles from F. Bennett, 20, Norman's Buildings, St. Luke's, E.C."

Fret Saw.—M. A. T. (*Farnham*) writes that he has a Rogers' Fret Saw which he can sell to H. W. (*Halifax*) (see WORK, No. 183), or would take tools or books in part exchange.

Catching House Flies.—EDDEFRA writes to W. W. (*Wembley*) (see No. 183, p. 430):—"I read of a trap which was seen at work in a chemist's shop window. I do not know if it was a patent. It consisted of two rollers, over which was stretched an endless piece of tough paper or linen; the distance between centres of rollers, about 12 in. Over one roller was a glass case. An electric motor was connected to one of the rollers, so that the paper was carried slowly under the glass case. Some sweet mixture was spread on the paper to attract the flies. They were carried under the case, when a rod across the paper caused them to leave the mixture and fly up the case. I think one could be easily made. For motive power, if there were one of those advertising fans fixed above shop door, it could be made to run the traps. The fan would require a new shaft—one long enough to pass through the wall into the shop—with small pulley on it. You will find you would get enough power to make it also work a fan ventilator for cooling the shop."

Kitchen Range Castings.—EDDEFRA writes to J. W. (*Askham-in-Furness*) (see No. 183, p. 430):—"The patterns for kitchen ranges are mostly made of a mixture of tin, lead, and zinc, on account of the castings being so thin, and having such a quantity of mouldings, carvings, etc., which would occupy so much time to make in wood. The boilers are made in wood. The tin-plate pattern-makers' tools consist of solder-iron, chisels, and files. They first make a long frame, if they want a long moulding, into which they run a quantity of plaster-of-Paris. The top is strickled over with a piece of wood cut to suit required mouldiag, with its edge protected with zinc. When the plaster has set, the mixture—tin, lead, and zinc—is run in. It is then taken out when cold, aad cut up and soldered together as required. It is a practice about here to knock the metal castings out of the sand as soon as they will bear it. They then keep their colour and do not rust, which is the case if they are left till morning."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—A REGULAR READER; T. S. (*Eastbourne*); W. H. K. (*Failsworth*); F. S. (*Ealing*); T. E. T. (*Forest Gate*); F. W. T. (*Ipswich*); E. N. R. (*Pickering*); ANXIOUS ENQUIRER; W. J. B. (*Cradley Heath*); H. M. (*Hampstead*); W. J. F. (*Cork*); G. V. (*London*); F. B. (*Hastings*); READER OF "WORK"; A. B. (*Keighley*); W. F. H. (*Limerick*); L. (*London*); JOINER; C. D. (*Exeter*); T. K. (*Liverpool*); H. T. B. (*Norwich*); STEEL CHAIN HARROWS; R. McC. (*Glasgow*); BICHROMATIC; F. J. (*Kingston-on-Thames*); T. R. (*Birmingham*); BUFFALO BILL; G. H. C. (*St. Georges, E.*); BAROMETER; C. L.; AN OLD HAND; PRO BONO PUBLICO; G. S. W. (*Dewsbury*); J. A. H. (*Cardiff*); A CONSTANT READER; PASTE; P. F. S. (*Leigh*); CONSTANT READER (*Leeces*); G. A. J. (*St. Georges, E.*); ZINO; W. S. S. (*Leeds*); J. R. L. (*Aberdeen*); A NEW READER; J. J. (*Ottawa, Canada*); KILKENNY CAT; J. McN. (*Glasgow*); H. L. (*Newport, Mon.*); DEBWENT; H. L. (*Earl's Court*); OLRAO; H. D. L. (*Worley*); G. B. (*Wolverhampton*); E. F. J. (*Market Harborough*); NEW READER; R. P. (*Stoke-on-Trent*); T. W. L. (*Hexham*); AXLE UPHOLSTERER; C. A. (*Sunderland*); W. P. (*Alford*); B. G. (*Wandsworth*); T. W. H. P. (*Bolton*); M. C. J. (*No Address*; W. A. (*Birmingham*); H. S. N. (*Sheffield*); W. M. (*Dublin*); BOSKINS; C. H. S. (*Midsomer Norton*); G. N. R. (*Dundalk*); P. S. (*Hull*); A. B. (*Waltham Cross*); M. B. (*Beckenham*); J. B. (*Poole*); NEW READER; PATENT; N. B. (*London, N.*); J. D. (*Port Talbot*); W. H. (*Halifax*); CONSTANT READER; WOULD-BE ENGINEER; J. C. (*Motherwell*); M. E. L. (*Lower Clapton*); J. W. H. (*Higher Broughton*); G. P. (*Hulme*); J. S. (*Burslem*); E. G. (*Bradford*); R. G. D. (*Burnley*); CORNISHMAN; C. O. (*Preston*); G. E. L. (*New Brompton*); C. I. C. (*Brixton*); G. E. (*Ipswich*); HORIZONTAL; W. H. T (*Mexborough*); H. & SONS (*Windsor*); A. F. (*Dalston*); S. G. C. (*Belfast*).

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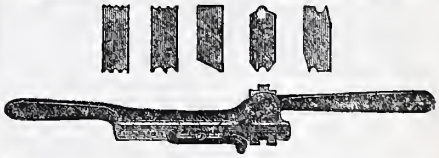

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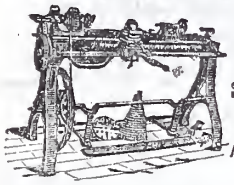

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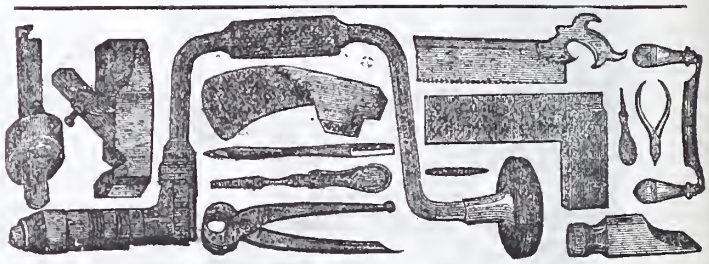

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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Vol. IV.—No. 196.] SATURDAY, DECEMBER 17, 1892. [Price One Penny.

WORK WORLD.

The Electric Railway from Brighton to Rottingdean will be nearly four miles in length.

* *

The present year's hop harvest shows a large diminution over that of 1891. Query, Will the brewing industry suffer in consequence, or will more chemicals be used?

* *

Some of the buildings of the Chicago Exhibition are painted by machines, which spray the paint upon the surfaces to be covered.

* *

Toy-making is an industry which ought to be fostered in England. The recent show at the Aquarium proved how much money leaves this country for articles of this description made for the most part in Germany.

* *

At the Newfoundland seal fisheries this season the capture of seals has been an unprecedented success. Three Dundee steamers alone have caught no less than 83,000 seals, of the value of £40,000. The sealskin industry this year therefore promises to be exceptionally brisk.

* *

A subterranean city has been discovered in Siberia near Karki, on the right bank of the Amu-daria. Its streets are described as regular, and laid out in a series of great caverns. A large assortment of pottery and metal-work has already been brought up.

* *

A new alloy of gold and cadmium, of definite composition (Au. Cd.), has been discovered. It is silver-grey in colour, very brittle, and exhibits a crystalline fracture. Cold acids have no action upon it, but hot nitric or hydrochloric acid dissolve out the cadmium, leaving the gold.

* *

Fluorsulphonic acid is a new acid, isolated by Professor Thorpe and Mr. Kirman, of the composition $SO_2(OH)F$, and obtained by the action of hydrofluoric acid on sulphur trioxide. It is a colourless, mobile liquid, fuming when exposed to air. It reacts with water with almost explosive violence.

* *

An alloy of silver, cadmium, and zinc has recently been tried for silver-plating by electro-depositing. This alloy is more costly than the ordinary alloy of silver and copper, but it is said to work well and show greater resistance to abrasion and less liability to tarnish than the latter.

* *

The saw is an instrument of great antiquity, its invention having been attributed to Dædalus, who, having divided a piece of wood with the jaw of a serpent, was led to imitate the teeth in iron. St. Jerome alludes to the use of a circular saw, and Pliny mentions the use of a saw in cutting building stones in ancient Belgium.

* *

Some experiments have recently been made on copper hardened by a process re-discovered by the French-Canadian blacksmith, Allard. Bullet-proof sheets of copper are reported to have been tested with eminently successful results, and it is stated that Allard has produced by his process a copper razor equal in edge and temper to the best article of the Sheffield manufacture.

* *

Steel tubes for boilers are being largely used to the displacement of copper. This movement started a few years back when a copper "ring" raised the price of that metal abnormally for a time. A ¾ in. steel tube, with a ½ in. bore, can be drawn to sustain a pressure of 1,000 lb. per square inch; the cost is less than that for copper, and the durability is quite as great.

* *

An association has been formed in London to promote the use of anthracite coal in private houses. This coal is smokeless, it requires upright bars, and is rather more difficult to light than the softer kinds of coal. A fire-clay back to the fireplace is also necessary. When once lit the householder has a bright, clear fire, no smoke or soot, and one which makes little dust and will keep in all night, and cost no more than ordinary coal.

* *

A new fruit which has been produced is a hybrid between the gooseberry and the black-currant. The bush resembles a gooseberry bush with currant-like leaves, and the fruits are like small gooseberries in bunches of two to four on a stalk. The fruits are seedless, of the size of black-currants, coloured like a red gooseberry, and beset with fine hairs. Spines are absent. They taste like gooseberry and black-currant mixed.

A fire-damp detector, which will indicate proportions of gas in air as low as 0·1 per cent., has been designed by M. Chesnau, secretary of the French Fire-damp Company. The apparatus is in the form of a safety-lamp, burning alcohol, and the difference in brightness between the halo or ring due to the fuel and the alcohol flame is rendered more perceptible by adding a little chloride of copper to the alcohol; this tinges the flame with green, while it gives the rings a greenish-blue colour.

* *

Although platinum is found in the serpentines of Brazil and the Cordilleras, Russia has hitherto held a monopoly of that material, and the only working layers are those in the Ural. The platinum is found in beds which are frequently auriferous, and often covered with layers of peat. The annual production during the past twelve years has been about four tons. The demand has increased in late years on account of its adoption for electrical and chemical industries.

* *

In China the stones of various fruits and shells of nuts are cleaned, dried, and carved into ornaments of the most graceful kind. The stones are selected with care, and dried at such a heat as will not cause them to crack or sprout. The design is then blocked out and the kernel extracted. A second treatment now takes place to dry the interior of the stone, as well as to prevent its fine lining from decay. The designer then completes his outline, and after assistants have worked it out, puts in the finishing touches, after which the perfected carving is cleaned and polished, or oiled or waxed.

* *

It is very important that the live load on bridge floors and those in buildings should be accurately determined. It has been usual to assume 120 lb. per square foot as the maximum load for road bridges, though architects allow 1½ cwt. per square foot as the load on the floors of public buildings. Professor Kernot has been experimenting upon this subject, filling an empty deck-house with fifty-eight Irish labourers of known weight; this showed a load of 147·4 lb. per square foot. This figure has been corroborated by other experiments, so for safety the weight of a crowd should be taken as 150 lb. per square foot.

SWEDISH WEAVING.

BY COUNTESS HAMILTON AND MISS CLIVE BAYLEY.

Looms and their Implements.

There are three principal heads under which we may class the material required in the art of weaving: First, the loom and all its various implements; secondly, the warps; thirdly, the woofs.

The looms and all materials may be obtained from Messrs. Newman, of Newman Street, Oxford Street; or Miss Dannfelt, 102, Haverstock Hill. We will first describe the loom and all that belongs to it, and will confine our attention to looms suitable for drawing-room and household weaving.

The Gobelin loom is the primitive form. It is the simplest to work and to understand, but at the same time it is the one which demands and admits of the most artistic use. Its very name suggests the tapestry which is so famous, and in which women of ancient days recorded in the earliest ages the achievements of their husbands and sons on the battle-field. It consists of a two-legged simple upright wooden frame, with two beams, and with the warp running from bottom to top.

In a later chapter we will describe the threading of the warp on to the loom and its manipulation. The only implements used with this loom are the wooden bobbins, similar in shape to those used in pillow lace making. On these bobbins the material for the woof is wound, and it is worked off them into the warp.

These looms are suitable for drawing-room occupation only, and cannot ever be really used for domestic purposes. No one but a very expert weaver could make a livelihood out of it; but from an artistic point of view nothing could be more attractive as an accomplishment, or more satisfactory in its result than this form of weaving.

For the Gobelin loom an ordinary low drawing-room chair is the most comfortable. This loom is shown (Fig. 1) as drawn by Froken Tersmeden, who has kindly illustrated this paper.

The ordinary treadle-loom, which can be used for all sorts of weaving, is a far more complicated affair. It is, however, on the other hand a far more useful machine than the Gobelin or tapestry-loom. Plain weaving, art weaving, homespuns for household or charitable purposes, ornamental or church draperies and linen, and every material in silk, cotton, or thread, can be made in this loom; and it has this advantage: that though the actual cost of production is perhaps little less than what would be paid for them ready made, the quality of hand-woven goods is always superior in strength and durability to machine-made materials.

The treadle-loom is formed thus:—(1) A square wooden frame (see A B C D), standing on four feet. It is necessarily much more cumbersome in form than an ordinary Gobelin loom. The smallest ones may, however, be placed in a drawing-room, and are both picturesque and useful objects. (2) A round wooden beam (*a*) swung on a pivot between the two back legs of the frame. On this beam the warp is wound preparatory to threading the loom. It is called the warp-beam. (3) A cogged wheel (*b*) of wood or iron regulates the winding of the warp. This is fitted with a handle, which is so placed that the weaver can reach and turn it from her seat. (4) The corresponding beam (*c*), placed a little way from the front of the frame, and also fitted with a wheel (*d*), which

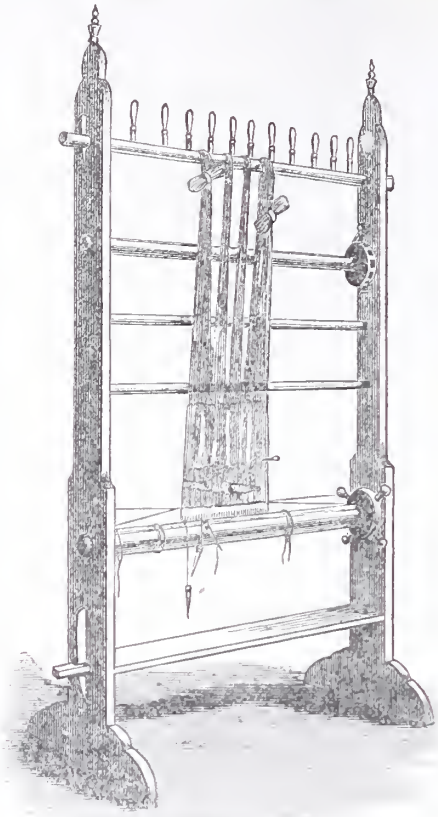


Fig. 1.—Gobelin Loom.

has several spikes, used as handles. This is the cloth-beam. The warp is, when the loom is threaded, fastened on this beam, as will be described later. Other parts are a wooden bar running across the loom, parallel with the beams, and close above the warp-beam (*a*); and another similar bar, not seen in this view of the loom. (5) The treadles, which may be any number beyond two (that number being sufficient for all plain weaving). The treadles are connected with (6) the heedle-sticks in a manner to be described later on, together with details about the heedles, not figured in this view. These heedle-sticks are again attached to (7) a flat wooden bar across the frame, and fitted with small grooved wheels, round which string loops again fasten on to pegs, which are attached to the heedle-sticks. (7*a*) Four pegs or jacks, on which to fasten the heedles. (8) The fly is composed of two flat laths and two grooved bars, of which the lowest is firm, and connects the laths. The other bar slides up and down the laths at the weaver's pleasure. Into this fly slips the reed, of which more hereafter. The fly hangs from the top of the frame by a bar across it, or stands upright from the bottom of the frame. In either case it must be towards the front of the loom, and straight before the weaver, for all the threads of the loom must pass through it. It swings on a movable pin, and is used to press together evenly the threads of the woof. (9) The chair on which the weaver sits is, in larger looms, generally affixed to the stand of the loom. (10) Several loose rods and laths used in setting the web.

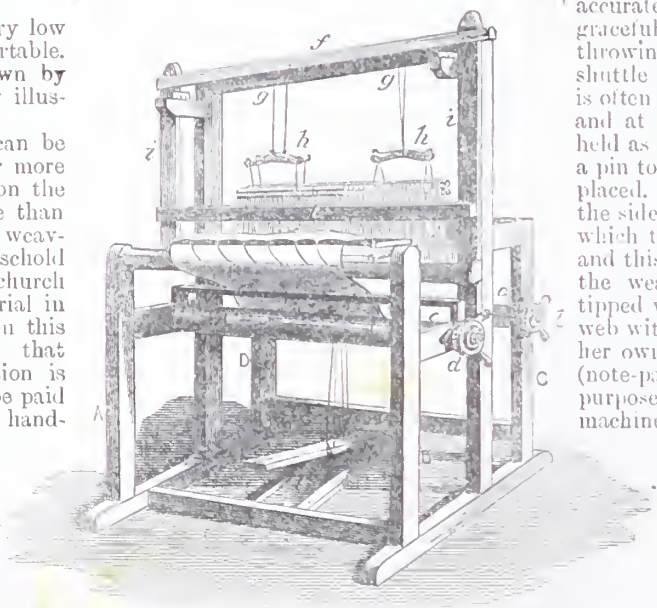


Fig. 2.—Swedish Hand-loom—A B C D, Frame; *a*, Warp-beam; *b*, Cog-wheel of Warp-beam; *c*, Cloth-beam; *d*, Cog-wheel on Cloth-beam; *e*, Treadles; *f*, Bar; *g*, Grooved Wheel; *h*, Jacks; *i*, Fly.

The implements necessary to weaving, but not generally sent with the loom unless ordered, are:—

(1) *The Reed* (Fig. 3).—This is made of steel or of wood, or of both. Generally it is a wooden frame, long and narrow, into which are fixed thin bars of steel. It fits, as we have said, into the fly, and through the interstices between its bars all the threads of the warp must pass. Therefore it is necessary, in ordering a loom, to order at the same time several sizes of reeds, for the meshes required will vary according to the material used.

(2) *The Shuttle* (Fig. 4).—This is made of wood, and is in shape somewhat like a boat. It is one of the more difficult models used in the wood *slöjd*, as it is difficult to produce accurately the double curve, which is both graceful and also necessary for the swift throwing of the shuttle. The centre of the shuttle is a deep well. A little bit of ivory is often fitted at either end of the hollow; and at the right end, when the shuttle is held as here pictured, a little spring allows a pin to be fitted in, on which the bobbin is placed. There is always a round hole in the side of the well of the shuttle, through which the thread off the bobbin is passed, and this hole must always be held towards the weaver. The ends of the shuttle are tipped with metal, so as to pass through the web without catching. The weaver makes her own bobbins (J) out of ordinary paper (note-paper or brown paper is used for the purpose). The weaver generally has a bobbin machine with her loom (Fig. 5).

(3) *The Tenter* (Figs. 6 and 6A).—This instrument is used for stretching the material in weaving, and to prevent its width contracting. Its action explains the meaning of the expression, "Kept on tenterhooks." It consists of two separate pieces, of the shape to be shown later on. They are tipped with brass at their broad ends, and are also spiked, so as to fasten into the web. When in use they are tied together with string, which is passed through the holes of the lower piece and between the wooden teeth of the upper one. There are several holes in the one, and several teeth in the other, and the weaver can regulate the width required by altering the position of the string.

The tenter is kept firm by a small brass catch.

(4) *Warp-laths.* — Several laths, about $1\frac{1}{2}$ in. broad and $\frac{1}{2}$ yard long, tipped at one end with block of wood 1 in. high. These are all the implements necessary if the loom is bought, as may be done, with the warp ready wound; but if the weaver makes her own warp the following apparatus is necessary:—

(1) *Bobbins.*—These may be either wooden ones—in which case they are like two or sometimes three long wooden frames, placed one inside the other; they may be about 18 in. high and about 1 yard in circumference—or they may be made like those used in the shuttle (of paper), only much larger, the whole length, in fact, of the winding-pin, and thicker in proportion.

(2) *A Winder* is also useful, but it may be dispensed with if the weaver can employ a friend to hold the skein, as for knitting. When the skein is wound off the winder on to the bobbins (the wooden bobbins can hold as many skeins as necessary, but paper ones naturally only take, at the most, one skein), the bobbins are ready for use.

(3) *The Winding-stand.*—In any case these bobbins must be placed on a winding-pin. The "shuttle bobbin-winder" (Fig. 5) comes in useful again for these warp paper bobbins, but for the wooden bobbins a stand with an axle and handle is necessary for winder.

(4) *The Bobbin* T.—This takes the place of the ceiling in a peasant's cottage. It is usual in cottages to fasten iron loops into the ceiling, and the warp from each bobbin is passed through one loop. The T is just a T-shaped stand, raised on a firm foot, and fitted with similar iron eyelet-holes. There are several eyelet-holes in the T, and you can, if you like, use as many bobbins as there are holes. The warp-winder sits by the T, and holds in her hands all the threads. Woman is often pictured as holding in her hands the threads of destiny. She here holds in her hands all the threads which run up to the warper.

(5) *The Warper.*—This is formed by a cubical frame bobbin, exactly like the one already described, only on a much larger scale. It is fitted with an upright axle, on which the bobbin is turned by the weaver with her hand. It has fixed wooden pegs, round which the threads held by the warp-winder are tied. The warper, when not required, can be folded together; otherwise it occupies too much space.

These are all the instruments or implements required for plain weaving, and these descriptions apply to all looms for hand weaving; for however different in size, and occasionally in the details of construction they may look, the general principle of construction is the same as is here given.

Implements not absolutely necessary, but convenient to have for weaving:—

(6) *The Reed Hook* (Fig. 9).—This can be made of wood or ivory. It should be a very thin, flat instrument, with a crook at the end of it, and will be illustrated later on. Its use is to pull the warp through the meshes of the reed when the warp is being threaded.

(7) *Shade-sticks.*—Thin pieces of wood, about 1 in. wide and as long as the loom is broad. They are used to keep the warp-threads in their places—by no means an easy task without them.

(8) *The Heedles.*—It is possible to make these latter, and they are hardly to be called implements. There are, it is true, stocks on which these heedles can be made, and a good weaver ought of course to know how to make them; but it is as unnecessary to make them as to carve your own shuttle in *slöjd* woodwork. They should be ordered ready-made with each loom. They cost a few pence for every hundred, and 2,000 of them are the allowance to every loom, as the finest web seldom has more threads than this, each heedle holding a thread. The heedle itself is generally made of coarse cotton, and consists of three loops. Into the top and lowest loop passes a heedle-stick; through the small loop in the centre passes the warp before it goes into the mesh of the reed. The necessity for the heedles all to be even in length is obvious; otherwise the threads would all pass through at uneven heights, and the whole web be in confusion.

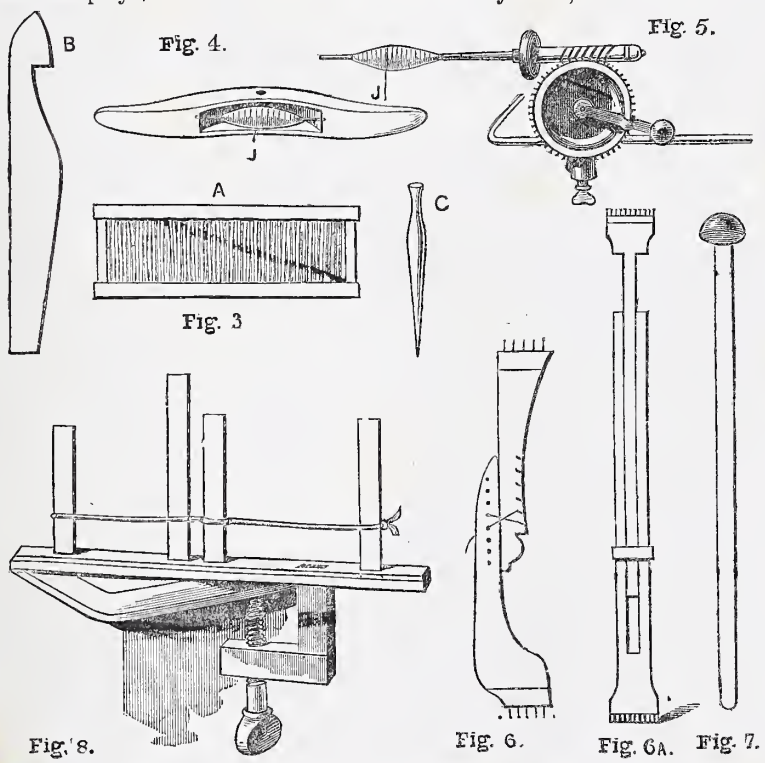
The heedle and the stock for making it is shown in Fig. 8. Should the weaver aspire to make her own, the only rule beside that of perfect evenness is to tie the knots of the heedle so that the knots should not slide.

The implements used for art weaving are shade-blades (two or three in number). They must be as long as the loom is broad, and about 4 in. wide, and either rounded or pointed at the ends, so as to divide the threads and pass easily between them.

For Opphemta some thirty or forty very light sticks are wanted, round or flat—bamboos are very suitable, as they are light and strong. For this purpose the sticks must be very firm. These sticks are required for the first method of weaving Opphemta, suitable for small looms and for amateur weavers with whom time is not an object.

Opphemta, however, can be much more easily and quickly managed with an entirely separate apparatus, which must be fixed with screws to the top of the loom, and which requires rather a larger loom, and is therefore better adapted to business establishments, where there is more space and a greater need for despatch. It consists (as will be seen in the chapter on that style of weaving) of frames fitted with reels and grooved wheels, connected together by strings coming up from the heedle-sticks, and these latter are brought forward and attached to little handles, which are within easy reach of the weavers. The number of the handles, of the grooved wheels, of the reels, and of the extra heedle-sticks (which must also be prepared for this work) must all be the same, and certainly not less than twenty should be provided; or, to speak more correctly, twenty pairs of heedle-sticks, for there are always two heedle-sticks for each set of heedles.

The number of heedle-sticks, reels, wheels, and handles in use at any one time depends upon the pattern of Opphemta woven.



Swedish Weaving. Fig. 3.—Reed. Fig. 4.—Shuttle and Bobbin. Fig. 5.—Bobbin Machine. Figs. 6 and 6A.—Different kinds of Tenters. Fig. 7.—Warp-lath. Fig. 8.—Heedle and Stock.

LOCOMOTIVE SMOKE CONSUMERS.

The Pennsylvania railway lines are fitting to their locomotives a smoke-preventing device which might well be adopted on London systems. The fire-boxes are fitted with the usual steam-jet entering both the front and rear, but instead of carrying air in with the jet which is taken from the atmosphere, pipes are carried to the ash-pan, and the air taken from directly beneath the grates. The object of this is to avoid carrying comparatively cold air directly into the fire-box, which must detract to some extent from the heat of the box. This will also lessen any tendency which the air might have to condense the steam and produce moisture in the fire-box. A blower is placed in the smoke-stack to operate in connection with the arrangement, the opening of one valve in the cab throwing them both into operation. It is the intention to use this attachment only within the city limits, where the smoke produced is a nuisance, and for this reason it is not made automatic, but is thrown in and out of operation by the use of a globe valve. The device has been carefully tested, and appears to be effective in preventing the emission of heavy black smoke, and the engines are all being equipped with it as fast as practicable. If only this or some better system could be employed upon our underground railway lines, travelling upon these routes would be much more pleasant.

NEW DEPARTURE IN PHOTOGRAPHIC LENSES.

A PHOTOGRAPH of Mont Blanc, taken from a distance of fifty-six miles, is calculated to excite the wonder and curiosity of photographers in no small degree. Hitherto, except in one or two cases which we need not consider, it has always been assumed that to obtain on the focussing screen an image larger than another necessitated the use of a longer focus lens and a longer extension of the camera; in fact, that the size of the image was proportional to the focal length of the lens. That this need not always be the case is shown by the introduction by Mr. Dallmeyer, at the close of 1891, of the tele-photographic lens, a rough account of the principles of which we propose to give.

If we consider the diagrams given below, which represent a beam of rays being brought to a focus on a plate, first by means of an ordinary, and secondly by means of the new lens, it will be seen that the parallel rays (R, R, Fig. 1), for example, passing through the lens (A, Fig. 1) undergo refraction and become convergent, and upon the amount of this refraction depends the focal length of the lens, and consequently the size of the image. But in the case of the second diagram, which illustrates the principle of the tele-photographic lens, in which, between A and the plate, *p l*, there has been inserted a negative lens, B, the effect of which is to cause the rays which have passed through A to become less convergent, the result obtained, as far as the size of the image is concerned, is the same as would be got by the employment of an ordinary lens in the position shown by the dotted lines (Fig. 2).

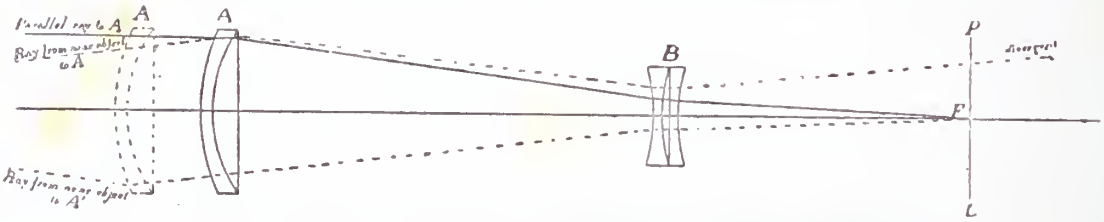


Fig. 2.—Diagram illustrating the Principles of the Tele-photographic Lens (compare Fig. 1).

To use the new lens, the camera is racked out until the focussing screen is in the position which it is thought best it should occupy, and the focussing is done by varying the distance between the positive and negative lenses. This is the method recommended by Mr. Dallmeyer himself, who has pointed out that under certain circumstances it becomes absolutely necessary; as, for instance, in the case shown diagrammatically below (Fig. 3). Here it is supposed the camera has been focussed for parallel rays; if then it is attempted to focus for a near object, as shown by the dotted line, it will be found impossible by any variation of the position of the focussing screen, since the rays will leave the negative lens diverging. By increasing the distance between the positive and negative lenses however, it will be seen that the near object can be focussed without any movement of the plate.

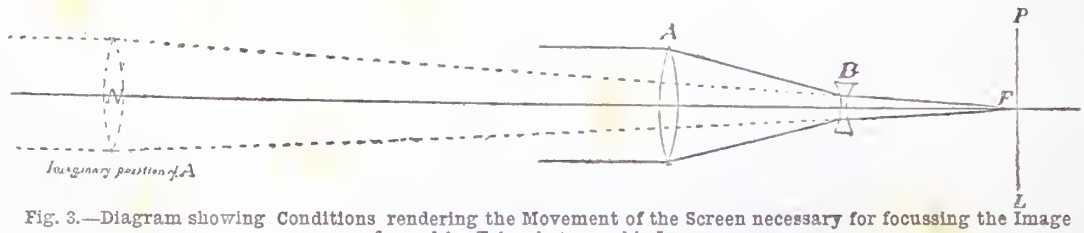


Fig. 3.—Diagram showing Conditions rendering the Movement of the Screen necessary for focussing the Image formed by Tele-photographic Lenses.

It should be borne in mind also that the effect of the introduction of the negative lens being to give the positive lens an imaginary position at a considerable distance outside the camera, as shown in Fig. 2, in estimating the rapidity the focal length must be measured from this imaginary position, and it is consequently advisable to employ as rapid a lens as possible for the front or positive part of the combination, or very long exposures will be necessary. It is found in practice that the front lens

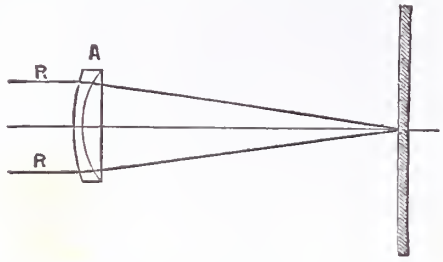


Fig. 1.—Formation of Image by an Ordinary Lens.

may be any ordinary photographic objective of large aperture, the "portrait" type being preferable.

We have seen very presentable photographs taken with an ordinary Petzval portrait lens, by interposing between it and the plate the back lens of an opera-glass, which was fitted in a cardboard tube attached to the inside of the front of the camera, the focussing being done with the rack and pinion of the portrait lens; but this form of instrument is not as satisfactory as might be wished, any slight optical defect being exaggerated in proportion to the size of the image chosen. Mr. Dallmeyer has constructed, however, a series of negative combinations which can be employed with his rapid short focus portrait lenses, which the introduction of the modern dry plate has, until now, rendered to a certain extent useless.

TICKET CEMENT.—A cement to stick tickets on ironwork and tin, that will stand water, can be made by mixing a little rye meal with a solution of glue and water and a little Venetian turpentine, but the cement must not be made too thick. If too thick, thin with the Venetian turpentine.

A FINE blue tint can be produced upon polished steel articles by placing them in a shallow tray filled with dry common lime, and heating them until they become the colour required, after which leave them to cool of their own accord. This recipe should prove useful to many correspondents who have inquired for a steel tint.

CHEMICAL APPARATUS: HOW TO MAKE AND USE IT.

BY H. B. STOCKS.

SYPHONING OF LIQUIDS—SYPHONS MADE FROM GLASS TUBE—METHOD OF POURING LIQUIDS—GLASS RODS: METHOD OF MAKING—AUTOMATIC FILTRATION AND WASHING—WASH-BOTTLE: HOW MADE AND USED—SUPPORTS FOR TEST-TUBES—HOW TO HOLD TEST-TUBE—WIRE SUPPORT FOR TUBE—TINPLATE CLIP FOR TUBES—TEST-TUBE STAND—CLEANING TUBES AND APPARATUS—TEST-TUBE BRUSH—TEST-TUBE CLEANER—BULB-TUBES: HOW MADE AND USED—WIRE HOLDERS FOR CANDLES FOR DETERMINING PROPERTIES OF GASES.

IN my last paper I pointed out the methods used by chemists for the filtration of liquids containing solid matters suspended.

Now, in the case of liquids containing solid matter which subsides on standing, the clear liquid may be syphoned from the vessel, thus avoiding filtration, except for the last small quantity. The syphon shown at Fig. 1 is a simple bent glass tube, one limb of which is longer than the other. The syphon is filled with water, and, keeping a finger on each end, inverted with the short limb in the liquid which it is intended to syphon away. A small piece of rubber tube and a pinch-cock placed upon the longer limb will be convenient for regulating the flow of the liquid.

The syphon seen at Fig. 2 can be readily made, and will be found very useful. It consists of a piece of glass tube, ½ in. in diameter, 4 in. long, one end being drawn to a point. In the other end two tubes, A and B, are placed, and sealed with cement, the end of A being longer than B. By placing A in the liquid, and sucking at B, a little of the liquid is sucked over, and this commences the work of the syphon. This will do for corrosive liquids.

At Fig. 3 is seen the method of pouring a liquid on to a filter, or from one vessel to another, by means of a glass rod. The vessel containing the liquid is slightly greased on its outside edge at the place it is intended to pour from; a glass rod is then held against the edge of the vessel and over the filter-paper. The liquid then flows down the glass rod, even though it may be considerably inclined, and not a drop is lost. This is an essential point in analysis.

Glass rod may be bought in lengths of various thicknesses at 1s. to 1s. 2d. per pound. For stirrers, it is cut into convenient lengths, 2 in., 4 in., or 6 in., according to the purpose they are intended for, and each stirrer has the ends rounded off by holding them in the blowpipe flame for a few seconds. Rods for dropping purposes are drawn out to a fine point (Fig. 4, *b*), two being made at the same time, and the points held in the flame so as just to fuse them.

Fig. 4, *c*, shows a rod with one end flattened for holding. This form may be made by heating the end in the blowpipe until a mass of pasty glass forms, then bringing it straight down upon a piece of smooth iron, and rapidly removing it as soon as it is flattened.

Automatic filtration and washing of precipitates may be carried out in the apparatus shown at Fig. 5, which is simply a flask intended to hold the liquid, a well-fitting cork, and two straight tubes, one reaching to the bottom of the flask, the other merely reaching through the cork. If the apparatus is arranged so that the tubes are covered with the liquid before the filter is full, no liquid will pass on to the filter-paper until the tubes are exposed, when air will pass up the longer tube and allow some of the liquid to escape. Thus the tubes are again covered, and this process goes on until the flask is emptied of its contents.

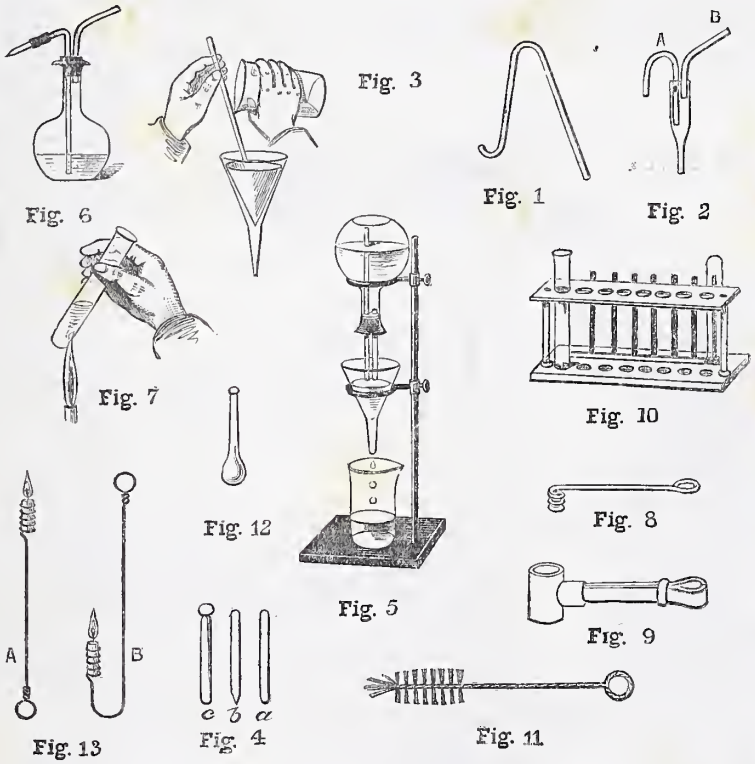
A useful piece of apparatus for washing precipitates is called the "wash-bottle." It is seen at Fig. 6. The flask may be about 20-oz. size. Two tubes are required, bent as shown. The longer one reaches to the bottom of the flask, and outside the flask is attached to it a fine-pointed tube by means of rubber tube; the second tube merely reaches through the cork, and by blowing through this a fine jet of water is shot out of the capillary tube. In some cases hot water is used for washing precipitates, and for this purpose the flask may be kept heated. If cold water only is required, then a bottle may be used instead of a flask.

It will be convenient at this place to mention the supports that are used for test-tubes. Supports for holding test-tubes in the hand are made, but they are seldom used except by amateurs, who are afraid of burning their fingers. Get your fingers hardened to the work, or apparatus will be broken by letting it fall when it becomes too hot to hold.

When boiling a liquid in a test-tube, hold it in the direction shown at Fig. 7—never straight, and never have it more than half full of liquid. Shake the tube slightly all the time it is being heated; otherwise, when the liquid boils some of it will be spurted out, and perhaps scald your hand. Never allow the flame to play above the surface of the liquid; and if there is solid matter present as well as liquid, shake it well up, or it will settle, and the tube will crack. If these instructions are adhered to, you will not feel the heat of the tube, even though it is held in the fingers; but if a continued boiling is kept up, then the tube will become hot, owing to the escaping steam. Then fold a piece of brown paper three or four times, so as to make a band about 1 in. wide, wrap it round the neck of the test-tube, and grip the two ends, so as to hold the tube. No inconvenience will then be suffered from the heat.

The wire support shown at Fig. 8, attached to a retort-stand, may also be used for holding test-tubes. It may be readily made from stout wire, as I explained for making rings for the retort-stand.

Fig. 9 shows another form of holder for test-tubes, also adaptable to a retort-stand. It consists of two tubes of tinplate, soldered together at right angles. In each is placed a cork—the one with a hole bored to take the retort-stand, the other has a slit cut in it, so as to hold the tinplate or brass clip for the tubes. The clip itself consists of two pieces of tinplate or thin sheet-brass, 6 in. long and ¾ in. diameter, the ends of which are curved, so as to fit to the shape of the tube. They are bent outwards a little, so as to give them a spring, and are then fastened together by means of a flattened ring made of the same material. By sliding this ring, the jaws of the clip are brought together or unclosed, as required.



Chemical Apparatus. Fig. 1.—Syphon. Fig. 2.—Syphon for Acids. Fig. 3.—Method of pouring Liquids. Fig. 4.—Glass Rods. Fig. 5.—Automatic Filtration and Washing Apparatus. Fig. 6.—Wash-bottle. Fig. 7.—Method of holding Test-tube. Figs. 8 and 9.—Test-tube Holders. Fig. 10.—Test-tube Stand. Fig. 11.—Test-tube Brush. Fig. 12.—Bulb-tube. Fig. 13.—Wire Candle-holders.

For supporting a number of test-tubes when not in use, the wooden stand (Fig. 10), called a test-tube stand, will be found useful. A stand of this description may be made by anyone who can work with a few tools. The upper piece of wood has holes bored clean through, large enough to take the test-tubes, and corresponding holes are scooped out in the lower piece for the bottoms of the tubes to rest in. If a row of pegs are added to the stand, and a strip of wood tacked on so as to incline the tubes a little, the tubes may be left to drain and dry after washing them out, and, being upside down, will be kept free of dust until required.

Those who do not wish to go to the trouble of making a wooden stand may make a good substitute in the following manner: Choose a box made of thick cardboard or of wood, such as a cigar-box, and bore holes in the lid large enough to take the tubes. A cigar-box would take one dozen test-tubes in two rows of six each. Get a piece of thick cardboard of the width of the box inside, and 2 in. longer, bore holes in this corresponding with those in the lid of the box, bend 1 in. down at each end, and place the card in the bottom of the box. This will hold the tubes in position, and not allow them to move in a lateral direction, so as to fall through the lid of the box.

After using test-tubes, they should always be cleaned before being put away. There are very few chemists who follow this rule, and I am not one of them; but the test-tubes, or any other pieces of apparatus, are easier to clean immediately after use than after they have been standing some time, so that, if time will permit, it is the easiest plan.

There will be found no difficulty in cleaning out apparatus with cold water alone, but any gas apparatus should be allowed to cool down before being cleaned. If any material sticks to the sides of the apparatus, a little sand and water and vigorous shaking will generally fetch it off. By no means use soap, especially if acids have been used, or you will get a greasy mass; and unless oils or fats have been used in the experiment, soap is of no use in cleaning. If there is a deposit upon the sides of the apparatus, hydrochloric acid will probably fetch it off; if not, leave it on—it is of no consequence.

In cleaning test-tubes, the test-tube brush (Fig. 11) is used, but after using a few times the bristles at the end come out, leaving the wire bare. Then, next time you use it, you forget this, and push the brush right to the bottom of the tube, when—pop!—out goes the bottom of your test-tube. I have done it many a time, so I have had plenty of experience.

To obviate this, a round stick with a piece of tow on the end will do, but the neatest thing in this line was invented by a laboratory boy I know.

A round stick, about 12 in. long, has a piece of india-rubber tube, 2 in. long, drawn on to it, leaving a little off the end, so as to form a soft pad when it reaches the bottom of the tube. For small tubes, a piece of ⅜ in. grey rubber tube will do, and for larger tubes a piece of wider rubber tube may be drawn over this.

Bulb-tubes (Fig. 12) are for the purpose of heating substances, to see what changes occur. They are very often used in the qualitative analysis of mineral substances. They are made from glass tube of about ¼ in. internal diameter. They are sealed up at one end by holding in the blowpipe flame, and when a lump of pasty glass is formed, a small bulb is blown upon the ends of them. As an example of the use they may be put to, if a little mercuric oxide is placed in the bulb and heated, a gas is given off which re-lights a match that is only glowing, and, on examining the tube, a mirror consisting of innumerable minute globules of mercury is seen. This experiment shows that mercuric oxide, on heating, splits up

into its two elements—mercury and oxygen. Wire holders for candles (Fig. 13) will be found useful when trying the effect of various gases upon burning bodies. A small candle may be placed in the cage of A, and pushed up into a jar of hydrogen. The hydrogen takes fire at the mouth of the jar; but if the candle is pushed up into the jar, the flame of the candle is extinguished, showing that hydrogen burns in contact with air, but the gas is not a supporter of combustion. If a candle is placed in B, and lowered into a jar of carbonic acid, the candle goes out, showing that carbonic acid does not support combustion; or if the candle is placed in a jar of air, and carbonic acid is poured upon it from a jar containing the gas, the candle will go out. If in this experiment a little of the smoke from burning brown paper be mixed with the gas, by dipping the burning paper in the jar and shaking up, the flow of the gas may be seen when poured, just as though it were a liquid. This experiment shows the weight of the gas.

HUNG SASHES ALTERED TO PIVOT LIGHTS.

BY B. A. BAXTER.

In answer to a subscriber who asks for a method of making the ordinary sash windows more easy to clean and less dangerous to the window-cleaner, these hints are offered as an endeavour to overcome the difficulty.

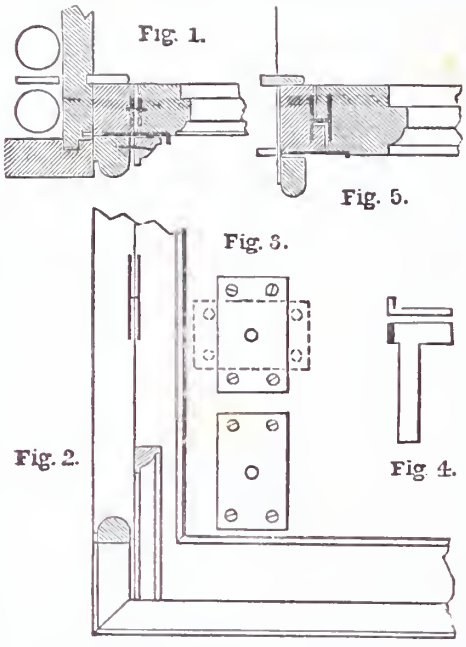
There have been patented methods, none of which I shall copy knowingly, as the only one of which I have seen the details does not appear suitable for existing windows.

Let the reader, then, imagine an ordinary sash window, and let the stiles be cut down just inside the $\frac{5}{8}$ in. bead, the cut portion being fixed by a pivot to the remainder of the stile. It is easy to see that the sash (in this case the lower one) could be swung on the centre like a pivot sash. At the same time, two defects will be seen to exist in such an arrangement—first, the liabilty to draught; and next, the danger of the pivots being moved from their horizontal position while the sash is moved on the pivots. The first difficulty may, I think, be overcome by making the sliding pieces with narrow stops, like the beads of pivot sashes, but smaller; the other difficulty may be overcome by having a fastening as drawn in Fig. 4.

If, however, the sash is to be capable of being turned a half revolution, or nearly so, then the beads will come in contact, so that if beads or their equivalents are fixed, then the sash will revolve only about a quarter of a turn, or the vertical surface of the glass become horizontal, or thereabouts. Therefore, in sashes of more than 6 ft. in height, the stops or beads must be abandoned; for it is not convenient to have to reach more than 3 ft. from the bottom of sash. Although it is possible to alter both the sashes in this way, I think it inadvisable; for if the top sash is on pivots it will, if moved on the centres before being drawn down, come in contact with blinds and curtains, and require the blind to be fixed outside the sash frame and above the $\frac{5}{8}$ in. bead, which is not always desirable. If, therefore, it is important to have the sash movable on the pivots to the full extent, the beads, or their equivalents, may well give place to an additional moulding, which is drawn as an ovolo, but this ovolo will have to be removed from each bead whenever the window is to be turned on the pivots. It is quite possible to make the upper sash turn in a similar way, but the added moulding just mentioned will not be applicable.

In order to prevent the sash pivots being put out of square by accident when the frames are being turned, some fastener ought to be provided; and the fastener shown will probably do well. It will be fixed to the sliding piece, to which also the sash-line is fixed, and when in one position the sash and slider will be fixed together by it; in the other position it will fix the slider to the sash frame. Small mortises will be required for this purpose at appropriate places on the inner surface of sash frame, just behind the bead. Perhaps it may be useful to have more than one pair of mortises for each pair of fasteners. The fasteners will have to be made to order, and they will be right and left. The hanging of the sashes will require care, and the cords had better be fixed with screws.

The pivots ought to be made as drawn,



Hung Sashes altered to Pivot Lights. Fig. 1.—Sectional Plan. Fig. 2.—Part Elevation. Fig. 3.—Pivots. Fig. 4.—Fastener. Fig. 5.—Alternative to Fig. 1.

two similar plates with screw-holes in position shown and rivcted together. The fastener must be cut into the sliders so that it will move, as a button, as far as needed to fix sash, or to enter the small mortises prepared in the edge of frame.

It is almost unnecessary to say that the movement is intended to be outwards at the bottom of each sash, and inwards at the top.

HAND-WORKING OF SPECULA FOR THE NEWTONIAN TELESCOPE.

BY EDWARD A. FRANCIS.

The Small Flat Mirror—The Test-tube and Cell—Eye-pieces—The Finder—Adjustment of the Mirrors.

Other methods of testing than the shadow-test require that the speculum shall be placed in some kind of test-tube, furnished with a small flat mirror and an eye-piece; and this apparatus is practically a complete Newtonian telescope.

In Fig. 2 the light rays reflected by the great speculum are intercepted and turned aside by a small flat mirror. This small mirror, like the larger one, is made of polished plate-glass. By obtaining three 5 in. discs of $\frac{1}{4}$ in. polished plate-glass, and working them alternately together with the finest grades of elutriated emery, three optically flat surfaces may be secured, two of which may be polished on a quite flat facetted polisher of hard pitch based on the third. From the polished discs several ovals may be cut, and the best selected.

I do not think it advisable that an inexperienced workman should attempt at first a flat surface. A small mirror may be purchased, or an oval may be cut direct from a piece of good commercial plate (from part of an old looking-glass, for example), which will possibly be more perfect than any first optical flat. It is difficult to polish with success a small plane surface. For those, however, who may choose the task, the directions given, together with the general knowledge of glass working gained in speculum polishing, will prove sufficient.*

The surfaces of commercial polished plate-glass are prepared very carefully by experienced craftsmen, and I have experimentally silvered and tested odd pieces of $\frac{1}{4}$ in. plate, and found them sufficiently satisfactory for ordinary work with a large reflector.

The flat must be about $\frac{1}{4}$ in. thick, and oval in shape (for an obvious reason), with its major diameter to its minor diameter as 7 is to 5. In our special case, with a $5\frac{1}{2}$ in. concave speculum of 5 ft. focal length, the actual measurements will be $1\frac{3}{4}$ in. and $1\frac{1}{4}$ in.

First, roughly cut the glass to shape with a diamond and pincers; then, if it be desired to edge it neatly, prepare a rod of wood, 6 in. or 7 in. in length, and $1\frac{1}{4}$ in. in diametrical section. Near to the middle of the rod mark off two rings exactly $1\frac{1}{4}$ in. apart, and cut across with a tenon-saw slantwise from one ring to the other. Then cement the roughly trimmed oval between the cut surfaces, so that the joined portions of the rod carrying the glass will run true in the lathe. Proceed then as when edging the speculum, but, of course, on a much more delicate scale. The glass will need to be reduced to the thickness of the rod. Fig. 31 is a sketch of the finished flat (exact size), which should fit truly into a piece of mandrel drawn brass tubing of $1\frac{1}{4}$ in. internal diameter. Such a piece of tubing, about 3 in. in length, should be prepared as in Fig. 32, the three little projecting pieces being soldered from the outside, and bent over to prevent the glass from falling out. The inside of the tube must be left smooth and circular.

Fig. 33 shows the flat mounted (in section), the glass oval, A (within C), being secured by B. The rest of the drawing is self-explanatory. The flat is, of course, silvered before being used; and to preserve the silver film a deep cap may be made to slide over C.

The movements necessary for adjustment are supplied by the sliding of B within D, and the raising or lowering of F within G. There should be no shake in any of the parts. The arrangement is not that which would be used by choice with a cylindrical tube, but was designed and constructed for use with a large wooden tube specially made for lunar photography. The carpentering of the wooden test-tube is elementary, and the sketches furnish the instruction needed.

Fig. 34 shows the exterior of the tube, which is bound by four metal bands. The band at D is stout, because that end of the tube may rest on the ground.

Fig. 35 is a plan with dimensions: A is

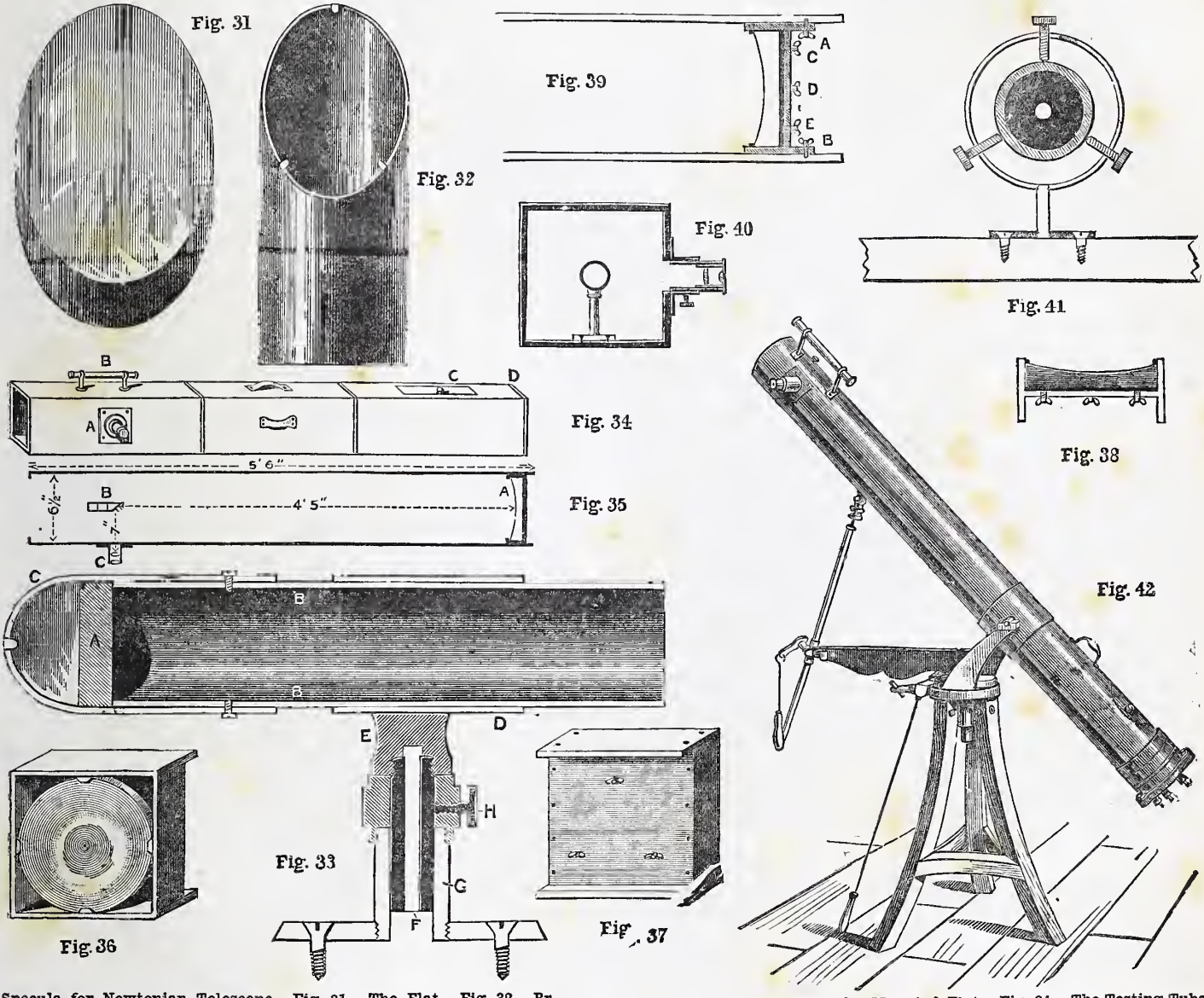
* I will describe the test for flat surfaces when it is needed.

the concave speculum, B the small flat mirror, C the eye-piece.

The method of mounting the speculum in a wooden cell is shown in Figs. 36, 37, and 38. The cell should be very carefully made of ½ in. well-seasoned wood, and should be of such dimensions as to easily and accurately slide within the great tube (see Fig. 39), where it is secured by means of the screws, A and B. The speculum is adjusted, when in position, by means of the three blunt thumb-screws, C, D, E, which should ends may often be adapted, by a little ingenuity, to supply the place of costly mechanism for experimental purposes. Pieces of optical brass tubing that slide accurately the one within the other should be jealously preserved.

The little telescope, B (Fig. 33), is made of one short brass tube, and has placed in the focus of its Ramsden eye-piece two crossed wires. It is mounted in rings, each pierced with three screws, as in Fig. 41; and so it is possible to adjust it that any object in the description of the Ramsden eye-piece be strictly followed, there will be little risk of error. An eye-piece by a good maker costs from seven or eight shillings to a guinea.*

The mirrors when in the tube are adjusted as follows: Turn the mouth of the tube towards the open sky or any source of diffused light. Remove the eye-piece. The oval of the flat seen through the eye-tube should appear a perfect *circle*, concentric with the eye-tube, and adjustment should



Specula for Newtonian Telescope. Fig. 31.—The Flat. Fig. 32.—Br ass Tube for the Flat. Fig. 33.—The Mounted Flat. Fig. 34.—The Testing Tube. Fig. 35.—Ditto, Section. Fig. 36.—Wooden Cell for the Specu m (Front View). Fig. 37.—Back View. Fig. 38.—Section. Fig. 39.—The Speculum Cell in the Testing Tube. Fig. 40.—The Flat and the Ey piece. Fig. 41.—Method of supporting the Finder. Fig. 42.—Newtonian Telescope (Altazimuth Mounting).

mark the extremities of an equilateral triangle (Fig. 37).

The flat has already been attended to, but its central position in the tube and the relation it holds to the eye-piece is indica ed in Fig. 40.

The eye-piece may be mounted ei ner in a plain sliding-tube or in a tube ith rack-work attachment—preferably the latter. Sometimes for a shilling or two the brass front of an antiquated ca era can be purchased, and this makes really capital rack-work eye-tube whe engthened.

It would be supe fluous to go further into detail. Those o my readers who are likely to succeed, wil speedily learn that odds and centr in its field of view will be within the field of view of the test-tube. It is known as the "finder," and the details of the making of such a small refracting telescope are given on page 654, No. 145 of WORK.

The Ramsden eye-piece is fully described, together with a very simple method of construction, in WORK, page 701, No. 148, and the Huyghenian or achromatic eye-piece has been treated of on page 293, No. 70, Vol. II. I must ask my readers to refer to those pages.

In eye-piece making, care has to be taken that the lenses are properly centred; but if the primitive form of mounting referred to be made until this condition is fulfilled. Then attend to the concave speculum, which will appear reflected in the flat as another circle having a dark central spot (the double reflection of the flat), and adjustment should be made, if necessary, by means of the three screws in the cell. The appearance when adjustment is perfect should then be: centrally, the dark spot; then the circle of the concave speculum; then the circle of the flat; and finally, the circle of the eye-tube.

* Much may be gained by the study of Mr. Charles A. Parker's papers on the Spectroscope—notably a capital chapter, dealing with eye-pieces, on page 323, No. 177.

NOTICE TO READERS.

NEXT week's WORK (No. 197) will contain, among other illustrated papers, the following:—

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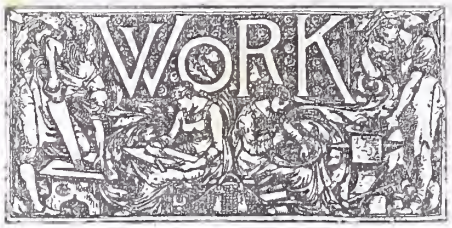

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WORK correspondents are wanted in every Town.

A NATIONAL PAINTERS' CONFERENCE.—On the evenings of January 16, 17, and 18 of the new year will be gathered together at the Painter-Stainers' Hall, London, painters and decorators from all parts of the kingdom. This gathering promises to be not only unique but successful. For the first time in its history the ancient Painter-Stainers' Company has lent its aid and countenance to schemes of popular progress and education outside its ancient conservative precedents; and the portals of its ancient hall will be thrown open to all sorts and conditions of painters, with a view to the unanimous promotion of a national scheme of technical education for their common art and craft. Our purpose is to provide some measure of sound technical knowledge for all descriptions of trades. House-painting and decorating has been one of the departments of industrial thought and labour to which prominence has been given in WORK, and it has been no unusual experience for us to receive letters from journeymen painters who have freely acknowledged that from our pages they have learnt more of the *technique* of house-painting than was taught them during their apprenticeship. In bringing the matter of this conference before the whole body of WORK readers, we feel sure that those who have no vital interest in paint and painters will not begrudge the space for our special note of invitation to those who, as masters or men, will be welcomed at the time and place mentioned. English, Scotch, Irish, and Welsh will show their common bond of British nationality at this gathering, and we believe the occasion will be the turning-point of the condition of the kindred trades. The pleasure and profit which employers and employed alike will derive in this united effort for the common good will not—must not—rest with technical education. The workers in all parts are awake and in earnest; and if those who comprise the capital and employing division will but bestir themselves and look to their interests also, the social, educational, and economic status of the house-painting and decorating trades may in a few years be removed from the lowest to the highest levels of honourable industry. Such is rapidly becoming the case in the United States, and so may it be with the craft in Great Britain. Therefore we wish the National Painters' Conference every success.

COMPENSATION FOR WORKMEN.—The London County Council propose to obtain Parliamentary authority to grant compensation to workmen who may be injured, and to the families of those who may be killed, in the execution of the works connected with the Blackwall Tunnel under the Thames. This evident anticipation of fatal and other accidents is at first sight rather startling, but when considered in the light of past experience is only reasonable; for those engaged in such concerns know well that no works of magnitude are carried to a finish without some accidents of more or less serious character, and such an undertaking as the Blackwall Tunnel is fraught with more than ordinary difficulty and danger. The Thames Tunnel at Wapping, through which the East London Railway now runs, was twice drowned out with loss of life, and that is only 1,300 feet in length, while the Blackwall subway will be 6,200 feet long. This boring will be run at a depth of only seven feet below the bed of the river, and that seven feet consists mostly of shingly ballast and gravel. The central part of the tunnel—that immediately under the river—will of course be the point of principal danger, and it is the lives of the men working in that section which the Council is desirous of assuring. Putting aside the humanitarian aspect of the matter, it seems only reasonable that if a man is desired to work under conditions of exceptional danger some provision should be made against possible consequences; and although the means of driving tunnels have been vastly improved since the original Thames Tunnel was made, yet the most unceasing human forethought is not always equal to contending successfully against contingencies of a doubtful character. Should the proposal made in this case be carried out, there can be no reason why it should not be adopted in future in connection with other large works of a risky nature.

A NEW CLEARING HOUSE.—We are familiar with the clearing-house principle as applied to railways and banks. It is now applied to the relief of distress, and the author of this new application is Mr. Arnold White, whose scheme deserves publicity. To carry the scheme out a committee has been formed, and the function of this committee is not the time-honoured—or dishonoured—one of receiving subscriptions, but to place those willing to assist the destitute in direct contact with them. All that anyone desiring of helping a family during the severe o[illegible] months has to do is to communicate win[illegible] the committee, who will place him in with [illegible] contact with a case or cases of suffer-direct co[illegible] calculated that if 50,000 of the ing. It is [illegible] take in hand one family each, well-to-do wi[illegible] deserving person in want in there need be no [illegible] is, without doubt, the London. The sche[illegible] relief of distress that most thorough for th[illegible] and if it be possible has yet been proposed, [illegible], then it should to relieve distress by givi[illegible] succeed.

THE PRESERVATION OF MINERALOGICAL SPECIMENS.

Isn't it excessively annoying—to use no stronger language—after getting together with great time and trouble, perhaps expense, a collection, more or less complete, of mineralogical specimens, to find some of them melt, others splinter, and others, again, effloresce? To guard against the first difficulty, there is nothing to be done but enclose the specimens in an air-tight receptacle—glass jar or glazed box, according to circumstances—but for the others there are lots of little dodges, recommended by Continental authorities, calculated to preserve the specimens, though freely exposed to the air.

Specimens impregnated with salt should, after careful drying, be coated with boiled linseed-oil or a varnish which will not crack—better still, a mixture of the two. Prints of ferns, or other plants in the shale of the coal measures, should be brushed over with diluted gum-arabic, having a little sugar added, to prevent any tendency of the gum to peel off. Bone, or other fossils liable to splinter, should be allowed to remain from one to twenty-four hours, according to their nature, in a strong solution of silicate of soda or potash.

Fossil bones may also be brushed over with hot spermaceti, melted over a spirit-lamp or atmospheric gas-flame, and then the coat reduced and equalised by passing the specimen rapidly over the flame in all directions. Small specimens of fossil ferns, etc., may be painted with silicate of soda in solution; or it might be worth while to try for this purpose the "Fluate" supplied by The Bath Stone Firms, Limited, Bath, for preserving building-stones.

The most difficult fossils to preserve are those which contain pyrites, a substance that unfortunately has too great an affection for oxygen. Paraffin has the merit of being absolutely free from this generally beneficent gas, and its point of fusion is 110° F. Melt your paraffin in a metal box of suitable size and shape; then suspend your specimen therein, and let the paraffin cool, when you will have a solid block containing the specimen, hermetically enclosed like a fly in amber.

In conclusion, if it be possible to detach a small piece from the specimen without great detriment to the latter, use this little bit—or, better still, several little bits—to experiment with, and see which treatment gives the best results. Above all, if you find the above advice judicious, do not forget to write to Work, so as to let other readers benefit by your experience. If any difficulty presents itself, "Shop" is open to all readers.

BLACK DYE FOR PEAR-WOOD.

The following method gives a beautiful dark black colour for carved and turned objects in pear-wood:—Two parts of pulverised nutgalls with fifteen parts of ordinary wine, which is let rest for some days in a warm room or in the air in warm weather. The liquid is then poured out and passed through a cloth if a great many pieces of nutgall float on the top; then about half its volume of water is added.

In the same way a condensed solution of vitriol and water is prepared. If the wood is coated with the first liquid, and, when dry, with the vitriol solution, a fine black colour is obtained, which is darker according to the denseness of the second solution.

Adding a coat of wax melted in spirits of turpentine, rubbing carefully, the wood appears like ebony. If you want a certain immediate polish, a light coat of shellac, dissolved in spirits of wine, must be used.

A BRACKET IN EGYPTIAN TRELLIS-WORK.

BY C. H. OZANNE.

The bracket illustrated is of very delicate workmanship, but it is not a very complicated affair, though it may look so at first sight. The back (Fig. 1) is cut in one piece with a fret- or band-saw. It is of $\frac{3}{8}$ in. walnut. The shelf (Fig. 2) and sides (Fig. 3) are also single pieces. Fig. 2 is $\frac{5}{8}$ in., and Fig. 3 $\frac{3}{8}$ in. thick. Two sides will, of course, be required.

On the back the two sides are screwed from behind, the top of the sides reaching to within $\frac{5}{8}$ in. of the top of the back, to allow room for the shelf, which is screwed down from above upon the upper edges of the sides and to the back. The sides are each fixed so as to be exactly above B, in Fig. 1, on each side. One piece (Fig. 4) is required $\frac{1}{4}$ in. thick. This is glued in position between the two sides and close underneath the shelf.

A quantity of the toothed edging in Fig. 6 is cut out, and divided into pieces of the necessary length to cover the edges of the shelf. The ends of each piece are cut off at the angle required to make them fit close to each other. Five of the corners of the shelf are right angles, so the edging for them will be cut off at an angle of 45°. The other angles can be similarly measured and halved, and the edging cut off accordingly. It is glued to the edges of the shelf.

Over this a moulding is glued. The size is given in Fig. 8, A, which is a section of the moulding. It will be seen that the moulding is the half of a squared strip sawn down along the diagonal. It can be made by sawing down the strip in this way with a fine dovetail saw; or the squared strip can be planed down until only the triangular piece required remains. The ends of this moulding will also be required to be cut off at various angles, in the same way as was the toothed edging. The moulding is ebonised and polished.

Another piece of moulding, shown in Fig. 8, B, is run round the top of Fig. 3 to hide the junction of the two sides, and the front piece (Fig. 4) with the shelf. It is also continued along the back, so as to cover the angle made by the back and shelf. It also runs round inside the top of the compartment made by the two sides and back. It is not required at the back of the front piece (Fig. 4), as it could not be seen. This moulding is also ebonised and polished.

Two pillars—or, rather, half-pillars—as shown in Fig. 7, are required to fill up the gap, A B (Fig. 3). In Fig. 7, A gives the front view and B the side view when mounted. These are also black, and polished.

Four of Fig. 5, A, will be required, and two of Fig. 5, B. A is fixed at C and E, and B at D (Fig. 3). The six drops are of lemon.

Nothing now remains but the three trellis-work panels (Fig. 9), which fit into the three spaces, A, in Fig. 1, and F, in Fig. 3. The

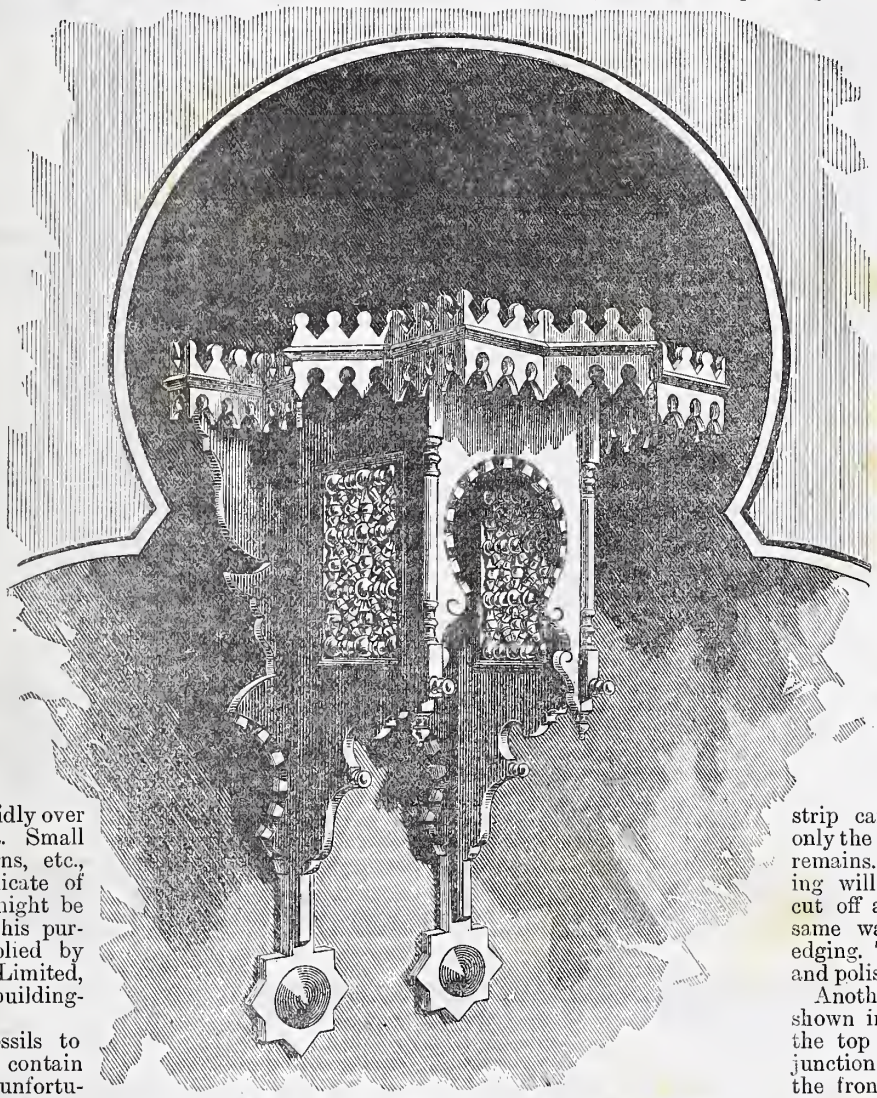
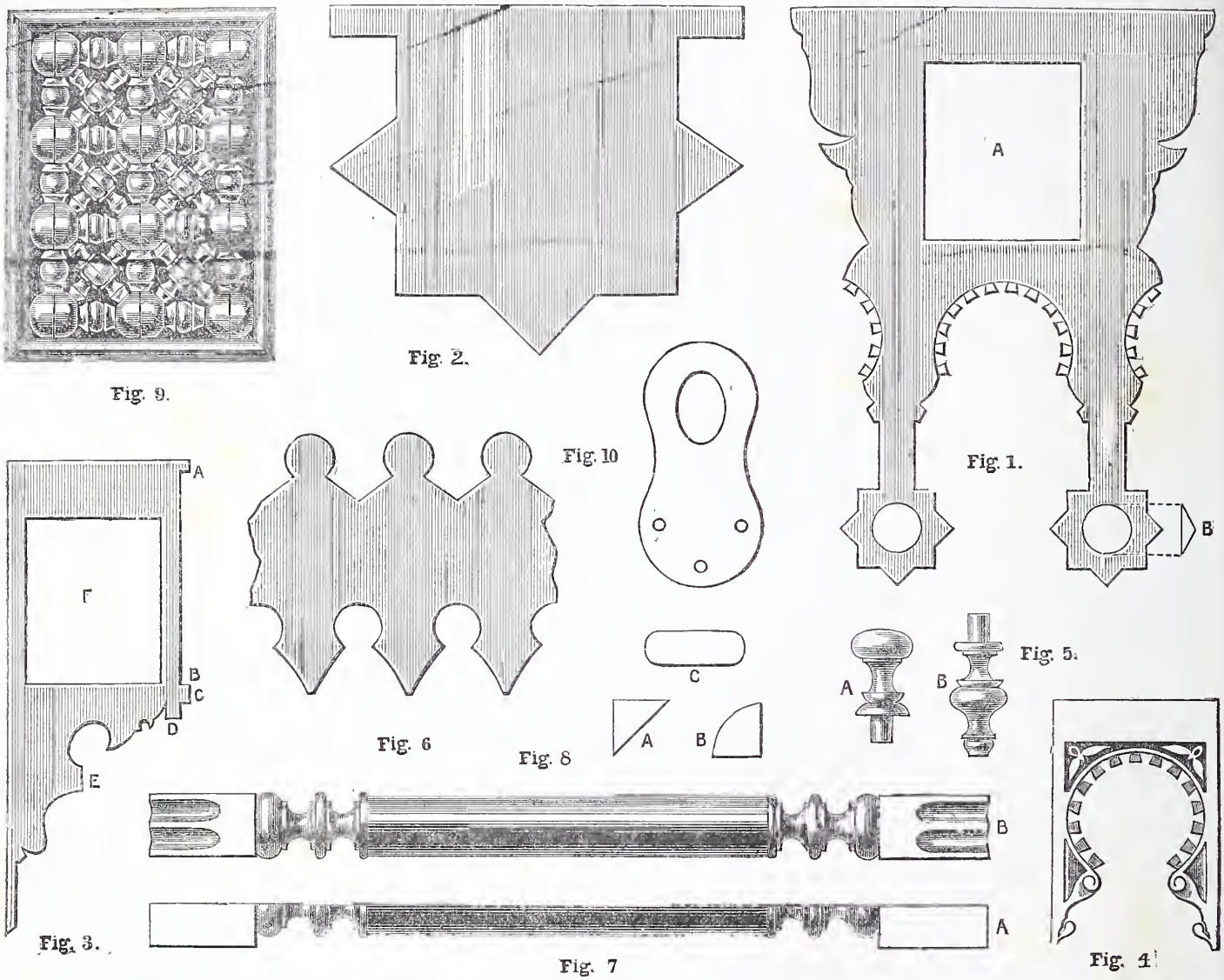


Fig. 11.—Perspective View of Bracket in Egyptian Trellis-work.

trellis-work is composed of walnut beads and lemon stars. The horizontal strips of bead-work are solid, and their ends are held by pegs turned upon them, and inserted in the moulding which frames it up. This moulding is shown in section in Fig. 8, C. It is black, and polished. The panel is first framed up, and then slipped into the space prepared for it, the edges being glued beforehand.

It would be best to fasten in these panels before the bracket is put together.



Bracket in Egyptian Trellis Work. Fig. 1.—Back of Bracket. Fig. 2.—Shelf. Fig. 3.—Side. Fig. 4.—Arch for Front. Fig. 5.—Pendants. Fig. 6.—Toothed Edging. Fig. 7.—Pillar. Fig. 8.—Mouldings in Section. Fig. 9.—Panel. Fig. 10.—Plate by which Bracket is hung.

The front piece (Fig. 4) is slightly carved in relief, as indicated by the shading. In Fig. 1, B is a black polished disc, laid on in the position shown. The bracket is left dull, excepting the black parts, which are polished, as has been said. It is hung by two plates (Fig. 10), let into the back edge of the shelf. If desired, a lower shelf could be introduced at the level of C (Fig. 3), to hold a statuette or vase. I shall be pleased to answer any points of difficulty through the pages of "Shop."

THE most durable grindstones are now composed of a mixture of pulverised quartz, powdered flint, powdered emery, and rubber. They outlast any natural stone.

BRITISH RAILWAY STATISTICS.

MIDLAND RAILWAY.

IT may be truly asked: How many of the millions of travellers who use the railways of the United Kingdom in the course of a year have any idea of the magnitude of these undertakings: the vast sums of money sunk in their construction and maintenance, the huge accumulation of engines, carriages, and other rolling stock required to enable them to meet and carry out the demands of the business they have to do, the amounts of money received therefrom, the cost of the working expenses, and the amount of the miles run in the half-year? In order that our readers may obtain some correct ideas on these subjects, we have selected one of the best managed and the most enterprising of the railways in the kingdom—namely, the Midland, with its own mileage of 1,434 miles 54 chains, or a total of 1,942¾ miles worked over by its engines.

The capital of the Company on which dividend is payable stands at £67,800,622 7s. 5d., and the authorised capital at £100,392,754 13s. The maintenance of way and works for the half-year amounted to £364,906 8s. 5d. The cost of the locomotive power was £731,844 3s. 10d. The cost of the repairs and renewals of carriages and waggons stands at £307,830 15s. 3d. The Traffic Department expenses amounted to the sum of £849,028 1s. 11d., and the general charges to the sum of £80,153 14s. To meet these enormous outgoings, we find that the total revenue for the half-year was £4,431,078, and, deducting the total of the working expenses, £2,473,276, and all other expenses and outgoings, there remains to be used as dividend the sum of £1,492,480 15s. 6d.

We will now give some particulars of the plant, or means of carrying on the business of this Company, and we find that there are 2,087 locomotives. In the Coaching Department there are 2,910 passenger vehicles, 1,600 horse-boxes, carriage trucks, and brakes: a total of 4,510 vehicles. In the Merchandise and Mineral Department there are 1,485 cattle trucks, 68,679 goods waggons, and 1,497 covered ditto, 20 creasote tanks, 2,019 timber trucks, and 1,277 brake vans; thus giving a total of 107,858 vehicles in this department, to which if we add that of the Coaching Department, we get the grand total of 112,368 vehicles of all kinds.

The cost of repairs and renewals of the above, as we have seen, amounts to £307,830 15s. 3d., and that of the locomotive haulage to £731,844 3s. 10d., and the traffic expenses connected therewith to £849,028 1s. 11d.; whilst the general charges of the railway amounted to £80,153 14s.; and for this above expenditure we find the passenger trains were run a total of 7,922,240 miles, and the goods and mineral trains 12,169,046 miles—a grand total of just 20,091,286 miles in the half-year; and 18,107,078 passengers, not including season-tickets!

WORKMEN'S CLUBS.

BY ECONOMICUS.

The workmen's club movement has had a great deal to contend with. It has, of course, had the usual difficulty incidental to all working-class movements: viz., slender financial resources. Superadded to this, however, a still graver difficulty has been the purely gratuitous prejudice with which these clubs have been, until comparatively recent times, regarded by the public.

It has now been discovered by most thinking people that the "poor working man" has great social problems to solve, and his clubs and unions are now looked upon as part and parcel of the institutions of this country. There are not now wanting signs of a disposition among all sections of the community to assist these working-class movements to enlarge the sphere of their operations.

The particular form which this increased activity is to assume is worth specifying, inasmuch as it will give readers an idea of what is being done to strengthen workmen's combinations, and to put opportunities in their way of useful recreation. The leaders of the club movement, who are comprised in the Workmen's Club and Institute Union, which embraces more than four hundred affiliated clubs in London and the provinces, have purchased on behalf of the Union a site whereon to build a Central Hall and Club. This site, which has a central situation in London, being just off Gray's Inn Road, has cost £8,000, and the building operations, which are to be entered upon forthwith, are estimated to cost £11,000. As a result of this outlay, there will be convenient and commodious offices for the officials of the Union, and also for the officials of trades unions and other working-class organisations. On the recreative and educational side there will be a large hall, which it is hoped "will be used every evening for some purpose tending towards the improvement of the social and economic condition of the people." Provision is also made in the plans for a capital library and reading-room, rooms for classes, and rooms for games. A place like this, as the secretary of the Union says, ought to prove a great boon to working-class London. Meetings can be held here, and conferences of labour leaders held in times of trouble. A great advance this upon the back parlours of public-houses, which have hitherto been, perhaps, too closely associated with the labour question. With an institution such as the Central Hall and Club properly conducted—and the well-tried men responsible for its conduct may be left to see to that—the workmen's club movement will receive a stimulus, and will acquire a dignity that must make it a great social strength in the near future.

As to the clubs that belong to the Union, we have already said that they exceed 400. The number is increasing every year, and the standard qualifying clubs for admission to the Union is always being kept up. No fewer than forty-seven clubs have been struck off the affiliated list during the past year, one of them in consequence of its giving undue prominence to certain forms of entertainment that the Union, as an organisation for the welfare of the people, could not countenance. Among these forms of entertainment, the most insidious appears to have been boxing contests, which had to be very promptly dealt with. On this point the year's report says:—"The attention of the Union having been directed to one or two cases where this had taken place, active steps were taken to discourage the introduction of this feature into club life, and one metropolitan club, which declined to give any satisfactory assurance to the committee, was expelled the Union by a unanimous vote of the delegates present at a special general meeting, called to deal with this question. We are glad to record that the action of the Union has had the desired effect, and that the clubs generally now prohibit such entertainments."

The management of a workmen's club is by no means an easy matter, and but for some such organisation as the Union, the continued improvement of such clubs would have been impossible. The subscription is so low—even down to sixpence a month, and that sometimes payable in weekly instalments, and rarely higher than a shilling a month—that the members comprise a very mixed multitude, with often no common motive. Such clubs, in consequence, often break up into sections, whose squabblings, if unrestrained, end in catastrophe. Another evil resulting from the low subscription—which, of course, is a necessity where workmen's pockets are concerned—is that small clubs are unable to meet their fixed expenses without relying too much on the profits from the sale of refreshments. This is apt to induce the management to encourage those members who spend their money freely, and the general atmosphere of such a club ultimately becomes far from wholesome.

With difficulties like these in the way, any body of workmen or others who decide on starting a club should always previously consult the secretary of the Club and Institute Union. The terms under which a club may join are not onerous, and the benefits are incalculable. It gives free legal advice, and, if desired, acts as a Board of Arbitration in disputes. It also issues publications as to the best method of starting and managing clubs, and will even send speakers to address meetings called in support of a proposal to establish them.

SCIENCE TO DATE.

Chlorophyll.—It is usually stated in books on botany that chlorophyll, the green colouring matter of plants, contains a little iron. Dr. Molisch has recently been investigating this substance, and states that it contains no iron.

Fossil Bones.—M. Carnot finds that the older fossil bones are, the greater is the amount of fluorine that they contain, and suggests that a determination of the quantity of fluorine present may assist in determining the age of fossil bones. The proportion of fluorine in many fossil bones is ten to fifteen times as great as in recent bones, referred to the same weight of ash.

Lake-dwellings.—The discovery is announced of an ancient lake-dwelling in Somersetshire, near Glastonbury. Excavations have been made during the present year of mounds rising from 1 ft. to 2 ft. above the surrounding soil, and measuring from 20 ft. to 30 ft. across, which were suspected of being of archæological interest. The search has been rewarded by the discovery of woodwork, bronze and iron implements, and pottery. A canoe, formed out of the trunk of a tree, was also found. The settlement is supposed to belong to the so-called late Celtic period, which followed the Bronze Age, though probably at a great interval of time.

Acetylene.—M. Maquenne has perfected a method for preparing pure acetylene easily and in large quantities. It consists in the action of water on barium carbide. This substance is obtained by heating to a red heat, in an iron bottle, a mixture of barium carbonate, magnesium in powder, and carbon. A product containing about 38 per cent. of carbide of barium, BaC_2, is thus obtained. It is powdered and placed in a small flask fitted with a double-bored cork, carrying a dropping funnel containing water and a delivery tube. As the water is allowed to drop on to the powder, acetylene gas is given off, and the rate of evolution can be easily regulated.

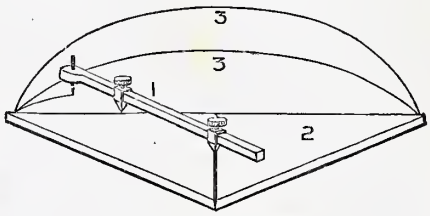
Cancer in Fish.—Professor Scott has observed the occurrence of cancer in specimens of American brook trout kept in confinement at Opoho (New Zealand). Males and females were alike affected, and the diseased fish never recovered. This disease has never been observed in fish before.

Incandescent Lamps.—According to Nichols, the diminution of efficiency in incandescent lamps is due to three causes—the loss of vacuum, increase of resistance due to the disintegration of the filament, and the deposition of the disintegrated carbon on the glass. This deposition gives rise to what is called the age-coating. The rate of deposit is quicker in the early part of the life of the lamp. Thus, in a lamp which lasted 800 hours, the greater part of the coating was deposited during the first 200 hours. There is no difference between treated and untreated filaments as regards the coating produced, but in lamps exhausted without the aid of mercury the age-coating is hardly perceptible.

NOTICES.

Jewellers' Tools.—Messrs. Calipe, Dettmer & Co. send their catalogue of materials for the jewellery, dental, and metal trades. It would be unwise to particularise any special item of the list, as it contains the sizes, prices, and generally an illustration of articles indispensable to wholesale and retail workers in the above trades, from a split ring or brooch catch to an iron safe or turning-lathe. We have inspected Messrs. Dettmer's *dépôt*, and can vouch for the facilities afforded for dealing with the largest or smallest requirements of workers in the jewellery and kindred trades.

Hicks's Ellipsograph.—The accompanying illustration shows the principle of Hicks's Ellipsograph—an ingenious instrument which we predict will be found of real use in every draughtsman's office. It consists of two parts: (1) The compass-bar, which carries the pencil and two movable pins (these slide along the bar, and can be fixed at distances required for width and length, in each instance measuring from pencil to pin); and (2) the grooved double set-square of 45°. Also a case for holding the same. It is an instrument less cumbersome than the ordinary



Hicks's Ellipsograph.

trammel, and as such is much wanted for describing elliptic curves in geometric drawings, ornamental headings, etc. An extempore enlargement of it, using only one set-square, would be well appreciated in the workshop for marking out oval table-tops, frames, etc. This drawing-tool was invented fifteen years ago by the present maker when a student in one of W. Busbridge's science classes. Since then he has greatly improved it, and now offers it to fellow-students and workmen at a low price, which should bring it within the reach of all.

Chip Carving.—This is a form of pleasurable and profitable employment indulged in, we know, by thousands of our readers. From time to time instruction and designs have been given in Work, and we hope to furnish more at judicious intervals. Meanwhile we can well draw attention to Mr. Joshua Buckley's wood-carving kits. These include chip-carving tools, ordinary wood-carving tools, books of designs for carving, and articles carried out in different styles of wood treatment. All that has been submitted to us has the merit of being original, good, and cheap.

Band-saws.—"History of the Band-saw," by W. Samuel Worssam, A.M.I.C.E. (Emmott & Co.)—This pamphlet gives a concise account of the history of the band-saw from its earliest traceable record in 1808, when one William Newberry patented a steel ribbon for sawing wood, down to the present year, which has witnessed the introduction of Ransome's improved band-saw machine for logs. No greater authority exists than Mr. Worssam upon the subject of the band-saw; and all who wish to know its history in a brief, concise way, should possess themselves of this pamphlet.

Phipps' Useful Jack.—These useful little tools are intended for the workman's basket, and will be found handy for a thousand purposes. They are strong and well fitted with right- and left-hand screw, 1 in. square thread, wrought iron, weigh only 4 lb., are 8 in. long when closed, will give a lift of 5 in., and will pull 3 in. They will be found useful by all sorts and conditions of practical workers, and every carman might do worse than carry one in case of breakdown or getting in a hole. The British Iron and Hardware Agency store them.

TRADE: PRESENT AND FUTURE.

**** Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

TINPLATE TRADE.—This is now looking up. Owing to the effect of the Presidential election in the United States, many employers in the tinplate trade have decided to reopen their works; and things certainly look better for the present winter than they have done for some time. Shipments are pretty regular to St. Petersburg and Russia.

OIL TRADE.—Palm oil is higher in price than it has been for some time. About 200 tons have been sold, New Calabar at £22 5s., Congo at £22, and Cameroon at £22s. 10s. to £23 per ton. Tallow is steady. Olive oil is £35 to £40 per ton, according to quality. Linseed oil is quiet at 19s. 3d. to 20s. per cwt. Cotton-seed oil is firmer at 18s. 6d.—cheaper than usual. Resin is in fair demand, prices being: Common, 4s. 4½d.; medium, 4s. 9d. to 7s. 6d.; and fine, 8s. 6d. to 11s. per cwt. Spirit of turps is steady at 23s. per cwt.

COTTON TRADE.—Another week of the great dispute in the Lancashire cotton industry sees both sides still firm. It is considered probable that any prospect of an early settlement is now remote. The locked-out operatives have received considerable assistance from their fellow-workpeople of Bolton, who have decided to subscribe £10,000.

ENGINEERING TRADE.—In the Lancashire district one or two large stationary engine builders are fairly busy, as are also boiler makers. The majority of works are, however, so very slack that not only are the workmen being discharged but the office staffs are also being reduced, thus indicating that there is little prospect of a revival of activity taking place for some time. Most of the large firms of textile machinists have but little work on hand, but in one or two cases makers of this class of machinery continue busy.

IRON TRADE.—Next to nothing is being done in the Lancashire iron trade. Finished iron is in little demand, and prices are very unstable. Recently finished iron merchants in this district reduced their list prices 10s. per ton for bars taken out of stock.

STEEL TRADE.—The prices for hematites are about 55s. 6d. for average foundry qualities, but steel billets could now be bought under £4 7s. 6d. In steel plates very low quotations are being made, and the best boiler-making qualities are being offered at £6 10s. to £6 12s. 6d.

SHIPBUILDING TRADE.—Our Liverpool correspondent writes:—Owing to the depression in the shipbuilding trade of this port, ironfounders, shipwrights, makers of forgings, etc., are all very short of work, and are working with as few hands as possible. Many men are out of work, and as prospects do not seem brighter for the future, the winter will be a hard one for them.

TIMBER TRADE.—Messrs. Farnworth & Jardine report that the timber imports have been large, and prices difficult to maintain. There is no change in value in yellow pine timber. The consumption of red pine has been good. Oak has moved off slowly. Ash has been in fair request, and prices are steady. The import of pine deals has been too heavy, the stock is much too excessive, and there is no improvement in values. Birch is firmer. Stocks of pitch pine have accumulated, and are too heavy, prices are declining, and the market is altogether unsatisfactory. Imports of furniture woods have been on a moderate scale. The recent sales were well attended, when most of the wood offered was disposed of, though, in some cases, at declining prices, and stocks are generally of moderate compass.

STEEL AND IRON TRADES.—In Sheffield there is no alteration in the prices of hematites, forge-iron, and Bessemer material. Railway material is not inquired for. There is but little work at the rolling mills, tilts, and forges. At the armourplate works in the neighbourhood of Brightside, 1,000 men are out of employment, and hundreds more are working short time. The same condition of things prevails in other manufactories—notably the cutlery and file trades.

SILVER TRADE.—The Sheffield silver trade is the one exception to the rule of general slackness, but in this trade the customary Christmas orders have not come in so freely as last year, and manufacturers and workmen are looking forward to the new year for a change for the better.

JEWELLERY TRADE.—In London this is duller now than most of the present generation of workmen can remember it to have been. The year soon ends, and with the new one trade may be expected to improve, if there is any truth in the reports of the royal marriage we hear of

SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

**** In consequence of the great pressure upon the "Shop" columns of WORK, contributors are requested to be brief and concise in all future questions and replies.*

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of WORK in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given.

I.—LETTERS FROM CORRESPONDENTS.

International Manufactures. — B. A. B. (*London, N.W.*) writes:—"As, no doubt, many of your readers are not well posted up in economics, and as every light upon the subject is of value, I, for one, am glad of your paragraphs on the middle page. But I must confess that I cannot understand your note in No. 183, headed as above, and I hope you will be able to give more light, and I believe in enlightening me you will do the same for thousands. To aid in the clearing away of the difficulty, I will state what I believe we both admit, and then ask a question or two. (1) It is best for each nation to export whatever it can produce advantageously, compared to the nation which receives the goods. (2) The converse holds good: It is best to import whatever we can buy of the foreigners better and cheaper than we could produce it ourselves. (3) If shippers are to transport goods cheaply, they must have a cargo both ways, in and out. (4) It is better that trade should be mutual. (5) In cases where the material is abundant abroad, but not here, it can be, and often is, the case that the finished article is brought here instead of the raw material. We believe that to be judicious. But now, I fear, we part company, except that we all agree that 'the sooner it is understood the better it will be for this country,' etc., to the end of the paragraph. Now the questions: (1) Do we buy and sell, or do we barter?—that is, do we put a value, expressed in money, on what we sell, and does the foreigner too? (2) If we barter, does your illustration hold good *unless* the same merchant wants to barter toys for textiles? (3) If the toys are sold here for less money than they cost the foreigner, someone must lose—who is he? (4) If the foreign buyer of textiles is a gainer by the toy-maker's loss (if the toy-maker does lose), does he recompense him? (5) If the textile seller gains, does he bear the loss on the toys? (6) If neither buyer nor seller gains or loses, because the goods are bartered each for each, how does it affect the English toy-maker in the case described? (7) How is it that we import and export goods of very nearly the same class of each to the same countries? (8) And is it due to protection, or lack of competition, or what other reason, that both the native and imported goods are dearer abroad? We are not surprised at English goods being dear in Germany, but some of us *are* surprised at German goods being dear in Germany, but cheap here. If all these questions are outside the scope of WORK, please refer us all to some book or source of information. At present, in WORK, economics are supplied just enough to whet our appetites."

Wood Tests.—A. R. (*Scorrier*) writes:—"The following are recent tests with the four kinds of woods mentioned, which may be useful to many readers of WORK":

	Weight per cubic foot.	Specific Gravity.	Transverse Strength per square inch.	Dimensions of each Piece.	Weight the Piece broke with.	Direct Cohesion on square inch.	No. of Years assigned for Shipbuilding.
	lb.			in.	lb. per sq. in.	lb. pr. sq. in.	Yrs
Indian Teak	49·47	807	2,203	2 × 2 × 30	13,207	3,301	14
English Oak	58	886	2,117	2 × 2 × 30	30,287	7,671	9
Jarrah ..	63·12	1000	1,800	2 × 2 × 30	11,760	2,740	12
Karri ..	61·31	981	2,284	2 × 2 × 30	28,280	7,070	12

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Manchester Dynamo.—WIRE.—A Manchester dynamo can be run as a motor, but is not such an efficient electro-motor as a machine specially designed and wound for the purpose. I do not see what good purpose can be obtained by using a Manchester dynamo to charge a set of accumulators, and then use the current from these to work the same dynamo as a motor.—G. E. B.

Trimming Dynamo Brushes.—JUMBO.—No secret. Simply cut the ragged ends off with a pair of shears, leaving the copper gauge or foil straight. Readjust the brushes to give the freshly-cut ends the same lead as at first.—G. E. B.

Hand Cycle.—W. J. H. (*Birmingham*).—About the best hand tricycle is the Velociman, made by Singer & Co., Coventry. Write them.—A. S. P.

Safety Tires.—A. J. S. (*Watford*) has not been reading up the papers on Cycle Making and the numerous replies to correspondents in "Shop," or he would have found all he now inquires for. As to tires, he does not say what kind: whether solid, cushion, or pneumatic. He will get best tires by paying the best price from any respectable cycle dealer, also good cement for putting them on. To re-enamel, scrape every part of the machine, and rub with emery-cloth. Get Guest's or Club black enamel of any cycle dealer; coat the work copiously with a flat brush. When dry, rub over with a piece of cloth with finest emery-flour; then apply another coat of enamel. For a better job, get it stove-enamelled by a practical enameller.—A. S. P.

Tiles for Hearth.—A NEW SUBSCRIBER.—Mark the face of the tile where it is to be cut, then lay it on the edge of a flag or hard stone, and bruise along the line with a small chisel and hammer, backwards and forwards, a few times, when, if it does not part, a tap on the back will part it. The tile should be held in an angular position, and the chisel carefully used; or the tile may be embedded on dry sand on a stone slab, and bruised with the chisel. After a little experience they can be readily cut; the rough edges may be rubbed on a stone.—M.

Rosette Papers.—D. J. E. (*Brynmawr*).—The most likely firm to supply you with the material you require is Bemrose & Sons, of 23, Old Bailey, London. They make a speciality of rosette papers cut mathematically correct to nine different sizes (extra sizes to order), in gold and silver, white, ivory (light buff), violet, light brown (to imitate leather), ebony, red, orange, primrose, cedar, dark blue, light blue, green, and lavender. In gold and silver the packets are 1s., and other colours 6d. You would probably find Mr. W. Bemrose's book on "Paper Rosette Work and How to Make It," interesting to you. It is plainly illustrated and described by thirty-six lithographic designs for various useful and ornamental objects. Following out the information, pretty effects may be obtained in home decoration.—F. G.

Hot-air Engine.—J. S. (*Preston*).—The makers of the Robinson hot-air engine are Messrs. Norris & Henty, Abchurch Yard, London, E.C.—Q.

Oil.—W. A. S. (*Birmingham*).—If you used any kind of oil with it, your blacking would not give a polish, the only object there is for using blacking. I think you will find the following suitable for the purpose you name. Put ten parts of beer, and one each of vinegar and sugar, into a bottle, and add it to the blacking as it needs it, well shaking the admixture first.—W. G.

Sewing Machines.—PERSEVERE.—I may state that there are no other books published on sewing machines alone but those of the manufacturers—viz., books of instruction on their own speciality. Let him write to the makers of the machines he is attending, and they will be glad to forward him the books of instruction free. As PERSEVERE is a fitter, he will have some knowledge of mechanical motion. He can greatly supplement that knowledge by reading "Mechanical Movements," by Thomas Walker Barber, Engineer, published by E. & F. N. Spon, 125, Strand, London, at 7s. 6d.; also "Practical Mechanics," by Prof. Perry, M.E., at 3s.6d., published by Messrs. Cassell & Co., Ludgate Hill. He must also pay marked attention to the arrangement of cranks, cams, and levers, the value of their relation to each other as arranged in his machines; by such attention there is nothing to prevent him from becoming an expert in the speciality. Being a good mechanic, with the use of tools at his hand, as well as some knowledge of mechanics, he will soon overcome any practical difficulty. With regard to slip-stitching, this is caused by the needle being either too high or too low; it may also be caused by the tension not being properly adjusted to suit the thickness of the material that is being sewn. The screw in front of the machine (if a Singer) is the one he must adjust. In adjusting the needle he must first place the gauge mark level with the top of the slide; the eye of the needle must be then level with the needle-plate. Try another method to prevent slip-stitching by not threading the shuttle through so many holes. If the point of the shuttle has become blunted, sharpen on a piece of Turkey stone, as a blunt shuttle is also likely to cause slip-stitching.—T. R. B.

Wiring and Knocking up.—T. D. (*Cambridge*).—It is rather a difficult job for an experienced workman to wire with such a large size as ¾ in. rod such a small circle as 24 in. diameter. I do not see the need for such a size to be used; ⅝ in. would be ample. I can tell you that, unless your articles are made of the best charcoal plate, they will not stand the flanging back, but will split. However, I will try to help you all I can. The tools you will want are a large bick iron, a pair of compasses, and a mallet, and if you have a "jenny," so much the better. Proceed by setting the compasses to twice the size of the rod you desire to use. Make a mark with them round the inside of the pan that is to be wired; this is for a guide mark in throwing off the flange. Now hold the pan on the bick iron so that the line is level with the edge of the tool; then go round it with the mallet, striking lightly, and not knocking the edge back too far. Do this very carefully, so as to get your edge or flange even all round. Shape up a bit after once round, and then repeat the operation, striking more on the outside of the edge in order to stretch it a little. When you have got the edge as far back as you can in this way, take the bick iron out and replace it with the pointed end in the hole of the bench. You will find that the other end is (or it should be) bevelled off;

this will allow of your bending the edge over the remaining distance required; do not make it too sharp in the angle, or you will have a difficulty in getting the wire close up. You will also find that the preceding operations have thrown the article much out of shape; but this does not matter, as it will come right again in the wiring, or near enough, so that it can easily be shaped afterwards. Cut off the rod to the required length, form it into a circle, lay it round the article, and cut off any overplus. Press well up, and give drawing blows with the mallet, using as large a tool as you have to wire on. When you have got all round roughly, go round again, putting the blows closer together. Then, to finish off, run it through the jenny, or, if you have not one, you must rest it on the square edge of a tool, and go round the top with a mallet, or turn it the other way up and "tuck" it with the paning hammer. Throw off the edge for the bottom in the same way, only it will not need to be more than $\frac{3}{16}$ in. in width. Cut the bottom $\frac{1}{16}$ in. larger all round than the edge, turn it up on a half-moon stake or on the flat end of the bick iron, as previously mentioned, slip it on, tap round with a small hammer, and then pane down. Next, slightly turn the bottom by running round it with a mallet on the hatchet stake, and finish knocking up on side stake or similar tool. See my lessons on Sheet Metal Work in Vols. I., II., and subsequent numbers of the publication.—R. A.

Glass Partition.—METRONNE.—My advice is to give up all idea of ferns, and substitute one of the patent "Glacial Decorations," or imitations of stained glass; these can be got in an endless variety of designs at all prices. Write or call on Perry & Co., Holborn Viaduct, London. Articles have appeared on Glass and Picture-frame Gilding on pp. 333, 364, 542, 603, 605, 637, 782, 795 of Vol. I.; also on pp. 245, 261, 357, 602, 634, 649, 686, 701, 708, 750 of Vol. II.; and on pp. 262, 350, 398, 412, 443, 604, 668, etc., of Vol. III. I should strongly advise you to take WORK in every week. You would find it a splendid reference on all matters; and likewise recommend it to your friends.—E. D.

Watch and Clock Cleaning and Repairing.—J. B. (*Norden*).—I am pleased to hear you find these papers helpful. Pivoting, etc., will be dealt with in due course, also lever and verge watches. All ordinary repairs will receive attention as far as space allows. With regard to the advertisement to which you refer, I can only say that it has nothing to do with the writer of the papers on Watchwork now appearing, and in its wording is, in this respect, calculated to mislead readers. As stated before, Messrs. Hunt & Son, of Ironmonger Street, St. Luke's, London, or Messrs. Grimshaw & Baxter, Goswell Road, London, can supply any tools or watch parts; and the former firm can, I know, practically assist any who get into trouble with watchwork.—F. J. G.

Spring Mattress.—T. T. B. (*No Address*).—When the wood tray is ready for the springs, arrange them equally, and fix with three wire staples to each spring; lace the tops of springs with lay cord, or bring a web across each row both ways, and sew with twine in order to keep springs from touching each other. Tack a strong canvas over the springs, and sew a 9 in. strip of canvas all round about 6 in. from the edge; stuff and tack this to form a firm, yet soft, edge to the mattress, putting in a row of stitches to keep up the edge. Then arrange rest of stuffing, cover, and taft as usual. Do the preliminary work well.—B. A. B.

Wooden House.—F. H. K. (*Brighton*).—You must contrive to get a current of fresh air passing through the house, especially when the fire is lighted—say, an inlet at the back or under the stove, and an outlet at the highest point of your roof, the inlet and outlet so arranged, with relationship to each other, that the whole area of the house is supplied with fresh *warm* air. What you want, as far as I can at present judge, is ventilation, and without it you are bound to suffer as you describe.—E. D.

Crafts Exhibitions.—READER FROM No. 1.—If you address a stamped letter to the secretary of the particular exhibition in which you are interested, no doubt the Agricultural Hall authorities will send it on.

Making Dynamo.—LAURÆRNEST.—Full instructions for making dynamos were given in Nos. 92, 94, and 99 of WORK (see pp. 642, 677, and 756 of Vol. II.). Dimensions of dynamos suitable to your requirements were given on p. 758, Vol. II. You do not give the candle-power of your lamps. If they are 10's, four will equal 40 and six equal 60 c.-p. Perhaps a 50 c.-p. dynamo will light these. This will take a ½ h.-p. motor to drive it. If the lamps are of 16 c.-p., you will require a 100 c.-p. dynamo, and this will take a ½ h.-p. motor, such as a small gas or steam engine, to furnish enough power.—G. E. B.

Copper Bronzing.—BRONZES.—Brass may be bronzed by dipping in weak nitric acid in contact with scrap iron. The article must then be rinsed, dried in hot sawdust, and varnished or lacquered. Green bronzes are obtained by dipping the articles in vinegar, and allowing this to dry on them. Repeat several times until coated with verdigris. Blue effects may be obtained by touching parts with a rag moistened with ammonia. When dry, brush with a soft brush soiled by rubbing against beeswax. The whole range of bronzes have been described in WORK, Vol. I., pp. 220, 637, 643; Vol. II., pp. 324, 390; and Vol. III., p. 602.—G. E. B

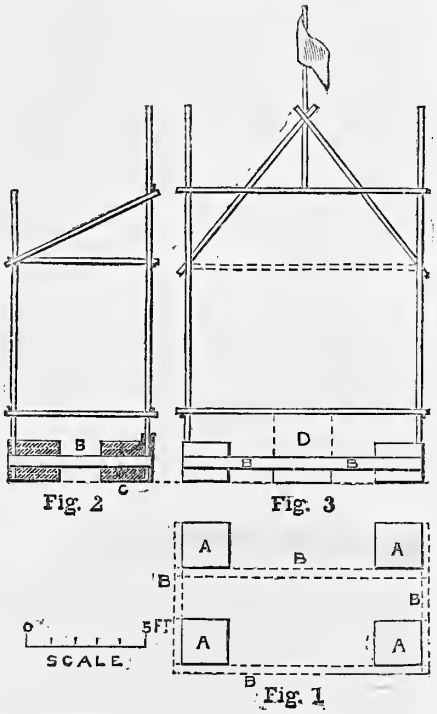
Lincrusta.—W. H. S. (*No Address*).—As this is a patented substance, it is extremely unlikely that anyone will give information as to its composition.

Photographer's Retouching Medium.—TIRO HUDD.—Take 2 drachms of gum dammar, and dissolve in 6 drachms of benzole; then add 3 drachms of turpentine, or sufficient to make it a workable consistency, or Canada balsam thinned with turpentine.—D.

Window Sashes.—C. C. (*N.B.*).—Write to Mr. Hough, of 135, Great Suffolk Street, Southwark, London, S.E., who will, I have no doubt, supply you with full particulars; but if you were to write a little more plainly you would stand a better chance of getting a fuller reply. There is a certain style about your writing that wants a lot of study.—E. D.

How to Make a Wood Lathe.—AMATEUR.—I can only find something on p. 621 of Vol. I. But then my Vol. III. is at the binder's.—F. A. M.

Design for Bazaar Stall.—ECONOMY.—Possibly the accompanying design will meet your economical views; it need cost but 2s. or 3s., and your own taste and that of your lady friends may make it as artistic as you please. Get four tinned-beef boxes (A, A, A, A, ground plan, Fig. 1). The lot may cost you 1s. 4d. at the provision shop. Fix them in position by nailing to stout pieces of scantling, as at B in the figures. The rear piece is placed inside the boxes, that it may not interfere with the feet of the stall-keeper. Fix uprights in outer angles of boxes, and wedge them tightly in with bricks, as at C, Fig. 2. Affix cross-pieces as shown, *lashing*, not nailing, them to the uprights, that the wood may not be damaged. The platform for display of goods will be of boards laid on cross-pieces, and a barrel set beneath, as at D, Fig. 3, will give the additional support it may need. The diagrams show construction to scale; and, except the four bottom pieces, which are nailed, the rest of the wood can be borrowed, as it will be none the worse. The framework thus made, you can drape and dress with evergreens to your taste. The drapery used you will, of course, dispose of at close of the bazaar by auction or some other of the methods usual on such occasions.—S. W.



Bazaar Stall. Fig. 1.—Ground Plan. Fig. 2.—Brick Fixing for Uprights. Fig. 3.—Platform.

Safety Bicycle.—C. W. L. (*North Tawton*).—The numbers of WORK in which the "Construction of the Safety Bicycle" appeared (Nos. 107, 111, 115, 119, 124, 127, 132, 137, and 142) are still in print, and can be obtained from Messrs. Cassell & Co., or any bookseller.

Bookcase.—F. H. R. (*Queen's Park, W.*).—Articles appeared in WORK, Nos. 36, 44, 48, 52, 75, 85, and 127.

WORK.—Writing-desk.—H. C. (*Clapham Junction*).—The price of WORK, Nos. 31 and 38, including postage, would be 3d.; No. 41 is out of print. Instructions for making writing-desks have already appeared in WORK. Purchase Nos. 61, 66, and 145.

Tuning Dulcimer.—P. J. (*Perranwell, R.S.O.*).—In the harmonium you have the best possible guide to tuning the dulcimer. The scale of all dulcimers, no matter what size, is that of G—that is to say, the lowest note is called G, although the actual pitch may be D, E, F, or any other note. If you therefore tune the lowest steel note to and the lowest brass note an octave lower, the actual notes of the whole scale will be as follows:

Brass:	1	2	3	4	5	6	7	8	9	10
	F	G	A	B♭	C	D	E	E♭	F♯	G♯
	Right of Bridges.									
Steel:	1	2	3	4	5	6	7	8	9	10
	F	G	A	B♭	B♮	C♯	D♯	F♯	G♯	B♯
	Left of Bridges.									
	1	2	3	4	5	6	7	8	9	10
	C	D	E	F	G	A	B♭	C	D	E

The additional two notes you name are really of very little value, although there is really no limit as to size of instrument or number of notes. Thirty, however, is, to all intents and purposes, sufficient.—R. F.

Bell Fitting.—CYMRU.—(1) "Practical Electric Bell Fitting," by F. C. Allsopp, 165, Queen Victoria Street, E.C., post free, 3s. 6d. (2) "Gas Fitting," by John Black, published by Crosby Lockwood & Co., price 3s.—T. W.

Coil.—S. S. (*Blackburn*).—If you are a constant reader of WORK, and have kept your back numbers, you will find, all through Vols. II. and III., many useful hints in "Shop" upon making coils; but should you be only a casual reader, let me advise you to obtain, through your newsagent or direct from Messrs. Cassell & Co., Vol. IV., Nos. 160, 164, 166, 170, and 178. In these numbers you will find a good and explicit series of articles by Mr. G. E. Bonney upon making induction coils of various sizes.—J. B.

Steam Return.—P. R. (*Alloa*).—Inquiries for the address of the inventor have been made from engineers in Glasgow and elsewhere, but so far without success. As soon as it is obtained it will be given in this column.—M.

Wheelmefna.—H. V. T. (*Harrogate*).—Any optician will supply this; price, from 7s. 6d. If you have any difficulty, write to W. F. Stanley, Great Turnstile, London, W.C.—A. B.

Steam Engine.—J. G. S. (*South Shields*).—The piston thickness and clearance you show will suit. The steam passages and ports should be about ⅝ in. by ¼ in. in the clear, and the exhaust port ⅝ in. by ½ in. If you work to your sketch you will not be far out. The diameter of piston and connecting-rods should be $\frac{3}{16}$ in.; slide-rod, $\frac{3}{32}$ in. to ⅛ in.; crank-pin, $\frac{3}{16}$ in.; shaft, ⅜ in.; cross-head pin, ⅛ in.; and eccentric-rod pin, $\frac{3}{32}$ in.—F. C.

Forge Fan.—C. H. S. (*Midsomer Norton*).—To make the fan, fasten four blades, preferably curved backward from the direction of the twin, on a spindle, which is fitted with a small driving pulley and mounted in bearings fixed to the side of the casing. The casing, to which the fan should fit closely, but without touching, is made with openings at central parts of the sides to let the air in, and an outlet running off at a tangent from some part of its circumference. The required speed is obtained by connecting the small driving pulley, by a strap, with a larger pulley on a shaft turned by hand or power. The fan-spindle bearings may be supported by bars extending across the central side openings in the case.—F. C.

Patenting Invention.—C. W. H. (*Wandsworth, S.W.*).—Before anything can be done in the way of creating a property in the invention, it is necessary first to ascertain whether it is of a kind to be registered as a design, or whether it is a subject requiring to be patented as an invention or an improvement. When this has been decided, the next thing to be done is to find out whether it has been registered or patented before, or such a modification of it as would be held to cover it by anticipation. Unless it is novel, useful, and not before known or described as an invention, any patent obtained for it would be held invalid; and the same would be the result if it were an improvement on any existing invention for the purpose. Registration is confined to the shape or configuration of the article registered, whilst a patent covers the object of the invention and the mode of carrying it into effect, as well as modifications of the mode. We should advise C. W. H. to spend a little time at the Patent Office Library (open free daily), where he can examine all the specifications of completed patents which relate to his invention, and where he will meet with every attention and assistance from a skilled and obliging librarian and duly qualified assistants. He thus will be able to find out whether his invention has been anticipated, and, perhaps, be able to decide whether it should be registered or patented.—C. E.

Inventions.—GASPIPE.—This matter is already before us for attention. Watch for announcement in WORK.

Rearer.—HARRY.—You will find full instructions for making rearers and other chicken-rearing appliances in WORK, No. 150, Vol. III. Pleased to hear of your success with incubator.—LEGHORN.

Incubator, Fittings for.—G. M. (*Sunderland*).—Thermometers and other fittings can, as before stated several times in these columns, be obtained from Mr. Stevens, 7, Selhurst Road, South Norwood, London, S.E.—LEGHORN.

Bent Iron Work.—W. J. R. (*Northampton*).—Whiteley, the universal provider, Westbourne Grove, London, will supply you with all materials. Designs for flower vases and lamps have already been given in the present volume containing these papers.

Bent Iron.—BENT IRON.—For materials, try Whiteley, Westbourne Grove, W.

"Escape from Fire."—J. L. W. (*London, W.*).—The competition—a very large one—will be adjudicated upon very shortly.—ED.

Model Engine Making.—REGULAR READER.—Try Pocock's work, obtainable through any bookseller.

Cylinder Plug.—NO NAME (*Liverpool*).—To put a new pivot in a cylinder, knock out the plug with a specially-shaped punch, and fit a fresh one. Upon this turn the new pivot. There is no necessity to take both plugs out to put in one new one. If a cylinder has to be put in the turns, always fill it with shellac. To get this off, place cylinder in a spoon with spirit, and boil over a lamp flame. Only send the 'scape wheel to the material shop, and if it is specially short or long, mention the fact.—F. J. G.

Finger Stains on Oak.—W. B. (*Penzance*).—If the finger stains are from ordinary handling, a very slight rub of fine glass-paper will remove them, or, perhaps, a little linseed oil will do so if the work will allow of oiling; but if W. B. has been sharpening tools, and some of the stained oil from the oilstone—consisting of steel and stone in a fine state of division—has been transferred from his fingers to the work, then scraping and glass-papering is necessary to remove such stains. Always sharpen tools first, and always leave the use of glass-paper until the use of planes, scrapers, etc., has been completely accomplished; then glass-paper will remove stains, if any.—B. A. B.

Manufacturers' Addresses.—FISH GRIMSBY.—You require (1) the address of a manufacturer of papier-mâché.—Try McCallum & Hodson, Summer Row, Birmingham. (2) That of a manufacturer of brass wire of all sizes.—Elliott's Metal Co., Selly Oak, Birmingham. (3) That of a manufacturer of small brass castings.—Go to James Cartland & Son, cabinet builders' and naval brass founders, 64-72, Constitution Hill, Birmingham. (4) That of a firm which works wood with bevelled or beaded edges.—You appear to want what are known as "steam-struck mouldings." Apply to Joseph Sandell & Co., Waterloo Bridge Road, Lambeth, London, S.E., who will supply you with a book showing sections of their mouldings, etc., with prices.—S. W.

Threefold Screen for Scraps.—J. D. McA. (*Manchester*).—If you have not the back numbers of WORK from the beginning, get them, and you will find, scattered throughout them, replies and useful information on almost every question that can arise with regard to such screens. It would be impossible for me to give references to all the places at which information on the subject is to be found, but I may mention pp. 600 and 618, Vol. II. (Nos. 89 and 90). The first has useful hints as to covering and decorating, the second as to the construction of the framework.—M. M.

Flooring Cement and Cost for Cellar.—J.T.J. (*Manchester*).—You say your cellar floor is damp. Does the damp rise from the soil under the floor, or does it come from the ground around the arch or walls of the cellar, which is sometimes the case? If so, the ground must be moved from outside, and concrete filled in, quite 12 in. thick, all over outside walls of cellar; or, if that cannot be done on account of neighbours' property, parish roads, or pathways, the inside may be cemented all over. This costs 15s. per square yard, builders' price. But you must not regard price against health and life, which have plenty of perils that are not so easily counteracted as the air poison of a damp cellar. If the walls are damp-proof, and the fault is due to damp under the bricks of floor—which are, doubtless, saturated with damp air, which may also be foul—take up bricks, and, if the soil is foul, take out 6 in. deep. Break up the bricks into ballast size of walnuts, and lay in and ram hard with mortar not too liquid, only pasty. Now mix to every yard of coarse sand two bushels of grey lime and one bushel of Portland cement to a pasty mass, and lay on by throwing on a shovelful at a time—for, remember, the sand is heavier than the other ingredients, and is apt to settle lowest; you want it fairly distributed all through. Cost depends on prices paid for materials. The builders charge 8s. 6d. a square yard for 6 in. thickness. The mixture of coal ashes, lime, and a little clay is admirable for an outhouse or barn, but a cellar is quite differently aired, lighted, and used. In explanation: Breeze (you mention) is partly burned fine coal from furnaces, and was formerly thrown away, but smiths found it a valuable aid to their work—as in spring making and tempering, it having an equable heat when lighted, and no jets of flame to injure delicate work—so it is in demand from its merits and low price. The paths about furnaces are made of it, and its binding qualities suggested its uses to builders for helping to make cheap floors, as was described in WORK. A barn midsty, or "draw-through" for waggons, has sun and wind always on the floor when the doors are open. The grain is not rough wearing, the barn-shovels are of wood, so that such a floor is admirable. The farmer, wiser than our City road-makers, would not use asphalte or smooth concrete or cement, as his horses would slip on it in hauling in waggons or carts or coming out of the "mow" after treading the barley or oats in the straw down hard—for horses are thus used—till they reach the roof or tie-beams, and then are slid down a gully in the barley- or oat-straw on to the midsty floor. This little bit of rustic lore is as a fillip to set town folks thinking, especially those who work in damp, unhealthy cellars, as mentioned by J. T. J., where farmers would not stall their cattle. The Editor has my address, if further information be needed.—PROFESSIONAL CONCRETER.

III.—QUESTIONS SUBMITTED TO READERS.

**** The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Hand Cleaners.—J. H. B. (*Pendleton*) writes:—"Will some reader of WORK kindly tell me what he uses to keep his hands clean after getting them dirty? I have tried many soaps—Brooke's, pumice-stone, sand, borax, etc.—with plenty of elbow-grease and nail-brush, but none are entirely satisfactory. I have contemplated a solution of caustic soda, but, before taking such extreme measures, should like to try something less severe."

Monogram.—L. F. (*No Address*) writes:—"Will any reader oblige me with a fancy monogram for the letters 'F. A. L.,' suitable for inlaid work?"—[The price of WORK cases for binding is 1s. 3d. Indexes cost 1d. each.]

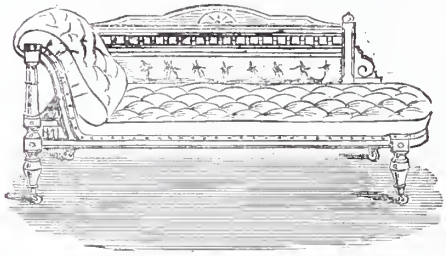
Wood Worms.—W. J. M. (*Dundalk*) writes:—"Can any reader of WORK inform me how to kill worms in mahogany bookcase, and to preserve wood from further decay?"

Reeds.—R. W. T. (*Newcastle-on-Tyne*) writes:—"I have one and a half octave of pedals, which I once had on a harmonium, with sticks and trackers, and as I hope shortly to buy an American organ, I would like to add these pedals, if an amateur could make reeds (wood); and I am handy at the tools. I would be glad of particulars how to make reeds, say, from C C 8 ft., bow to box and arrange beneath pedals, and to conduct wind from chest. If I am asking too much in these particulars, I would be obliged if someone could refer me to a number in WORK or any periodical where I could find the principles laid down."

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Corn Bushels.—H. C. (*Abbey Cottage, Dorchester, Wallingford*) writes:—"I notice, in No. 187, p. 494, of WORK, IRONWORK is wanting handles, etc., for corn bushels. I should be glad to make them for him cheaply and well, if he will communicate with me."

Couch.—M. (*Bishop Auckland*) writes to C. R. (*Nottingham*) (see No. 182, p. 414):—"I send sketch of couch with spindle back. The full length may be



Spindle Back Couch.

6 ft. to 6 ft. 6 in.; width from back to front, 2 ft. 2 in.; height to top of cushion, 1 ft. 4 in.; legs, 2½ in. square; spindles, ¾ in. diameter."

Hollow Grinding.—F. PIGALL, 4, *Rupert Street, London, W.*, writes, in answer to A. E. B. (*Ashford*) (see No. 189, p. 526):—"We do all our hollow grinding on the premises, and we rarely keep razors more than a day. A corkscrew was made in papier-mâché 3 ft. high, from instructions in the second or third number of WORK, and hung outside my shop as a sign. I had often tried to make the worm or screw part, but was unable to until I saw your paper."

Elementary Carpentry.—C. W. W. (*Southsea*) writes, in reply to WOODSPOILER (see WORK, No. 188, p. 510):—"I beg to recommend him, with every confidence, a little book entitled, 'Handicraft for Handy People' (seventy-five illustrations), by An Amateur Mechanic. Published by M. H. Gill & Son, Dublin; Simpkin, Marshall & Co., London; and John Menzies, Edinburgh. The book was given to me by a friend in Ireland. It is 1s. to national schools; I do not know the price to an ordinary purchaser."

Phonograph.—A. J. R. (*Byfleet*).—Mr. H. Durose, 6, Ruth Street, Leeds, writes to say that he can supply shafts and needles for the above at reasonable cost.

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—IGNORAMUS; COLZA; E. H. (*Wandsworth*); S. M. C. (*Newcastle-on-Tyne*); T. A. W. (*Kilburn*); R. J. (*Gnytherin*); LINOLEUM; P. E. S. (*Worcestershire*); DOUBTFUL; G. D. (*Holloway*); BRACKET; STICKFAST; H. B. P. (*Southport*); ALBATROSS; J. W. T. (*New York*); T. G. (*Exeter*); A. J. P. (*Manchester*); F. H. H. (*Galway*); S. H. B. (*Birmingham*); P. B. (*Banff*); J. W. & SON (*Ormskirk*); W. H. K. (*Birmingham*); S. B. (*Bradford*); ARTISAN; ART STUDENT; E. M. (*Leicester*); OLD ENGLAND; S. S. (*London, S.W.*); M. MOM. (*Glasgow*); HOT-PLATE; P. L. (*Selly Oak*); J. E. P. (*Birmingham*); A SCULPTOR; T. W. (*Salford*); F. M. (*Carlisle*); R. & W. (*London, E.C.*); J. M. (*London*); T. C. (*Durham*); CONSTANT SUB-SCRIBER; J. P. (*Leamington*); G. L., JUNR. (*S. Hackney*); J. B. (*Birkenhead*); W. J. (*Wolverhampton*); A. W. (*Barking*); TINSMITH; O. H. S. (*Coldstream*); AMATEUR; THOS.; HAMLET; G. C. P. (*Cambridge Heath*); A. J. E. (*Mullingar*); MRS. S. S. (*Boston*); H. G. (*Stratford-on-Avon*); W. J. R. S. (*London*).

"WORK" PRIZE SCHEME.

FIFTH COMPETITION.

"Domestic, Commercial, or Scientific Application of Electricity" Competition.

CONTINUING our scheme of Prize Competitions of a useful and practical nature, we propose to devote the present one to the subject of Electricity, in which our readers and the world at large take so keen an interest. We invite competition for the following prizes—

First Prize, £3;
Second Prize, £2;
Third Prize, £1;

for the three best suggestions of an original and practical nature, involving the application of electricity to some domestic, commercial, or scientific use. This application may be on a large or small scale, to take effect on land, sea, or in air—the main conditions being the newness and practical possibilities of the suggestion.

All manuscripts intended for the "Electricity Suggestion" Competition must be addressed to the Editor of WORK, c/o Cassell & Co., Ld., Ludgate Hill, London, E.C. They must reach him on or before Saturday, December 17th, endorsed, "Electricity Suggestion" Competition.

*** For conditions and rules see previous numbers.

Subscribers who can exhibit a WORK *Weekly Contents Bill can have one sent on forwarding name and address to the Publishers.*

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Victor Supply Co., Grimsby, sell Mail-cart Wheels and Parts. [7 R

The Capitaine Oil Engine.—Economic, reliable, safe; for all driving purposes.—LEOP TOLCH, 38, Byrom Street, Liverpool. [9 R

Lettering and Sign-Writing made Easy.—Also full-size diagrams for marking out eight alphabets, only 1s.—F. COULTHARD, Darlington Street, Bath. Note.—100 Decorators' Stencils (60 large sheets), 2s. 6d. Complete stock-in-trade.

100 Fretwork Designs (new), 100 Carving, 100 Repoussé, 30 Fret Brackets, 35 Photo Frames, 100 Sign-writers' Stencils (all full size), 300 Turning, 400 Small Stencils. Each packet, 1s.; post free. All fretwork requisites, machines, wood, etc. Catalogue, with 600 Illustrations, 3d.—F. COULTHARD, Darlington Street, Bath. [3 S

Caplatzi's Scientific Hire and Exchange Stores.—Established 1860. The largest and cheapest for amateurs and professionals. Goods warranted. Advice free.

Catalogues—General, Electrical, Telescope, Microscope, Spectroscope, Photographic, Lantern, Chemical, Lathe, Model Machinery, Miscellaneous, 2d. each.—CAPLATZI, Chenies Street, Bedford Square. [8 R

Fretwork.—New set original designs, entirely unlike any other. Post free, 2s. 8d.—KNIGHT'S Library, Ventnor.

Water Motors from 5s. each. ½ h.p., price 20s. List, stamp.—WALTON, 9, Queen Anne Street, Stoke-on-Trent.

Picture Moulds.—15 to 25 per cent. saved. Send for wholesale list, one stamp.—DENT'S, Importers, Tamworth. [4 R

Silvered Plate Glass, with or without bevel edges, any sizes.—EDWIN HAMMOND, The Pavement, Romford, Essex.

Cycle Parts.—Tubes, fitting, brazing, turning; cheap.—ROLLINGS, Stamford.

Exchange.—Tool Cabinet, amateur made, 20 drawers; space below for saws, etc. Cash, 35s.—J. G., jun., Castlerankine, Denny.

Tortoiseshell Bamboo, for tables, etc.; 1—1¼ in., 6 ft. lengths. 4s. 6d. per dozen.—BARRAN, 36, Ebberston Terrace, Leeds.

WORK.—Complete to date, plates, index, etc., unbound; also "Photography," Vols. III. and IV., unbound.—Offers to KILGOUR, 164, Lochee Road, Dundee.

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"ELECTRICITY SUGGESTION" COMPETITION.

This Coupon is to be Cut Out by Competitors and Pasted on the First Page of their MS., as mentioned in this Number of "Work."

DR. CHEYNE

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"He that would have a clear head must have a clean stomach."

HEADACHE.

When the tongue is coated, the head heavy and aching, an offensive taste in the mouth, the appetite poor, and the spirits dull, the patient should at once resort to an old and well-tried remedy.

WHELPTON'S VEGETABLE PURIFYING PILLS

search through the blood and cleanse the liver, expelling impure and harmful matter. After a few doses all unpleasant symptoms will disappear, and the patient will perceive that he is on the high road to sound health by increased strength of body, vivacity of mind, a good steady appetite, and sound refreshing sleep.

To Ladies.—These Pills are particularly suitable in removing the distressing complaints peculiar to the sex.

Many thousands of sufferers have blessed the day that brought this reliable remedy to their notice. For more than half a century Whelpton's Vegetable Purifying Pills have been known as the safest and most useful family medicine. If you are a sufferer, their virtues may be proved in your own experience at the small outlay of 7½d. A full-sized box can be obtained of any chemist at this price, or if you prefer we will send a box post paid to your own home if you will forward eight stamps.

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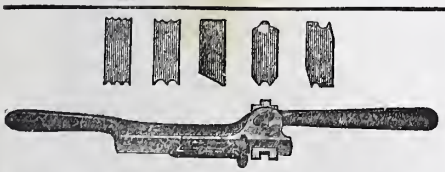

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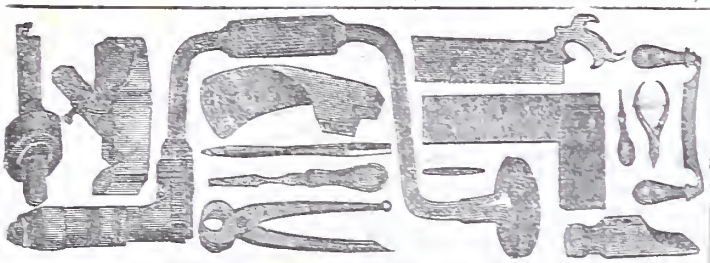

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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VOL. IV.—No. 197.] SATURDAY, DECEMBER 24, 1892. [PRICE ONE PENNY.

WORK WORLD.

A WOMAN has been enrolled as a member of the London Society of Compositors. A new departure indeed!

* *

A granite bridge to be erected at Rutherglen, Glasgow, will have three arches, the centre span being 100 feet and the side spans 90 feet each.

* *

A new telescope is being made for the Greenwich Observatory. It will be nearly 30 ft. in length. The large lens now nearly completed is 28 in. in diameter.

* *

Gauge and lamp glasses made by combining two kinds of glass are reported to stand great and sudden changes of temperature better than those made of glass homogeneous throughout.

* *

Magnolia metal has been awarded the gold medal at the Italian-American Exhibition lately held in Genoa. This is the third time this alloy has obtained the highest award in its class at various exhibitions.

* *

The largest artificial stone in the world is said to be the Bartholdi Statue of Liberty, near New York Harbour. In its formation more than 500 cartloads of sand and 20,000 barrels of cement were used.

* *

About the latest idea for using aluminium is for making tobacco-pipes. The result is a pipe much lighter than one of similar size made of briar-root. The metal bowl is lined with meerschaum, a non-conductor of heat.

* *

Experimental work in connection with the Observatory on Mont Blanc shows that the crust of snow is so thick, that an attempt to make foundations on the solid rock has been abandoned. It has been found that the snow itself forms a sufficiently firm basis on which to erect buildings.

* *

To remove a deposit of nickel when the coating does not adhere well, or if it is necessary to re-nickel the piece, plunge the article in an oxidising liquid composed of potassium bichromate, sulphuric acid, and water in the proportions used generally for batteries. Take out more or less quickly, according to the thickness of the deposit, wash, and, if necessary, repolish.

* *

The distribution of hot water on the principle of the penny-in-the-slot machines has been successfully undertaken by a company in Paris. Small edifices, resembling the familiar "kiosques," have been erected, and the automatic delivery of a couple of gallons of water heated to from 140° to 160° Fahr. is obtained by inserting a five-centime coin (a halfpenny) in a convenient slot, and pressing a button.

* *

The water supplied from these automatic machines is heated at the time it is being drawn off, and not maintained at a high temperature as might be supposed. The action of the mechanism is to turn on a powerful gas-flame, which acts on a coil of small tubing, presenting a very large heating surface. The water contained in this coiled tube is quickly heated, and by drawing off slowly even boiling point may be attained.

* *

The largest gas-holder in the world, and the first six-lift holder erected, is now in use at the East Greenwich Station of the South Metropolitan Gas Company. This holder is 300 ft. in diameter, and has a capacity of 12,000,000 cubic feet. The novelty—a striking one—is that the two upper lifts rise above the framing to a height of 60 ft. The floating vessel of the holder weighs 1,300 tons, and the outside framing 900 tons.

* *

The printed tins in which tea and other comestibles are sold undergo several processes in production. Each colour in the design is taken off a lithographic stone on to a "blanket," which is then pressed upon the tin by passing both between rollers. The tin is "stoved" after the application of each colour. When the design is completed upon the tin, it is varnished with copal, and again "stoved." The tin is, of course, printed and stoved before it is made up into the shapes required for the market.

* *

Considerable interest is centred in the shoe-making industry on the question of the manufacturers providing indoor workshops, and so relieve the workers from working at their own homes. At Northampton, Kettering, and other centres of the county, the manufacturers have under consideration the demand by the men for them to find indoor shops within three months. The men, through their unions, have, by considerable majorities, voted to press their claims for the indoor shops. Should the manufacturers consent to their demands, the building trades will be benefited, as many new shops will have to be erected.

* *

If the polished surface of an alloy is etched with dilute nitric or sulphuric acid while under the influence of a weak electric current, and then examined in reflected light, figures are seen which vary with the composition of the alloy, with the temperature of fusion, and with the nature of the mechanical properties it has undergone, but which are characteristic for any definite alloy. These images may be best studied in enlargements made by photography. As examples in bronzes and aluminium gold, the grooves take the form of filaments, while in phosphor-bronzes the figures are like fern leaves or branches of fir. It is stated that they form a reliable test whereby the nature of any alloy can be determined by the simple inspection of an etched surface; and further, that they at once show whether the alloy has been forged, stamped, or undergone any mechanical treatment.

* *

West End London shoemakers do not work like men in other trades, in their masters' workshops, but have to find their own "sittings," as they are called. These occupy a space in a large room where, perhaps, some twenty or thirty men have sittings. Each man is allotted bench space for his own seat, with sufficient room to pull out his threads at arm's length without touching his neighbour. This means about 5 ft. of frontage and 4 ft. depth. This space used to be let by a landlord at a rental of 1s. per week for each man, and has proved to be much better for the men than working at their own homes. Now the men rent a whole shop, and buy all things for it, such as stove, skiving machine, etc. These become shop property. The men pay the 1s. per week just the same; but generally at the end of the quarter, after all is paid, there is a surplus to be divided. There is something of the co-operative idea in this arrangement, and workers of London would do well to apply the principle in further directions where they stand affected.

ELECTRIC PENDULUM.

BY J. BROX.

INTRODUCTION—CLOCKWORKS—PARTS OF PENDULUM—PARTS OF CONTACT BREAKER—FIXING—ACTION OF PENDULUM—FINAL REMARKS.

Introduction.—In this article it is not proposed to go into the construction of clocks, although some hints will be given for applying an electric pendulum to clockworks in general; but a full description of a pendulum driven by electricity will be considered. The great difficulty to be overcome in designing a pendulum of this sort, is to make it automatic and self-regulating; to ask for the current only when it is required, and to cut it off at the proper moment. All these troubles are got over by this pendulum that it is proposed to put before you.

It has been found from experience that when a short pendulum is used, it is somewhat greedy, and asks for a little too much electricity. The best form is a long heavy one, such as can be well used in a grandfather's clock; some very pretty cases for which have appeared in the back numbers of WORK, which would be well suited for this purpose by those who wish to make as much of the clock complete as they can.

The drawing is all to scale, but no scale has been given, so that by choosing one to your own convenience true proportions can be kept by scaling off the design.

It will be seen that in Figs. 1 and 2 the pendulum is shown broken; this has been done to save space. The true length should be half as long again from the armature at the bottom to the hangers at the top. The construction of the pendulum and works also is of the simplest kind, being nothing more than a strip of hard wood, two thick discs of lead, with a small nut to adjust them with, and nearly all the rest of the work cut out of sheet brass. By doing this it brings the pendulum within the reach of those who are not blessed with the good things of this world, without in any way interfering with the demonstration of the system upon which it works, leaving those who wish to put more work and finish into it, to do as they please, in such matters as a delicate adjustment to the bob, hangers, etc.

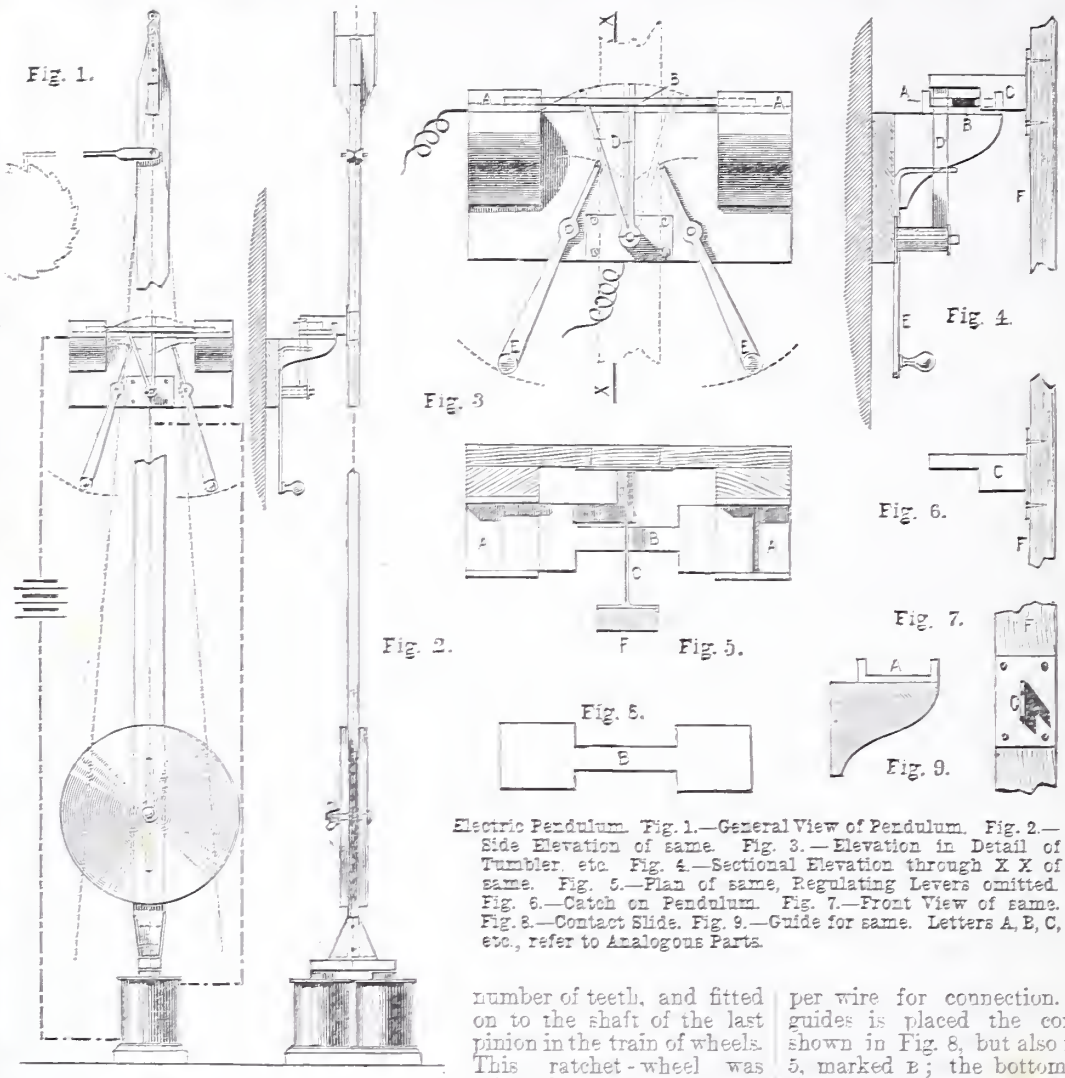
Clockworks.—It is possible to use almost any kind of old clockworks. One has been made from the inside of an old cheap round American clock in the following way:—The spring and the wheel attached to it were removed, as also were the balance-wheel and spring, etc.; then, beginning with the wheel and spindle upon which the small hand is fixed, a train of wheels was retained which would work with a pendulum of a given length, of course taking into consideration a ratchet-wheel, which was cut out of a piece of sheet brass, having the requisite number of teeth, and fitted on to the shaft of the last pinion in the train of wheels. This ratchet-wheel was driven by an arm from the pendulum, as shown in Fig. 1 by the small dotted lines in the left-hand top corner; the only other wheels in the old clock which were kept were those in connection with the long hand; the ratchet-wheel was also furnished with a back catch to prevent it slipping back by the friction of the ratchet arm on the return stroke. The whole was then placed in a suitable case, and has kept the best of time for more than a year.

Parts of Pendulum.—Before going into the action of the pendulum, it would perhaps be advisable to give a short description of the chief parts, and in doing so the simplest forms will be adhered to. As has been stated before, the pendulum shaft can be made of any kind of hard wood, etc.; the bob and hangers being left to the discretion of the reader. At the lower end of the shaft is fixed a soft iron armature, in such a way that it is square to the length, and at right angles to the line of motion of the pendulum. Directly under the armature is placed an electro-magnet; the size by proportion in Figs. 1 and 2 is shown amply large enough, as it does not require much force to keep a pendulum with a short stroke and doing light work in motion, and in working it is better to have a few mild impulses at short periods than one very strong one at longer intervals, as it makes the motion more regular and smooth.

The other part of the pendulum of importance is the catch, shown in Figs. 4, 5, 6, and 7, and marked C, which is best made of steel, in order that it may be as thin as possible. The position of this catch will be shown hereafter.

Parts of Contact Breaker.—Upon a suitable piece of hard wood, as in Figs. 3, 4, and 5, the whole of the mechanism of the contact breaker is fixed, except of course the pendulum catch, C. At each top corner of this wooden bed two little brackets of hard wood are fixed, and upon these the contact guides, A, in Figs. 3, 4, 5, and 9, are fixed. These must have their inner surfaces true, square, and level to each other; and underneath one of them must be fixed a short length of covered copper wire for connection. In these two guides is placed the contact slide, best shown in Fig. 8, but also in Figs. 3, 4, and 5, marked B; the bottom of the contact slide must be true, so that it may make perpetual contact between the two guides, although free to move backwards and forwards. The inner corners of this contact slide should be covered with two small slips of platinum, as also should be the outside of the tips of the tumbler marked D, and best seen in Fig. 3. This tumbler, as can be seen in Figs. 3, 4, and 5, is a V-shaped piece of metal, working freely on a pin, the back part of which pin is connected to a short piece of covered copper wire. E, E are two regulating levers with turned-up points, to catch the tumbler, D, seen in Figs. 3 and 4.

Fixing.—After having determined upon the length and swing of the pendulum, the small wooden bed, upon which are fixed the tumbler, slide, etc., should be placed at the back of the pendulum, at such a distance from the top of it, that the length of the



Electric Pendulum. Fig. 1.—General View of Pendulum. Fig. 2.—Side Elevation of same. Fig. 3.—Elevation in Detail of Tumbler, etc. Fig. 4.—Sectional Elevation through X X of same. Fig. 5.—Plan of same, Regulating Levers omitted. Fig. 6.—Catch on Pendulum. Fig. 7.—Front View of same. Fig. 8.—Contact Slide. Fig. 9.—Guide for same. Letters A, B, C, etc., refer to Analogous Parts.

swing at that place shall be equal to the openings of the contact slide, B, when in the exact centre between the guides, A (See dotted lines in Fig. 1.) The catch, C, should be placed on the back of the pendulum shaft at such a place, that the narrow part of the catch just touches the upright tip of the tumbler, D, and the wide part catches the outer lips of the contact slide, B, when in full swing. (See Fig. 4.)

The regulating levers, E, should be turned until the tumbler falls on both sides, so as to touch both the inner lips of the contact slide, B, and the turned-up points of the regulating levers. (See Fig. 3.)

If a ratchet arm and wheel are used to drive the clock, the arm should be placed at the top of the pendulum, where the length of swing is just longer than the pitch of the ratchet-teeth.

In Fig. 1 will be seen the manner in which the whole is connected up to the battery, by the thick dot and dash line; these connections can be made in any way that is convenient, as long as the system remains as shown.

Action of Pendulum.—In considering the action of the pendulum it will be as well to imagine it in full swing—that is, beating at the length you have designed it. You will now find that as it passes the centre the narrow part of the catch, C, touches the upright arm of the tumbler, D, and lifts it over to the other side, then the pendulum proceeding on its way, the wide part of the catch, C, comes in contact with the outer lip of the slide, B, and pushes it a little on one side, so that the tumbler falling misses the slide and rests upon the point of the regulating lever, at the same time placing the other arm of the tumbler in an upright position, and in the centre. As the pendulum returns we will imagine that it has lost some of its impulse; this time, as before in passing the centre line, the narrow part of the catch, C, touches the other arm (now upright) of the tumbler and pushes it over. The pendulum then proceeding fails now to touch the slide, B, having lost impulse, so that instead of the tumbler falling upon the point of the regulating lever, E, it falls on the inner lip of the contact slide, B. This completes the circuit, and when the pendulum returns it finds that contact has been made, and so receives fresh impulse from the magnet; but again as the pendulum passes the centre the catch again touches the upright arm of the tumbler, which breaks the contact at the moment the pendulum is in the centre and the armature over the magnet, so allowing it to go on its way. This action is repeated over and over again. Every time the pendulum fails to complete its given length of stroke, on either side, contact is made between the tumbler and the slide, and it receives more power. Every time its impulse is too great it pushes the slide out of the way, causing the tumbler to fall upon the points of the regulating levers, and thus keeps the current broken. It will be seen from this that the length of the stroke can be very delicately adjusted by means of the regulating levers; the time of each stroke, of course, is regulated in the usual way by altering the pendulum bob.

Final Remarks.—In constructing this pendulum it will be found best to keep all the mechanism, such as the tumbler, slide, etc., as small as possible—it prevents clatter. Those who have good tools at their command can make many improvements on this system, such as substituting a delicate balance-wheel with two short radial teeth or lips, instead of the V tumbler, etc. But whatever alterations are made, great care must be taken that all the contacts fall good and true; in this way the clock can be made very silent. But those who are differently situated, and are obliged to make the pendulum from scraps, etc., must not be disappointed if it makes about as much noise as one of the old-fashioned wooden American clocks.

The battery to drive the pendulum depends greatly upon circumstances—a long heavy one can be driven by any dry battery. A Fuller is at present driving rather a greedy one, with a short pendulum, and is doing its work well. One of the great advantages of this system is that the constancy of the battery in no way interferes with the regular working of the clock, as the pendulum only asks for the current when it is wanted. It is now hoped that all, even the humblest, can set themselves up with an electric clock that can be relied upon.

A PORTABLE ROADWAY FOR CARTS.

BY P. B. H.

Most readers of Work know how difficult it is for horses to draw heavily-loaded carts over soft and yielding roads, but more especially over sand; the cause being that the surface of the wheel in contact with the roadway is so small, being actually at first only a line, which gradually grows, however, into an ever-increasing surface as the wheel sinks deeper into the yielding sand. Now, if a broad-surfaced, unyielding roadway could be laid for the carts to pass over to do away with the difficulty; and if the traffic was great, and went backwards and forwards between two *fixed* points, this would be in most cases done; but when the destination of the cart varies, such a plan would be too costly. In this case it would be the best for the wheels to carry their own track or roadway themselves, if it could be arranged.

Having lately seen such a contrivance at work on the extensive and yielding sands of a northern seaside resort, I make no apology for sending sketches and account of the same, as it will be interesting as a novelty to most readers, and it may prove useful to some in the future; as, besides the novelty, it is in daily practical use, working on the sands, and only needing one horse to draw the cart when heavily loaded, where, without this arrangement, two or three horses would be required.

Fig. 1 is a side elevation of the wheel and seven slippers. Fig. 2 is an end elevation of one slipper and wheel, showing trough in which wheel runs. Fig. 3 is a perspective view of one wheel and side of cart.

From these three figures the arrangement should be perfectly clear; and as each of the seven slippers is an exact counterpart of the other, a description of one will do for all. The wheel A runs in segmental troughs, B—not quite continuous, to allow for bending round wheel—which are made of wrought-iron, ⅜ in. thick, slightly wider than the wheel at the bottom of trough; but the sides form an angle (as shown in Fig. 2). These troughs, B, are riveted to flat wrought-iron plates, C, ½ in. thick, rather longer than the trough, and considerably wider to allow for the small fixings, D, riveted at each corner. The plates, C, are strengthened also by having transverse strips of wrought-iron, E, riveted at each end, underneath plates, C. The rivet-holes are countersunk, and no rivets project out from the plates. The fixings, D, are all drilled for ½ in. pin to hold the small links, F, the diameter of which is about 1 in., and they connect each slipper to its neighbour. Each slipper is supplied with a pair of wrought-iron handles, G, to facilitate its removal, and also to act as guides to a certain degree.

Where this arrangement is used the wheels of the cart should be vertical, and not inclined, as in most general use. As I mentioned before, one horse can draw a loaded cart without any extraordinary exertion over the yielding surface of sand; and on examination, the slipper, with the exception of each end, which sinks in about ⅜ in., makes very little impression on the soft road-bed. I may here state that this is not a very noiseless contrivance, but it is not very irritating; and the noise can be borne on account of the tractive power gained by its use. Since writing this article I have been informed that such a contrivance is used on the wheels of some of our numerous lifeboat carriages.

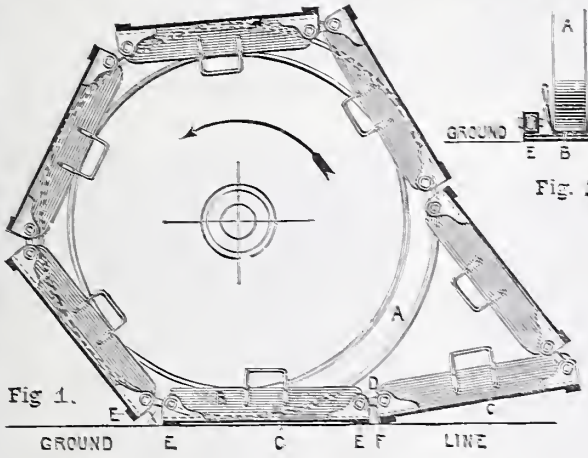


Fig 1.

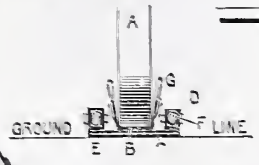


Fig. 2.

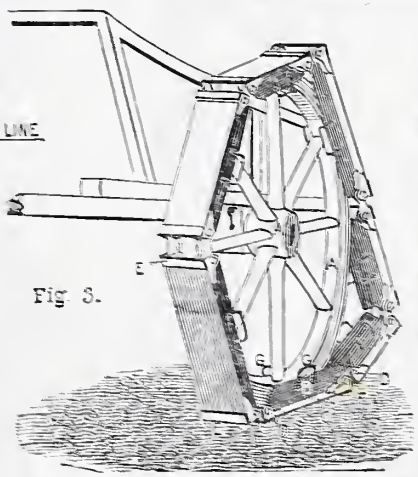


Fig. 3.

Portable Roadway for Carts. Fig. 1.—Side Elevation of Wheel and Slippers. Fig. 2.—End Elevation of Slipper and Wheel at X. Fig. 3.—Perspective View of Portable Roadway on Cart Wheel.

CARPENTRY FOR BOYS.

BY McDONALD.

PLAIN FRAMING (*continued*).—A RABBIT-HUTCH: MATERIAL AND CONSTRUCTION — BRACING — ROOF—DOOR.

LIKE our workshop, the subject of this paper is rough, and not difficult to execute: it is a rabbit-hutch—an article, by-the-bye, which is frequently nothing better than an old box turned on its side, with a piece of wire netting placed in the front to serve as door and window.

Lots of youths, however, would prefer something tidier and more comfortable than a box—such as we have in the sketches. At the same time, the expense is not very great, and the making of it affords good exercise at this stage. It is intended to accommodate a pair of rabbits, but, of course, the design may be altered to suit other requirements.

The tools needed for such a thing as this are, chiefly, a rule, a square, a cross-cut saw, a rip-saw, a chisel or two, and a hammer. The sketches should pretty well explain the arrangements.

Referring to the plan (Fig. 2), it will be seen that there is a small trap in the floor at *m*, which can be lifted out for cleaning purposes, and all refuse swept down into the box kept underneath, at *o* (Figs. 1 and 3). The trap is also perforated, and the floor should have a fall towards it, so as to drain off water or other liquid into the box. The sleeping places, or caves, are placed at the back, as secluded as possible from the door. To facilitate their sweeping out conveniently from the door, their inner sides are hinged, and fastened to the floor when in position with small buttons or slip-bolts. These are shown in Fig. 5. A tiny rack, made of bits of wire, is set at E (Fig. 2), to hold clover or other herbage. This also is easily reached from the door. Abundance of ventilation is procured by the door and the perforations in the gables (shown at Figs. 3 and 4). The latter may be made larger or smaller, as may be desired.

Material and Construction.—The material used in this little structure may be white or coarse yellow pine, all from the saw. According to the drawings, the sizes and quantities are, roughly: Four corner-posts, 3 ft. 8 in. × 3 in. × 3 in.; two door-posts and one back-post, 3 ft. 8 in. × 2 in. × 2 in.; four side sills, top and bottom, 5 ft. 4 in. × 2 in. × 2 in.; four end sills and one joist, 3 ft. 2 in. × 2 in. × 2 in.; four diagonal braces for ends and two for back (as indicated by dotted lines on Fig. 5), 4 ft. 3 in. × 2 in. × 2 in.; six rafters, 2 ft. 3 in. × 2 in. × 2 in.; three collars, 1 ft. 10 in. × 2 in. × 1½ in.; and about eighteen square yards of ⅝ in. rough sarking, for floor, roof, side and end covering, and inside divisions.

If the hutch is to be kept outside or exposed to the weather, the roof covering must be overlapped; and in doing so, it makes a firmer job to reduce the boards a bit towards the edges by the jack-plane, as at Fig. 7. Either that, or it may be put on plain, and covered with felt-cloth.

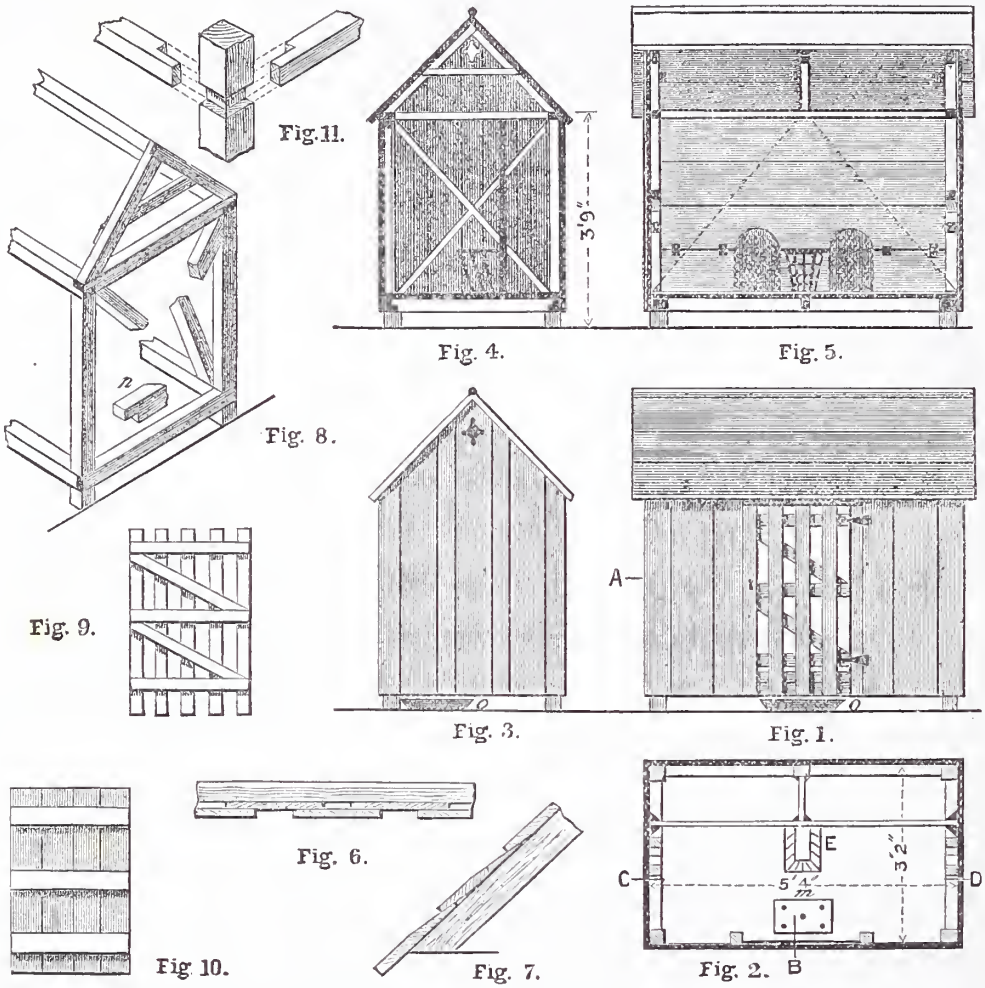
The side and end boarding is simply nailed up and overlapped, as at Fig. 6. The floor and inside divisions are boarded close. The longitudinal division is fixed to the end boarding and to small fillets nailed up the corners. The central one is a board set up on end, and fixed to the back-posts and to the other, with fillets in the corners also. The floor can be made to incline towards the trap by putting a rind of sarking below each end on the sill-plate, and keeping hard down on the joist. The trap is formed by cutting a piece out of a flooring-board, bevelled all round. This, together with the rest on the joist, is sufficient to keep it flush with floor. The bottom sills are notched into the posts, as shown at Fig. 11. They are kept up a few inches from the ground, and the boarding cut flush with their lower sides, to give ventilation underneath, and to admit of the refuse-box being used. The top runners are halved at the corners, and nailed down on the posts. The door-posts and back-post may be mortised and tenoned into the sills, or they may be put in with square joints, cheek-nailed, as directed for our workshop.

Bracing.—An addition to the framing employed in our workshop is here introduced — namely, the diagonal bracing, shown in Figs. 4 and 5. The object of this, as may be understood, is principally to stiffen the angles and keep them right, but, at the same time, it gives increased scope for nailing the boarding, and so strengthens the structure both ways. Not that this erection, any more than the former one, requires very great strength in the construction, but in all framings of any magnitude or substantiality bracing ought to be used; and this the learner must understand.

In our example, that in the back and ends, in which the braces act in opposite directions, is double bracing. A specimen of single bracing is shown in the door, where the two act in the same direction. The former is by far the best. The mode of fixing here is — square, well-fitted joints, cheek-nailed at the corners, and halved at the intersections. In good work, however, it must be borne in mind the corners are fixed by oblique mortises and tenons.

Roof.—The roof adopted here is also different from our last. It is that known as a pitched roof, whereas the other was a lean-to. Here, instead of single rafters crossing the entire span, they are in pairs or couples, notched together at the crown, and secured lower down by a collar-piece. This is also notched on the couples about one-fourth of its thickness, but no notching is taken out of the rafters, as that would weaken them. The couples are all made first on the bench—or, when large, on any convenient platform—then set up, and the sarking nailed on. A bit of rounded rind is nailed on the ridge by way of finish, and to cover the joint of the boards.

Door.—For light and ventilation, the door of a rabbit-hutch is frequently made of wire netting fixed to a light frame, but in this case we have a sparred one. Its con-



Carpentry for Boys. Fig. 1.—Front Elevation. Fig. 2.—Plan at A. Fig. 3.—End Elevation. Fig. 4.—Section at B. Fig. 5.—Section at C D. Fig. 6.—Boarding on Sides and Ends. Fig. 7.—Roof Boarding. Fig. 8.—View of Part Framing. Fig. 9.—Back of Door. Fig. 10.—Ordinary Ledged Door. Fig. 11.—Joint of Bottom Sill and Corner-post.

struction is quite simple. The spars are ripped out of sarking-boards, and nailed to the bars and braces on the back. These are also of sarking. Doors of this class are called ledged doors. Generally, the boards are grooved and tongued on the edges, and driven up close, as at Fig. 10. When braces are put in, such doors are said to be ledged and braced. In all ledged doors the nails should go right through the bars, and have the points turned in or clenched on the back. The door of our hutch is hung with a pair of small T-hinges.

OXYGEN IN GLASS-MAKING.

There has been little or no improvement in glass-making during the last twenty years. The employment of furnaces with gas generators, saving 30 to 35 per cent. of fuel, was the last improvement in this interesting branch of trade. Recent experiments made in England give hope of something better.

By directing a current of pure oxygen into the fused glass, the combination of the substances in fusion is accelerated, and, in consequence, liquefaction of the glass. The speed of the fusion makes it possible for the melting-pots to remain longer in use without damage. The economy resulting is reckoned at 30 per cent. Several English glass-works have already adopted this new mode of manufacture.

According to the *Revue de Chimie Industrielle*, the following conditions must be observed for a rational application of oxygen to the manufacture of glass :—

Gas contained in steel tubes at a pressure of 120 atmospheres is expanded by means of a regulator, which allows of its regular expansion at a uniform pressure of 2½ atmospheres. It is conveyed into the melting-pot containing glass by a platinum tube with a spiral end on the lower extremity, and perforated with four holes underneath.

The oxygen should, firstly, pass slowly into the glass, then quickly, and, finally, with great speed ; the evolution of gas should be regulated according to the state of the fusion.

According to the remarks communicated, the manufacture of 225 lb. of window-glass requires about 1,050 pints of oxygen.

Glass melted with oxygen is, according to workmen, easier to work ; but the difference is principally apparent in casting plate-glass. The glass runs with much greater speed, and blisters are much less numerous. —*Cosmos.*

How to Hang a Grindstone.—As some workmen prefer to grind their tools at home, it may be useful to give a hint or two how to hang the grindstone on its axle to keep it from wobbling from side to side. The hole in the stone should be at least ⅜ in. or ½ in. larger than the axle-tree, and both axle and hole square. Then make double wedges for each of the four sides of the square, all alike, and thin enough so that one wedge from each side will reach clear through the hole. Drive the wedges from each side. If the hole through the stone is true, the wedges will tighten the stone true. If the hole is not at right angles to the plane of the stone, it should be made so; but as this may be difficult to a novice, the difficulty can be surmounted by altering in the taper the wedge which corresponds with the irregularity in the hole. These particulars must be carefully carried out, and a properly hung grindstone will be the result.

SKATES: HOW TO GRIND AND REPAIR THEM.

BY N. MACLEAN.

Introduction — Popular Skates — The Acmé Skate—The Whittlesea Runner Skate—The No-toe Skate—The Canadian Skate—Hardening-up Long-bladed Skates—Repairs of Skates—The Clog—Grinding—Brazing — Riveting — Heel-screws — Toe-points—Leather Strapping : Its Treatment—Conclusion.

The approaching advent of King Frost, who, it is hoped by all lovers of skating, will bridge rivers, canals, ponds, and marsh waters with his usual translucent covering, forming a roadway on which the tired artisan, the overworked brain-worker, and the *ennuyéd* dweller in cities can win back mental and physical strength by the aid of this exhilarating exercise — with this end in view, skating men, women, and boys will begin to look out their skates, to get them into proper order for the coming season, and to ascertain what repairs, if any, are required.

Before proceeding further, it may be as well to glance at the illustrations, in order

Fig. 1.

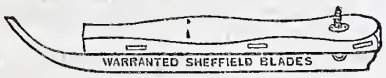


Fig. 2.

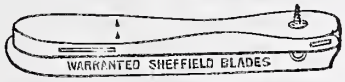


Fig. 3.

Fig. 1.—American Acmé Skate. Fig. 2.—Whittlesea Runner. Fig. 3.—No-toe Skate.

to become acquainted with some of the leading forms of skates—for the patterns are almost endless—and to briefly explain their principal characteristics.

Fig. 1 is known by the name of the "American Acmé" skate (a patent), the chief factor in which is that it is entirely of metal. Fig. 2 represents the "Whittlesea Runner," the peculiarity of which is that it is higher at the heel than at the toe, and is largely used by professional skaters for racing purposes on the Lincolnshire marshes and other long stretches of ice. It will readily be seen, even by a non-skater, that this pattern of skate is useful only for straightforward skating. Fig. 3 shows the "No-toe" skate, the face of the blade describing a gentle convex curve from the flat, commencing 2 in. from the toe.

There are, of course, many other makes of skates, in almost endless variety, made according to taste for individual skaters, and also for the various markets of the world ; and passing allusion may be made to the Canadian skate, which is 20 in. in length, and in which the chief difficulty is the hardening without warping.

The hardening of long-bladed skates is only accomplished by makers of experience in the usual way—that is to say, the blade is heated to a cherry redness, and quenched in water, giving the blade a peculiar sweep through the water, which ought to be seen to be properly understood.

But as skate-making is only practised at certain seasons of the year—being, in fact, a joint trade with joiners' tool-making —a visit to a Sheffield file-hardening workshop would probably be the best course for a country tradesman to adopt; and I should be pleased to give the name (through the editor) of a good Sheffield workman, who, for a pecuniary consideration, would instruct him in the art of hardening long articles of steel.

The repairs of skates most commonly required are re-grinding, riveting of broken blades, renewal of heel-screws and toe-points, and the leather strapping, the clog or wooden portion of the skate usually outlasting the blade; and, as a matter of fact, it would be almost useless for a non-expert to attempt the manufacture of the clogs, looking at the affair from an economic point of view.

We will now attempt to deal with the re-grinding. The stone used for this purpose is usually about 30 in. in diameter, and 8 in. or 9 in. wide, and is run at a most moderate speed. It is "raced" or trued-up on the face perfectly flat. The skate is now held on the stone crossways and *upright*, and ground till the edges are perfectly sharp, and an almost imperceptible curve in blade till within 2 in. or 3 in. of the toe and heel.

The sharpness of the edges is most important, as every skater ought to know, as every stroke is taken either from the inside or outside of skate-blade ; and if the edge of the blade will not take a firm grip of the ice when making a stroke, it is a sure sign that re-grinding is required.

I may here mention an apparent anomaly in the fact that all common skates are made of steel, all the more expensive manufactures being of iron, steel-faced to the extent of ¼ in. in depth. In the former case the steel blades are left unhardened, and consequently lose their sharpness of edge very quickly; in the latter, the steel portion is hardened, the iron back developing considerable elasticity, and also compensating to a large extent for sudden changes of temperature.

The re-grinding being done, the "glazing" or polishing remains. The "glazing" is done on a buff-wheel, 12 in. × 1 in., fed with crocus, a high degree of polish being obtained, care being taken to preserve the sharp edges of the blade. The common qualities of skates are left unpolished.

The repair of broken blades is usually accomplished in two ways—*i.e.*, by brazing and by riveting. If brazing tools be handy, this is the quickest method of joining ; but riveting will make the best and most lasting job. In riveting a break, care must be taken to drill your holes *above* the hardened steel portion of the blade of the skate, or you will spoil your drills.

Here I take it that only best and highly prized skates will become the subjects of your tender consideration, as common goods are—well, rubbish!

For riveting, provide yourself with some soft rolled brass of $\frac{1}{32}$ in. in thickness, and some steel wire the size of the drill. Now cut out two pieces of brass, about 2 in. long and about ½ in. wide, or as much wider as the width and position of the breakage on the skate-blade will permit. Now drill a hole right through the skate-blade and the two brass plates, and pin them loosely together. Now fit together the two points of breakage, and secure them in the vice, and drill the second hole opposite to the first, on

the other side of the breakage, in a similar manner to the first. Then see to the perfect alignment of the skate-blade: in other words, take it to a good light, shut one eye, and look *down* the blade; then reverse the position, and look *across* it. There only remains now to tighten up your first two rivets, looking again down and across the blade to see if it has shifted. Then drill the remaining holes—sufficient to make a firm job. Rivet them neatly, clearing off the surplusage of rivet-heads with a file. In every case, re-riveting ought to be followed by re-grinding.

The renewal of heel-screws—unless you have laid in a stock, anticipating a good demand for this variety of repair—must be left in a great measure to individual ingenuity.

The first thing to be done is to extract the broken screw. Now take an ordinary wood screw, and, holding it in the hand-vice, measure off the length over all; cut it off, and with a saw-file get it into shape, and screw it home. The "toe-points" of the clog seldom break, but more frequently get bent, and, in trying to bring them once more to the upright position, invariably break off short. The easiest way to renew these is to drill, with a fine drill, a hole through the clog, file up to a point, and harden (the point only) 1 in. or so of the aforesaid steel wire, and drive in from the under side of the clog.

The leather strapping now claims our consideration. How often do we find, on looking up skating tackle, that the leathers are all shrivelled, hard, and in many instances cracked—ready to break upon the smallest pull being given? This should not be. What would be said of a groom who never overhauled his saddle-room until his master's hunting appointments were required? There are many ways of keeping leather strapping soft and pliable, but beware of saddle-paste! Saddle-paste is good for saddle-seats, but should never be used on straps. Of two good things—dubbin and soft-soap—we prefer the latter; although dubbin preserves the brightness of the buckles, which, if the sponge with which the soft-soap is applied be not *too wet*, will do equally well. The plan we adopt for skate leathers is to wring out a moderate-sized sponge—one which can be doubled up in the hand—and place in the middle a small quantity of soft-soap. Now hang on a convenient hook the strap buckle, holding the other extremity in the left hand, and with the right work in the soft-soap. If the straps are hard, this should be done every day for a week, hanging them up in a dry place. New straps treated in this manner can be easily manipulated by cold fingers.

We have purposely refrained from going into particulars of repairs appertaining to the "Acmé" skate, thinking that these repairs may be more effectually done by the makers. However, the foregoing remarks apply in an equal measure to the "Acmé" as well as to other styles of manufacture, judgment being exercised according to the nature of the repairs required.

A hard winter, joyously looked forward to by skaters, brings in its train innumerable hardships for outdoor workers. May I, then, without unduly lengthening this paper, be allowed to call attention to one means of earning a nice little wage by the temporarily unemployed?

The arrangement I have seen carried out in this district is for one man to find capital for a co-operative working company of men. The capitalist goes to the owner of a pond, mill-dam, section of canal or river, and bargains for the use of the ice for so much money paid down.

The next thing to be done is to get together as many men as the acreage of the sheet of ice will employ. Some of these men are supplied with brushes for sweeping the ice; others with gimlets and leather-punches for punching holes in the straps. These men perambulate the ice with a chair, inviting ladies and other individuals (temporarily helpless from frozen fingers) to sit down and have their skates put on for the "small fee of 1d."

The financier, who should be a good and rapid skater, will look after the interests of the "firm," issuing little coloured tickets—one colour for an hour or two's spin, and the other colour for the day-tickets. The proceeds of the day are divided at the close.

Of course, there are many other methods by which an income may be earned in connection with the pastime of skating. Torches might be provided and sold at a profit at night. A tent, provided with a rough counter and a few temporary seats, in which a rest and a cup of good tea or coffee might be obtained by the skaters, and discussed round an open coke fire, would be, I think, a certain source of income.

PRACTICAL PAPERS ON PLUMBING.

BY R. A.

Pipe Bending (*concluded*)—Traps and Their Uses—Some Forms of Traps Illustrated and Described.

An appliance for bending pipes from 1 in. to 2 in. diameter, which many of my readers may find useful, is Billings' patent pipe bending device (Fig. 29); it is, like many of our tool novelties, of American origin, and consists of a strong spiral coil of wire; it is made of crucible steel, finely tempered, and the bending operation is performed as follows: the tool is inserted in the pipe to be bent, thus practically performing the same office as the filling with sand or water, the spiral core keeping the pipe from flattening or "kinking" during the operation of bending; the bender is withdrawn by giving a slight turn to the left, which slightly reduces its diameter, when it can be drawn out. The loop at the end is for this purpose; a little oil should be used with it. These benders are made in various sizes, and are useful appliances for jobbing men. It is obvious, however, that pipes bent in this way will be rendered thinner at the back by reason of the stretching at that part, as explained in the last paper.

Bending with Balls and Followers.—This is a method that was followed a deal more years ago than it is at the present day. It is not considered a good way by first-class plumbers, for reasons that will presently appear. It is done in this way: the piece of pipe to be bent is pulled round a little till it dents in the throat; two or more hard wood balls, slightly smaller in diameter than the bore of the pipe, are then inserted in the pipe, and driven past the bend by means of some short round blocks of wood, called followers (Figs. 30 and 31 show a ball and follower); this takes out the dent caused by the bending (Fig. 32 will assist the reader in understanding the process); the pipe is then bent again, and the process repeated until the required angle is obtained. The objections to this method of bending are that the pipe is weakened at the heel of the bend, and also that it is liable to damage by the edges of the followers catching in the angle of the bend. I myself am of opinion that the latter objection is rather fanciful, as, if the followers are well rounded off, as shown at Fig. 31, and both them and the balls well greased, there is very little fear of that happening. Of course, if this method is adopted, a set of balls and followers will be wanted for each size pipe that it is required to bend: most useful for lead pipe, 1½ in. to 3 in. diameter; above or below these not recommended.

Traps.—We now come to the study of one of the principal articles in use in plumbing and sanitary work. A trap briefly described is, broadly speaking, a barrier of water placed in suitable places to prevent the escape of foul smells into the house or apartment. Traps are made of lead, earthenware, and cast iron; the situations in which they are or should be placed are as follows: at the outlet of w.c.'s, at the connection of the soil-pipe with house drain or with the sewer, under urinal basins and slop hoppers, beneath sinks, lavatory basins, and bath wastes, and so on. I suppose it would take many whole numbers of Work to illustrate and describe all the various traps in use at the present day; this, however, is not needful. Many of them closely resemble each other, and many are traps only in name; I shall, therefore, confine myself to some of the most useful and well-tried traps, also mentioning some that should not be used. First of all, let us ask the question, What are the most essential requirements of a trap? I reply as follows: a trap should be self-cleansing; it should be of such a shape that the water barrier which it contains (and which we technically term its "seal") should be changed as far as possible each time a discharge is sent through it. It should have such a seal as will be least liable to be lost through the various causes which induce loss of seal; it should be simple in construction, and accessible for cleaning. We will, for our first study of a trap, take what is known as the D, or ᗡ, as some people prefer to express it in print, which, after all, is correct, as it shows it in its natural position when fixed. This is an unsanitary Goliath that hygienists and sanitary reformers have been slinging at for the last twenty-five years, and he is not dead yet, though I think almost at his last gasp, metaphorically speaking. I will add my little pebble to the rest, and if I cannot say anything new, I will at least say what is true concerning it. It is a trap that, *in general use*, is not, and never can be, self-cleansing, as I will endeavour to show. In the first place, it offers a very large surface for foul matters to adhere to, the total superficial area of a full-sized D trap being about 3 ft., more or less. Fig. 33 will illustrate this; it shows patterns of the various parts of a D trap: A is the band; B the top; D dip pipe; C, cheeks (of which, of course, there are two). Fig. 34 shows the trap as a whole, showing their positions.

In the next place, from its construction it offers lodging-places for filth where, as easily can be seen, no water flush can ever reach with any cleansing action: viz., in the corners, at the back of the dip pipe; the inside of the top and the outside of the dip pipe are also parts that cannot be scoured by a flush of water sent through the trap. These are not random assertions, but facts which have been proved to demonstration, both as experiments and in actual practice. I have seen these traps completely choked with a gradual accumulation of filth. Advocates of the D trap, on account of some qualities it possesses, of which I will speak

further on, have endeavoured to overcome these inherent defects, and have succeeded in doing so to a limited degree by narrowing the band, by keeping the dip pipe close back to the band, and making it the full width of the trap; a D trap thus made can certainly claim to be "improved," but not "perfected," for though the fouling surface is thereby lessened, the parts unscoured by water remain the same.

Another defect in this trap is that it can get into a very bad state without showing any signs on the exterior, even if that could be seen: which is seldom. For instance, should the dip pipe be eaten into holes, as is sometimes the case, the seal of the trap is rendered useless, as sewer gas would have free access to the house through the holes in the dip pipe, as shown by the arrows in Fig. 35. I think these are sufficient reasons for the condemnation of the D trap as unsanitary and dangerous; in fact, one eminent sanitary authority has said that the use of them ought to be forbidden by legislative enactment. The one redeeming feature about them is that they are very tenacious of their water seal, being more proof against syphonage, waving about, and momentum than probably any other trap known, especially in certain situations.

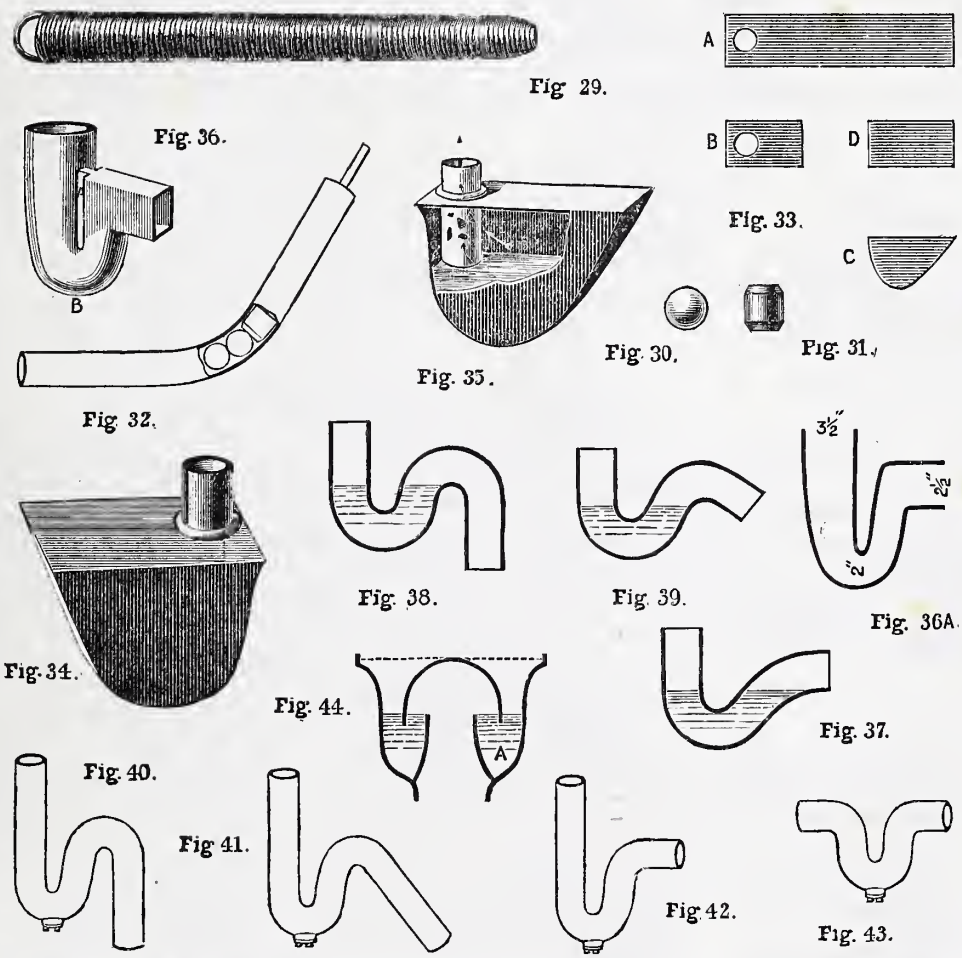
Nearest approaching the D trap in its non-liability to syphon, etc., is the anti-D trap, invented by Mr. S. Stevens Hellyer, of the well-known firm of Dent & Hellyer, whose services to the cause of sanitary reform in general, and to plumbers in particular, are beyond praise. Himself a thoroughly practical man, he has, by voice, pen, and practice, for many years advocated all that is good and useful in sanitary matters, and not a few inventions stand to his credit. To return from this digression, however, to the trap in question, it is illustrated at Fig. 36, and its principal features are that it is perfectly self-cleansing, that if ventilated it is perfectly proof against syphonage, and that the water it contains is comparatively very small in quantity, yet gives a seal of about 3 in. It is also termed the V dip trap, from the manner in which the seal is formed. Its cleansing properties are due to its shape, which, as will be noticed on reference to the section (Fig. 36 A), is somewhat peculiar, being larger at the top than anywhere else, tapering downwards till its smallest section is at the bend, and then enlarging slightly and merging into a square outlet: considered the best shape, as allowing matters to flow away more freely. These traps are made of cast pure pig lead, and are of good thickness and suitable for many classes of work, including closets, sinks, baths, etc.

Figs. 37 and 38 show two classes of trap in very common use. Fig. 37 is known as the half S, and by some termed a P trap, though incorrectly: it is, however, more generally spoken of as a P trap in the trade, especially by closet manufacturers—I suppose for shortness.

Fig. 38 is the full S trap; they are made in scores, of slightly varying shapes and forms, by various makers, some of which are the subject of patents. They possess the merit of being self-cleansing, but are easily syphoned out. The Q trap (Fig. 39) is a modification of the S trap; it is also sometimes termed the three-quarter S. These are the principal traps in use for closet-work.

There are the same things made in small-sized pipes for sinks and other similar purposes. Figs. 40 to 43 show some of them as made by Dubois' patent; they are solid drawn without seam or solder, and are a great boon to plumbers. Claughton's patent traps are of similar kinds and shapes, but are cast in two halves and burned together. It will occur to my readers that all these patent cast and drawn traps must have made a vast difference in plumbing work, which is actually the case; very few plumbers now make their own traps, except for special jobs where some variations from the ordinary shapes are needed. The D trap is still made to a limited extent, but even these are to be had in cast lead (Pullens' Improved). I do not, therefore, propose to describe the making of traps, unless specially asked and class of trap stated, when I will briefly do so in "Shop," believing that I can occupy my space with more valuable information on other subjects.

Another trap in frequent use that is a delusion as regards its trapping qualities is the bell trap, seen in nine out of ten of our cottage sinks, and very frequently in houses of a better class. By referring to Fig. 44, which shows it in section, readers will understand the objections to it. (1) It is not self-cleansing; it accumulates filth in the recess, A, in which the trapping water stands. (2) Its insufficiency of seal, which is seldom more than ¼ in. or ½ in.; this is easily lost by evaporation or other causes. (3) That as it is usually made for sink-work, it is soon choked up, and to avoid trouble it is oftener left off than on, unless the grating is fixed. A round pipe trap or small anti-D, fixed about 10 in. from the sink, is far better; this gives the water a drop from the outlet of sink, which assists in forcing sediment, etc., out of the trap. Other kinds of traps will be dealt with in the next paper.



Plumbing. Fig. 29.—Tapering Coil of Wire. Fig. 30.—Ball. Fig. 31.—Follower. Fig. 32.—Diagram showing Bending with Balls and Followers. Fig. 33.—Patterns of Various Parts of a D Trap. Fig. 34.—D Trap. Fig. 35.—Ditto, showing defects in Dip Pipe. Fig. 36.—Anti-D Trap. Fig. 36 A.—Ditto, Section. Fig. 37.—Half S Trap. Fig. 38.—Full S Trap. Fig. 39.—Three-quarter S Trap. Figs. 40, 41, 42, and 43.—Dubois' Drawn Lead Traps. Fig. 44.—Bell Trap.

GREAT ELECTRIC LIGHT.

The great light which is to illuminate the World's Fair grounds is perched on the high tower of the Transportation Building, and is the largest and strongest in the world. It has been made by Schuckert & Co., of Nuremberg. The light is what is known as a 4-ft. reflector—that is, the great magnifying-glass through which the rays are thrown to such a distance is 4 ft. in diameter. The direct power of the light is 150,000 candles, without any glass whatever. With the big glass, however, the power is magnified to 160,000,000 candle-power. The carbons used in the radiator are 12 in. long, and 1¼ in. in diameter. They are fastened inside the lamp merely with two upright pieces of steel. The lamp itself is operated on a sort of carriage, something after the manner of a Maxim gun. It can be turned in any direction, and can be tilted so that the rays will ascend vertically. When the full power of the light is turned on, the city of Chicago can be viewed.

NOTICE TO READERS.

Next week's Work (No. 198) will contain, among other illustrated papers, the following:—

Watch and Clock Cleaning and Repairing.
How to Make a Harmonicon.
Experiments with Induction Coils.
Design for Inlaid Workbox.
Slating for Slaters.
Readily-made Fern or Flower Table.
Specula for Newtonian Telescope.
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*** The Editor makes this intimation in the hope that readers, having friends interested in any of these subjects, will bring the same to their notice.

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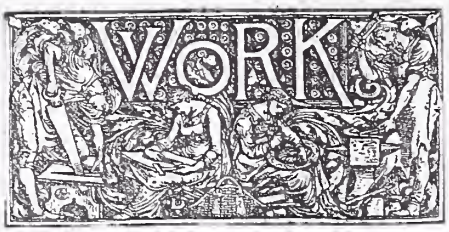

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*** Advertisements should reach the Office fourteen days in advance of the date of issue.

*** All letters suggesting Articles, Designs, and MS. communications for insertion in this Journal will be welcomed, and should be addressed to the Editor of Work, Cassell and Company, Limited, London, E.C.

Work correspondents are wanted in every Town.

Female Employment.—He would be a very hard-hearted man who would seek to exclude women from the various industrial fields that they now occupy. Still, there is an element in the case that is not altogether favourable to what is supposed to be the advanced view, and this element is being forced upon our attention more and more every day: the marriage rate is declining, and has been declining for some years now. Of this persistent decline no satisfactory explanation is given. We offer one—viz., that it is due to the extension of female employment. When women do the work, how is it possible for them to get husbands to keep them? The men are thrown out of work, and, of course, cannot marry. If the ladies who are filling our offices had stayed at home, or taken to house-work by way of preparing themselves to become wives, men would be now in these offices and would require wives.

Paraffin Lamps.—One can scarcely pick up the daily newspaper but that it contains an account of some accident caused by the careless handling of paraffin lamps, and only recently in the neighbourhood of Birmingham a family of father, mother, and two children lost their lives in a night by the upsetting of a lamp such as is commonly used by the poorer classes. Owing to the many improvements in the better class lamp-burners, thus enabling them to give a brilliant light, coupled with the artistic shapes of the oil vessels, they are finding more favour amongst the upper classes even in preference to gas or the electric light. What we wish to call particular attention to is the flimsy and ofttimes dangerous nature of the oil vessels used in the cheaper kinds—made for the most part entirely of glass—which find a too ready means of distribution through the medium of "tea-shop presents." Where children are about, these lamps are highly dangerous, and at all times ought to be handled with care. We would rather advise our readers to have nothing to do with them, but to select only such as have stout metal stands, or those made entirely of metal. Better still, as a further safeguard, adopt a more extensive use of hanging lamps either from the ceiling or against the wall. We would heartily commend to the notice of our readers and manufacturers a system of making the oil vessels entirely of metal.

The Unwilling Workman.—The unwilling workman is he who does work because he is compelled to do so by circumstances over which he has no control, nor any genuine desire to obtain control. He works because he must do so or starve, or at any rate suffer some kind of privation. He has no interest in his work. It may "go hang," as far as he cares, and he shirks it at every available opportunity. He does not like work at all, and is frequently wishing some old uncle will die and leave him a fortune, so that he shall never have to work again. He can never wake in the morning until someone more wakeful than himself tries to rouse him to a sense of his duty, and then his troubles for that day begin. His eyes fairly ache with drowsiness, and must be vigorously rubbed open with his fists; his scalp itches as if it was afflicted with one of the ten plagues of Egypt, and has to be well scratched with his finger-nails; his lower jaw frequently drops in a prodigious yawn; every limb in his body seems to him to be rheumatic; and it is only by dint of repeated exertions on his part and that of his good angel (who, truth to tell, does the largest part) that he can get out of bed in time to hurry on his clothes and scramble into the workshop. When there the pain in his limbs returns, and his lower jaw relaxes. It gives him pain to make the slightest movement in the direction of work; but the hard-hearted foreman or master fails to notice his sufferings, and puts down his slow movements to the account of laziness. Should a strike be projected, he is one of the first to support the proposition "to play," and it is such workmen as himself that bring strikes into contempt. He is also among the first in the ranks of the unemployed, and no one wonders more than himself how it is that such a good workman is out of employment. He is usually the loudest talker about the "rights of man" and the "veniality of the aristocracy." In fine, he esteems himself always a badly-treated man, who has never had his dues, and this opinion is shared by many others, but on different lines of thought to those held by him. The disease he suffers from is one affecting that inscrutable part of a man, denominated the will. The cure of the disease may be effected by giving him interest in his work. This may be administered to some constitutions in the form of piecework; but we have known this to fail in others, whilst there is always the danger of fostering another disease named selfishness. Profit-sharing is a far better form of administering interest than piece-work, and profit-sharing with co-operation has been known to effect a perfect cure in most cases. That man, however, is the most healthy who creates for himself an interest in his work, be it ever so humble or so badly paid; and the workman who loves his work will make the best co-operator in the good time coming, when profit-sharing will be the rule instead of an exception.

DESIGN AND DECORATION OF ALL AGES.

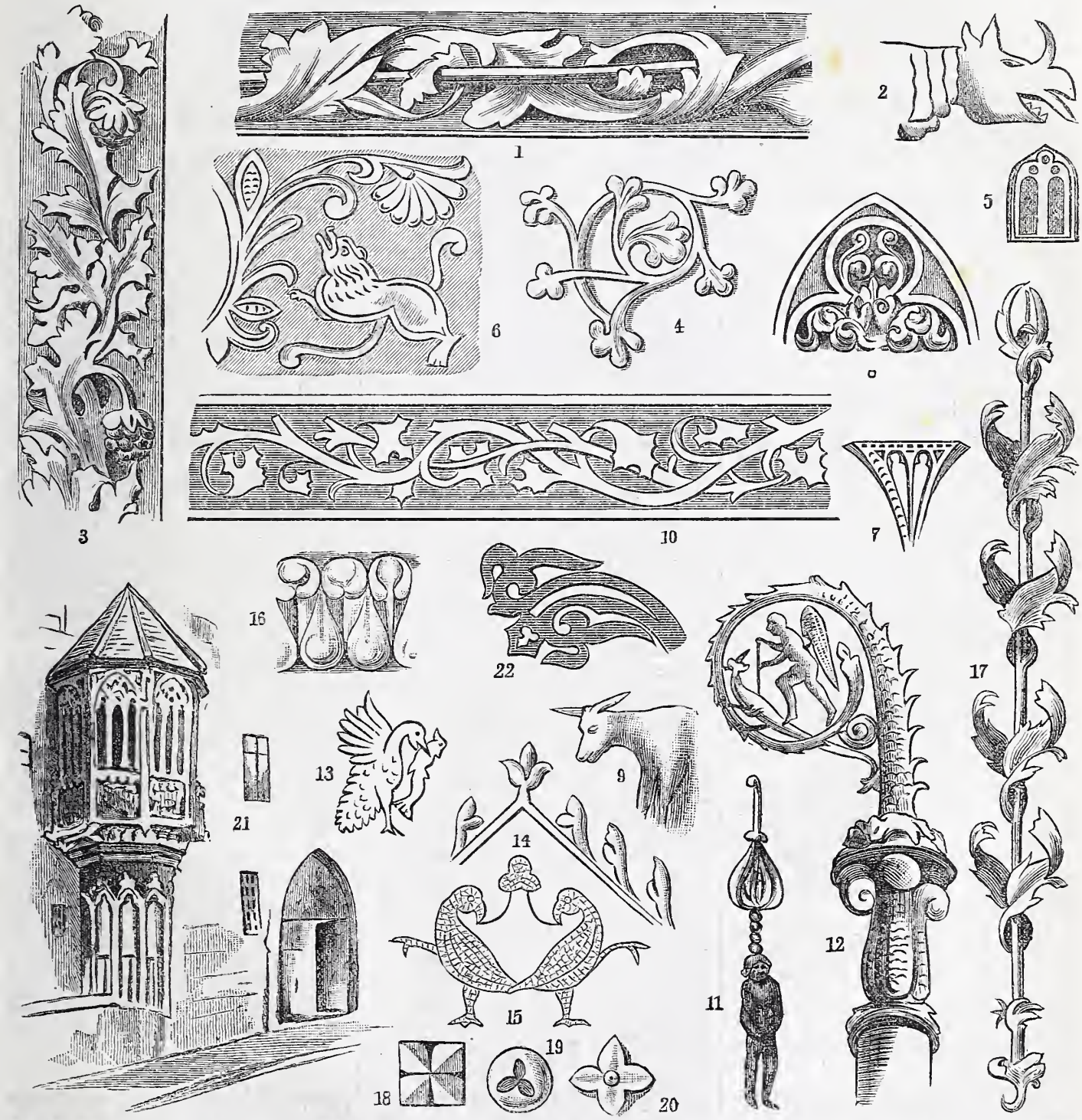
BY M. H. C. L.

Mediæval.

The Art of the Middle Ages is especially interesting and instructive for us English people, because it is our own indigenous art. From this point of view it appeals to us as no other can. The Anglo-Saxons had, it is true, their art, but it was chiefly, if not entirely, copied from that of the Celts; while in the Middle Ages, as the fusion of the Saxon and Norman races became more and more complete, our own national life sprang up, and with it our national art.

The great new school of the Mediæval period was the Gothic. There was a beautiful old tradition that the idea which we see in our Gothic cathedral, with the pointed arches, which mark this style, and high mysterious vaulted coop, was taken from the forest aisles in which the people of the North had wandered for so many centuries, and where they had formed their first mystic yearning after the God they knew in Nature alone.

So poetical is this notion, that one would prefer clinging to it rather than searching out the actual process — matter-of-fact enough — by which this new style was evolved. However, we must look at facts; and the facts appear to be these. The pointed arch was introduced into Europe by the Crusaders, who saw it in the Arabic



Mediæval Decoration. Fig. 1.—Carving on Choir Stall of Ulm Cathedral. Fig. 2.—Gargoyle on Cathedral at Rheims. Fig. 3.—Stone Carving, Church of S. Juan de los Reyes, Toledo. Fig. 4.—Foliage carved on Tomb of Archbishop Grey, York Cathedral. Fig. 5.—Early Gothic Window. Fig. 6.—From Italian Leather Coffer: Fifteenth Century. Fig. 7.—From Church of S. Juan de los Reyes. Fig. 8.—Stone Carving from Notre Dame, Paris. Fig. 9.—From Font of S. Bartholomew's Church, Liége. Fig. 10.—Tyrolean Flat Carving: Fifteenth Century. Fig. 11.—Iron Bell-pull, Nuremberg. Fig. 12.—Pastoral Staff, Champ-levé Enamel, Thirteenth Century, Limoges. Fig. 13.—From Silver Box. Fig. 14.—Crockets and Finial. Fig. 15.—Mosaic, Orvieto Cathedral. Fig. 16.—Silver Beaker Embossed Work: German. Fig. 17.—Iron Bell-pull, Nuremberg. Fig. 18.—Early English Dog-tooth Ornament. Fig. 19.—Ball-flower, Decorated Style. Fig. 20.—Four-leafed Flower, Decorated Style. Fig. 21.—Window in Albrecht Dürer's Platz, Nuremberg. Fig. 22.—Iron Hinge Ornament from Door at Blutenberg.

buildings; the Christian architects gave it a more upward direction, increasing its beauty and suggesting a symbolic aspiration. The cusped arch was also an importation of the Crusaders, and this idea met with a happy development in new hands. All the "foils" came into existence thereby, and in architecture a much broader and more systematic use was made of the cusping, which had been simply a graceful but meaningless ornament of the Mohammedan arch. The tracery of Gothic windows, which we should like to think represented the branches of forest trees, are, as Ruskin too clearly shows, an evolution from the piecing of the solid mass of masonry with which the system of separated lights in one window began.

It has been said that Gothic architecture had its birth in the North. It is the style best adapted to countries where, under grey skies, and with a climate destructive to delicate surfaces, massive forms and grandeur of a building, as a whole, are what must be aimed at rather than vivid colouring or highly finished detail.

We work in sandstone where the Italian works in marble. We need steep-pitched roofs to let the snow slide down, and this necessity in the external form influences the interior, which again reacts on the outer part, necessitating buttresses and flying buttresses from the walls.

As with all other styles, the Gothic had its period of rise, of perfection, and of decadence. There is not space here for more than a flying glimpse at the different periods it went through in our own country. These were: The Norman (sometimes not counted as Gothic, as the arch was still round), with zigzag decoration; the Early English, the chief ornament of which was the dog-tooth ornament (Fig. 18), and a prevailing feature the clusters of shafts, of which its columns were composed, as in Salisbury Cathedral; the Decorated, where the severe simplicity of the earlier styles gives way to richness and redundancy of ornament. The ball-flower (Fig. 19) and four-leaf (Fig. 20) belong to this period and the Perpendicular, which came into vogue about the Elizabethan age, and is marked by the large use of straight lines, both vertical and horizontal, in the tracery of the windows, as well as in the general lines of the building. The last was a period of decadence, and since then we cannot be said to have had any genuine style of our own.

We have built on *réchauffés* from various lands and various periods up to the present day, when our artistic diet may be described as an *omnium gatherum*. The only really beautiful feature of the Elizabethan period was the fan tracery, which is the most beautiful decoration of a constructive nature ever devised for roofs.

Gothic architecture, in France, corresponded very nearly with the English Gothic, though there were certain national distinctions. The French churches were larger. Clustered columns and tracery of the Decorated order were rare in France, and when the debasement of English architecture produced the Elizabethan style, that of France went off into the Flamboyant.

The chief marks of the Flamboyant style are the wavy and flame-like traceries of the windows. The form thus produced was often used in wood carving. A *fleur-de-lis*, heart, or heraldic device was often frequently introduced at the top of a window. The mouldings—very important features in Gothic architecture, and best, of course, when the style was purest—became debased and feeble. By degrees the Flamboyant merged into the pseudo-classical style, and such was also the fate of the English Perpendicular. Gothic Decorative Art was simply Gothic architecture in little. The shrines and reliquaries were chapels in miniature. The crockets (Fig. 14) which adorned the gabled roofs appeared on the bishops' croziers (Fig. 12). The conventional foliage of early Gothic Art, which was carved in stone on the capitals, was also produced, with the slight difference of treatment necessitated by the different material in wood and iron work.

The idea of cusping, as has been said, met with a very full and beautiful development in Gothic Art. Here it early suggested the foliated form, so familiar to us now in our church architecture. The trefoil, quatrefoil, and cinquefoil are repeated over and over again, and show what great effects may be produced from one single motive.

So far, the Gothic style in England and France alone has been noticed; for in these two countries it, as it were, started afresh, and consequently reached its finest and most characteristic development. But its influence was wide-spreading. It reached as far south as to Spain—where we have some beautiful specimens of Gothic architecture—and to Italy. In Italy, however, except in Venice, where it is not pure, the Gothic influence on architecture was small.

Romanesque and Byzantine art and architecture were still in vogue, and though in Germany the old style amalgamated with the new with happy results, the Italians were too satiated with the traditions of old Rome and its successor in early Christian work to take to so new and different a development of art. Moreover, the Gothic style was more suited to the materials and weather of the North than to the bright sunshine and delicate marbles of Italy. The Decorative Art of the Middle Ages did not begin with the Gothic period, but was carried on from the Byzantine and Romanesque. In the later Romanesque we find the highly decorated porch, which was later a Gothic feature; and the fabulous human forms, the dragons, reptiles, beasts, and birds of the early Romanesque period were continued down in somewhat varying forms till the end of the Middle Ages.

The monks seem to have had a quaint and humorous fancy, and they loved to portray grotesque heads and queer impossible beasts. We find such in the gargoyle water-spouts (Fig. 2) which adorned the flying buttresses of Gothic churches, for which the legend that they represented evil spirits flying from the sacred building was invented. But equally odd and monstrous beings are sometimes found inside the churches, as in Beverley Minster, the nave of which is decorated with the most hideous and extraordinarily conceived bogeys. Early Romanesque and early Gothic foliage were conventional, but in a later period, in both styles, natural leaves and flowers were represented, sometimes with great beauty and fidelity. Fig. 3 shows a thistle border from a cloister of the Church of S. Juan de los Reyes, at Toledo, built by Ferdinand and Isabella. Fig. 9 is one of ten iron cows round the brass font of S. Bartholomew at Liége, of the twelfth century. The craftsmen of the Middle Ages were famous metal-workers. They cast bronze, engraved brasses—such as we see in the pavements of old churches—and embossed brass and silver. They worked in leather, embossing or incising the surface and boiling it down to a pulp, and using it as an elastic substance. Their work was in part in high relief, with sharp distinctions of light and shade, as in the stone carvings which adorned the buildings. But there was also good flat work done, and the early English wood-carving—such as we see on old chests of furniture—is of this order.

The finest wood-carving of the Middle Ages, however, was done in Germany, where the bold Gothic treatment of foliage produced the most beautiful results in undulated light and shade, and grace of flowing curves. Just such wood-carving is being done at the present day, under the auspices of Professor Herkomer, at Bushey; there, too, iron-work such as was done in the old days is produced. Fig. 22 shows a hinge ornament of the fifteenth century from a door of a building at Blutenberg, now in that delightful treasure-house of Mediæval Art, the Museum at Munich.

Figs. 11 and 17 are from bell-pulls sketched in the museum at Nuremberg: another place where one would like to spend a lifetime, if it were not for the living fascinations just outside its walls. For Nuremberg—almost alone in the world—is still a mediæval town: the gabled and balconied houses, the beautiful church of S. Sebaldus, the old moat and walls, with their many gates and towers, take one back six centuries, and the streets seem as though they should be peopled with frocked monks, and bekirtled ladies and knights, and crusaders, and all the picturesque inhabitants of those romantic days.

It is impossible not to make a digression concerning Nuremberg, in writing of Mediæval art.

The staining of glass is an art which dates from the Middle Ages. The first specimens of stained glass, as is supposed, were made at the Monastery of Tegernsee and at Hildesheim. The best stained glass, as the best woven designs, embroidery, and illuminations—all of which arts flourished in Mediæval Europe—were coloured without shading, in avoidance of any attempt to destroy the effect of a flat surface, such as they were employed to decorate.

All these minor arts might be treated separately at length; that of illumination, for instance, which went through its distinct period with marked changes of style, from the beginning of enlarging and ornamenting the initial letters in the sixth century to the debased naturalistic and shaded ornament of the sixteenth. Space, however, fails; and with a few general words this paper must end.

The Art of the Middle Ages was, in the main, religious art, full of symbolism, in part handed down from early Christianity, in part fancifully invented by the monks to give a reason for existing forms—as when the trefoil was taken as an emblem of the Trinity. It was an aspiring ideal art tinged with mysticisms: the upward curves of the arches, the spires—an invention of Gothic Art—ever pointing up to heaven, are typical of the conception which found its expression in the Art of the Middle Ages.

Since the introduction of forced draught into boiler furnaces, several chemical industries have adopted coke-breeze and gas-house-breeze, a very inferior kind of fuel, three to four times the quantity of which has to be used in comparison to coal, on account of it not containing the same amount of volatile matter as the latter fuel.

SCIENCE TO DATE.

Snake's Meals.—M. Léon Vaillant has been observing the alimentation of the great anacouda of Central America now in the reptile menagerie at Paris. Since 1885 the snake has eaten, on the average, five meals per annum, consisting of goats, three rabbits, and one goose. The interval between two meals was, in one instance, two hundred and four days.

Proto-iodide of Carbon.—Moissan has succeeded in preparing a substance of the composition C_2I_4 by heating crystals of tetra-iodide of carbon in a sealed tube to 120°. A better method of preparation consists in reducing the tetra-iodide with silver powder. Proto-iodide of carbon is thus obtained in beautiful pale yellow crystals of density 4·38, fusing at 185°, and volatile without decomposition below their point of fusion. It is soluble in carbon bisulphide, carbon tetrachloride, and also in ether. It is a very stable substance, not being oxidised by potassium permanganate or nitric or chromic acids.

Azoimide.—A very interesting method of preparation of azoimide, N_3H, has been discovered by Professor Wislicenus. The reactions by which this substance has been hitherto prepared have all been of an organic nature and of some complexity. The new method is very simple, and only inorganic materials are used. Metallic sodium is heated in a stream of ammonia gas, and when it is completely converted into sodamide, the stream of ammonia is replaced by one of dry nitrous oxide, the temperature being about 200° C. By this method the sodium salt of azoimide, NaN_3, is obtained. On dissolving the product of the reaction in water, filtering, and distilling the filtrate with dilute sulphuric acid, a solution of azoimide in water is obtained. Other metals besides sodium may be used, but sodium azoimide is less explosive than most of the other salts of azoimide, and is best suited for practical use.

Magnetic Fields.—Professor Houston describes the following process for obtaining a map of the magnetic field at any place. A photographic plate is placed in the position where the field is required, and, while in the dark, iron filings are dusted over it. It is then exposed to light for a few moments, and, the filings being removed, it is developed in the ordinary way.

NOTES FOR WORKERS.

Twenty millions of acres of land in the State of Washington are covered with a growth of wood which will cut an average of 25,000 ft. of mercantile lumber per acre. Much of it in the vicinity of Port Crescent will cut an average of 100,000 ft. and more to the acre, while single trees are common that will cut 3,000 ft.

The best-wooded counties of England are Kent, Surrey, Sussex, and Hants. The area of the woodlands of this country is now 2,695,000 acres, some 134,000 acres having been added from 1888 to 1891.

It is estimated that there are 11,000,000 acres of uncultivated land in the United Kingdom, all amenable to some kind of cultivation.

The Electro Novelty Co., of Boston, have brought out a "two-mouse power" electric motor and battery, which is said to be a perfect model of the Edison dynamo.

Silver chloride is readily soluble in ammonia, a solution of sodium thiosulphate (hyposulphite of soda), and a solution of potassium cyanide.

Tobacco acts rapidly as a depressing agent, but its influence soon passes off. In one experiment, total work at 8.30 a.m. was 10·25 kilogrammetres, but eighteen minutes after smoking an ordinary cigar it fell to 6, and an hour after to 2 kilogrammetres. At 11.30 a.m. it had risen again to 10·25 kilogrammetres.

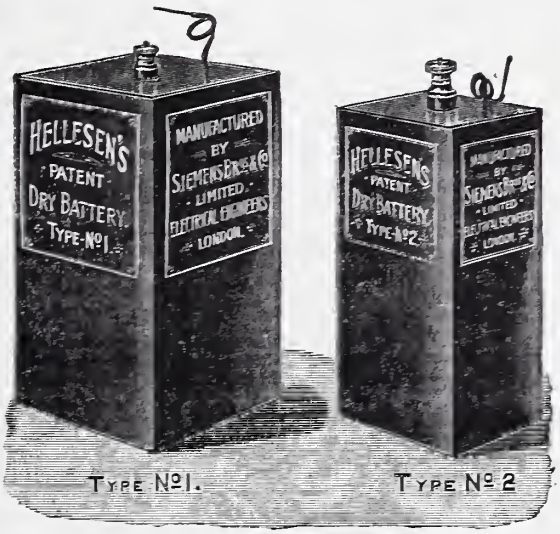
A good seam of coal, from 7 ft. to 8 ft. thick, has been discovered on the banks of the Tenasserim River, in Burmah.

The recent Tasmanian Exhibition was a financial success, there being a credit balance of £1,500.

A meteoric stone, about the size of one's fist, has been found at Cave City, Calaveras County, U.S.A., which contains a large amount of gold. Gold has never previously been found in meteoric iron, although other precious things, as red diamonds, have.

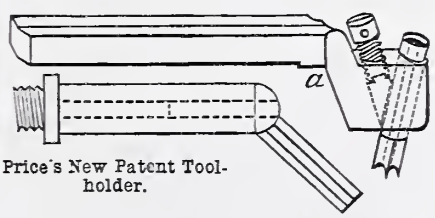
NOTICES.

The Hellesen Patent Dry Battery.—We have received from Messrs. Siemens Bros. & Co., Limited, a specimen cell of the Hellesen patent dry battery, manufactured and sold by this firm of electrical engineers. The specimen cell—which is their No. 2—is of rectangular form, measuring 3 in. by 3 in. by 6½ in., and weighing 3 lb. The outer case is of zinc, and this forms the positive element of the cell, to which a connecting wire is soldered, the negative element being a carbon plate bearing an ordinary brass binding screw for connection. A battery of such cells is highly recommended for telegraph and telephone work, and for ringing electric bells. The cells are quite free from liquid, are always clean, and, after having been set up, they require no attention until they are completely exhausted. A larger size, weighing 5 lb. 12 oz., is made for working induction coils, and smaller sizes are made for electrical testing purposes and for working medical coils. Tests made by eminent electricians at home and abroad show that the battery, when fairly used, will last in working order for a long time, the E.M.F. of its elements being 1·5 volts, and the internal resistance of its cells varying with their size from 0·2 ohms to 0·65 ohms. The prices range from 4s. per cell for No. 1, down to 1s. 6d. per cell for No. 6, the price of a No. 2 cell being 2s. 6d. We can recommend this battery to all who may be seeking a good thing in the form of a dry battery.



Patent Dry Battery Types.

Lathe Tool.—Mr. F. Price, the inventor of a new patent tool-holder, submits a specimen turning tool, together with its sharpener, for our examination. He claims for it the following advantages, viz.:—(1) It cuts with equal ease, forward, right or left, without altering its position in any way; (2) the circular end of the tool will last twelve times as long as an ordinary tool without re-sharpening; (3) it is easily adjusted to any height; (4) no skill is required in sharpening, as the cutting angle depends upon the diameter of tool and sharpener—for instance, if the diameter of the tool is half the diameter of the sharpener, an angle of 45° is given to the tool, and this, with a rake of 15°, gives to the work a cutting angle of 60°; (5) it saves a great amount of power, as the same angle is presented in every direction; (6) a side-rake can be given by resting it upon one of the angled under-faces; (7) the bottom end can be plugged and the central channel filled with a lubricant, which will keep it cool when it is required to do heavy work.



Price's New Patent Tool-holder.

F. A. M., our specialist in lathe matters, writes on the above:—"I think Mr. F. Price's tool-holder is very ingenious, but it is one of those things that must be tested by actual work; opinions upon it will certainly differ, some will like and others dislike it; it is sure to interest lathe-men, and some will give it a trial. The cutters are easily made, yet not so easily as those of the Haydon bar; they are very firmly fixed, and the point, *a*, in the figure, where the holder is weak, will make it act partly as a spring-tool, and prove no disadvantage, since any yielding will tend to withdraw the tool from cut, and thus prevent digging in and chattering. The overhang of the tool is less than in the Haydon bar, which is an advantage. Being away from home I could not try the tool in my own lathe, so I took it to a small shop near by and saw it tried, when it cut freely and required but little power, the turner appearing well pleased with it; we also put the emery grinder in a chuck and tried its effect, but the lathe would not run fast enough to cause the emery to cut well, and I imagine, the grinder being of such small diameter, should run at a very high speed, say 5,000 revolutions per minute, to give a good result; in fact, I suspect the emery grinder would have to be mounted on a spindle of its own, away from the lathe, where no grinding ought to be done, and run at a much higher speed. All that the inventor claims for the tool may be granted except No. 4, where it is said that if the grinder be twice the diameter of the tool an angle of 45° is given to the edge, and this, with a rake of 15°, gives a cutting angle of 60°. The cutting angle would not be 45° unless the diameter of the tool bears the same relation to the diameter of grinder that the side of a square does to the diameter of the circle drawn around it. 45° would be too weak for the cutting edge, which could not be reckoned as 60°, because an inclination of 15° of rake, front or side, is given: an angle of 45° given to the tool edge means a cutting angle of 45° whatever be the rake of the tool. When, however, the diameter of the grinder is twice that of the tool, then the angle produced at the cutting edge is 60°, and this is very suitable for wrought iron, and will still be 60° cutting angle, even when a rake of 15° is given.

Woodwork.—"Second Year's Course of Manual Instruction in Wood," by Joseph H. Judd, M.Inst.C.E. (Moffatt & Paige).—This is a publication designed to follow up the author's First Course, to which we drew attention in an earlier volume of Work. It cannot be denied that scope existed for a more advanced course, treated after the fashion of the previous book. Mr. Judd is Head Master of the Brighton Technical School, and therefore knows fully the requirements of teachers and pupils of elementary and technical schools. The present course will be found equally as practical as its predecessor, and, pending more definite information from the Science and Art Department upon the subject of Technical Education in Schools, Mr. Judd's practical teaching cannot but be useful and valuable. We anticipate a large sale for this eminently helpful manual.

Slöjd Carpentry.—"Practical Directions for making the High School Series of Slöjd Models," by Alfred Johansson (George Philip & Son).—This is a translation, by Mary R. Walker and William Nelson, of a Swedish book treating of the Slöjd system of imparting instruction in carpentry in schools, intended for teachers and students. The book is not to supersede the instructions of a teacher for those who are ignorant of Slöjd; the condensed notes are for the guidance of a pupil working with a teacher. The notes and work set out are admirable, and will go a long way to make Slöjd—the latest addition to the school curriculum—more understood and appreciated.

TRADE: PRESENT AND FUTURE.

*** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

DERBYSHIRE COAL AND IRON TRADES.—With the near approach of Christmas, orders are flowing in for fuel for domestic requirements, and the volume of business has materially increased. A better tonnage is being put on the rails for the Metropolitan and Southern markets, but a marked decrease is noted in the sales for general manufacturing purposes. Gas coal is in good demand, and heavy consignments are being despatched for many of the large works. The iron trade of the county is not so buoyant, orders being lacking for the various brands of pig iron, and a dearth of new orders for foundry work. The finished iron trade is brisk, and firms are well employed on building work and roofing. Specialities in malleable iron are in good demand.

COTTON TRADE.—It is now thought that the crisis in the great struggle will not be reached until the end of January, by which time it is considered the stocks of yarn will have become exhausted. The Federation of Master Cotton Spinners, at a meeting on the 9th of December, were of opinion that it was the duty of the trade to adopt short time to the extent of three days per week. If such a system were adopted as recommended, the financial position of the operatives would be affected to a large extent. A general system of short time throughout North and North-east Lancashire would mean that the special levies now being paid by the workpeople in these districts would cease; hence the unemployed operatives in the South would be deprived of a considerable monetary assistance. The decision is not binding on the North Lancashire employers, who will remain at liberty to please themselves whether they come to the assistance of the Federation or not. In Rochdale and district the working class is beginning to feel the effects of the lock-out, some of the societies having made appeals for aid to the general public; and although it is far better here than in the surrounding towns—in some of which great distress prevails—yet it is very bad here, and it is feared that it will go from bad to worse. In spite of the distress, the operatives remain firm, and there is no sign of either side giving way.

CYCLE TRADE.—A number of bankruptcies have come about in the cycle trade recently. These have resulted from the great numbers who have engaged in the trade, many of them knowing next to nothing about it, and the keen competition engendered in consequence. Cycle makers, in many instances, have realised the mistake of opening credit accounts with inexperienced dealers, ignorant alike of the practical and business (or financial) requirements of the trade. Makers are now looking for, and finding, a surer market for their wares in the hands of accredited ironmongers and hardware dealers, and it is expected the trade in cycles will develop considerably in this direction in the near future.

SHIPBUILDING TRADE.—This goes from bad to worse in Aberdeen, and about fifty men were discharged from one of the yards this week. The same yard, it may be added, is working short time. The total tonnage of the vessels built during the past twelve months was only 3,414, as against 6,724 in 1891, and 9,228 for 1890.

ENGINEERING TRADE.—Machine tool makers, locomotive builders, and stationary engine builders are experiencing a very marked scarcity of inquiries, and scarcely any work of moment is likely to come forward this year. Boiler makers are fairly busy, but prices are lower than have been obtained for a long time. An engine to drive the machinery in the British Section of the forthcoming Chicago Exhibition is being built by a Manchester firm.

IRON TRADE.—There are considerably more sellers than buyers in the Lancashire pig-iron market, while manufactured-iron makers report only a very small amount of business doing. Lancashire bars are still being quoted at £5 13s. 9d. to £5 15s., while for sheet, £7 2s. 6d. to £7 5s. is being asked.

HATTING TRADE.—A dispute in the wool-hatting trade of Denton commenced recently, and, the masters insisting upon a reduction of 7d. per dozen in the price paid to the hatters, the latter refused to work. Arbitration has, however, been accepted, and the dispute will be referred to the two members of Parliament of the divisions concerned.

SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

I.—LETTERS FROM CORRESPONDENTS.

Slot Machines.—J. C. K. (*Lisson Grove*) writes:—"The slot machine for automatic supply is an old affair. Two thousand years before the Christian era Heros the Egyptian, of Alexandra, refers to a drachmæ being put into a slot to turn the small sweeps of a water-wheel, to supply the worshippers at shrines with a modicum of purifying water."

Chucks.—C. C. E. (*Lincoln*) writes:—"N. M. will remember that all the ornamental chucks of my old French rose-engine had noses adjustable by four screws, and I think he concurred in the general opinion that their intended use was to more accurately centre work chucked approximately true in pitch. For that purpose they were of some little use, but nothing could be more objectionable for complex turning, from which every element of error or instability should be eliminated as far as possible; so, if it is necessary to affix the chuck nose by screws at all, by all means cut the screw upon it *after* it is fixed. The chucks upon my new lathe have steel backs and noses, are very strong, and if, after many years' use, any wear should take place, are very easily adjustable."—[I thank you for having called my attention to the noses of the chucks of your French rose-engine, and if my memory serves me, I remarked to you that the late Mr. Fieldhouse, the celebrated London engine-turner, who was only excelled by his contemporary, the late Mr. Alfred Deacon, constructed the noses of his chucks in a similar manner. But there the analogy ends; there is not sufficient play in my chuck to assist in adjusting the work as suggested in your note, but only to centre the nose. My contention is simple enough—that is to say, the central pin is not nearly strong enough; and the maker of the chuck evidently knew what he was about when he adopted the method of which my short article was the subject. I have not the slightest doubt that, in the execution of your particular work, such an arrangement would be unsuitable; the more so as, in your case, the work would be changed from chuck to chuck. At the same time, there is a certain amount of skill exhibited in being able to overcome the difficulties that arise where two or more chucks do not run quite so truly as might be desirable. In conclusion, I hope you will be able to find time to give the readers of WORK an account of your new lathe, if but a brief one.—N. M.]

Hand-power Circular Saw Bench.—A. R. (*Scorrier*) writes:—"I take the article in No. 184, p. 435, by CHOPSTICK to be a reply to my question. I was pleased to see the long-looked-for article. I suppose I am one of the 'carping critics' referred to by CHOPSTICK, as I criticised some of his communications to WORK. It is not probable that I shall be making a bench as described by CHOPSTICK, but as so much has been said in reference to the merits and demerits of a hand circular saw bench, I would like to hear from anyone making the bench as described by CHOPSTICK. After giving it a fair trial in cutting stuff 3 in. and 4 in. deep, he might write to WORK and say candidly which he prefers—the ripping with hand saw or turning the wheel. My motto is to live and let live—not live myself and, in doing so, kill my fellow-man. Pushing timber to a saw is not turning the wheel. In reference to there not being such a machine in the market, there have been hand-saw benches worked nearly on the same principle for years, with the cog gear precisely the same; and men that have much to do with machinery will know that to increase speed is to lose power. I hope CHOPSTICK will not take offence at this letter. I give him credit for the clear way in which his article was set out."

Slide-valve.—A CORRESPONDENT writes:—"In regard to the reply of F. C. to MANES, on p. 253, there must surely be a misprint in line 7; 'the *weight* of lead to be given to the valve' has no meaning, as, though the metal lead is heavy, the lead of a valve (pronounced 'leed') is a distance, and space is not heavy. But further on we read, 'The lead is the distance the valve is ahead of its mid-position when the crank is on the dead-centre.' Not so; the lead is the distance the valve is open when the crank is on the dead-centre—it is, in fact, the '¼ in. opening at the start' referred to in the last line but three. What authority can be cited as giving the lead (lineal) any other meaning?"—[The words "weight of" should not have appeared; in this connection they are without meaning. I do not know if they were in my MS., as I have no copy of it, but I think it unlikely. Your correspondent mixes lap and lead when he says that the ¼ in. opening at start represents the lead, and as for the authority to be cited as giving lead (lineal), I give no authority, as my replies are based upon over thirty years' practical experience in my business. I fancy your correspondent thinks he knows me, but he is mistaken, for I always pronounce *lead* as *leed* in this connection.—F. C.]—["Amount" was written in F. C.'s MS., and there has been a printer's error.—ED.]

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Watch and Clock Tools and Materials.—L. F. (*Stafford*).—In No. 179 of WORK, p. 356, the names of two firms were given as supplying watchmakers' tools and materials. As some readers appear to have difficulty in finding them, their full addresses are now given: Messrs. Hunt & Son, 21, Ironmonger Street, St. Luke's, E.C.; Messrs. Grimshaw & Baxter, Goswell Road, E.C. Catalogues can, no doubt, be obtained from either for the cost of postage. Full addresses are not given in leading articles in WORK, but only in "Shop." Firms mentioned in leading articles should advertise their addresses in WORK.—G.

Patenting Invention.—WHITESMITH.—It was quite unnecessary to have copied the Patent Office circular; all that needed to have been done was to have sent a copy of the paper that had been lodged with the application. This so-called specification is neither more nor less than an advertising circular, and as much like what a specification should be as the moon is like a green cheese, and about as likely to create a property the law can support. It is a fair sample of the general or "popular" ideas of inventors in regard to specifications and the kind of thing people are rushing with to the Patent Office daily, with the idea that they can create and secure a property by so doing. We should advise WHITESMITH to refer to No. 44, Vol. I., of WORK, where, at p. 694, he will find some information on patent matters that will, if studied and realised, be found of great use to him. We think it must be evident to him by this time that, to obtain what he desires so that it shall be capable of being of any benefit to him, he should secure the assistance of a qualified and experienced person to carry out the matter. A thing which is of no use when obtained is not worth the trouble of obtaining, and we think no man of common sense would waste his time in getting it.—C. E.

Management of Electric Machinery.—ENGINEMAN.—You should get the following books: "The Dynamo Tender's Handbook," "How to Manage a Dynamo," "Electro-motors: How Made and Worked," and "Electric Light Installations." These four books will teach you all you require to know on the subject.—G. E. B.

Amateur Type.—A. E. A. (*Sharpness*).—The cause of the imperfect appearance of some of the letters in the specimen card sent is that the type is "off its feet"—that is, that the types are not all perfectly perpendicular—the result being that one part of a letter prints, and the other does not appear. You will certainly obtain a better impression by slightly damping the cards and allowing them to lie under pressure for a few hours before printing. They should not curl unless made too damp.—W.

Musical Glasses.—S. M. (*Leeds*).—See reply to Dan Brearly in No. 185, p. 461.—R. F.

Mandoline.—E. D. (*Wandsworth*).—See reply to R. W. B. in No. 189, p. 524.—R. F.

Watch Repairers' Certificates.—HOROLOGIST.—A printed paper, containing the particulars of these examinations, can be obtained from the Secretary, British Horological Institute, Northampton Square, London, on sending a stamped envelope. The examination consists of two parts: (1) A series of practical tests of good workmanship (running in a cylinder, putting a balance-staff, etc. etc.); (2) A set of questions on theoretical matters (depthing, action of cylinder, lever, and other escapements, etc.). Any practical repairer of watches, who has given a little careful attention to the theoretical side of his business, should have no difficulty in answering any of them. A study of Mr. Britten's "Handbook" will be helpful, as it covers the whole of the ground. It is impossible to give the actual questions, as they are varied at each examination.—F. J. G.

Gilt Picture Frames.—FRAME.—(1) Gilt frames are cleaned by washing very carefully with a sponge barely moistened with hot spirits of wine. The gilding must afterwards be left to dry naturally, and not wiped. (2) The eye alone, if practised, is quite sufficient to detect the difference between gilding with good gold leaf and with Dutch metal. (3) In Vol. III., p. 262, No. 121, is an article on Making Gilt Picture Frames. Directions and hints about picture frames of other kinds are so liberally scattered over the back numbers of WORK that it is not possible to give references to them.—M. M.

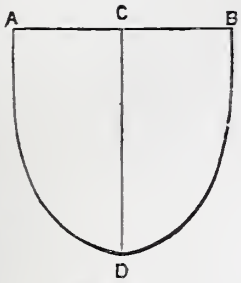
Making a Wood-turning Lathe.—W. S. (*Battersea*).—If you have made "the bench," I think your best plan would be to try to pick up the headstocks, crank, and wheel second-hand; this would really be cheaper than if you bought the materials and tools to make them new. You should have some practice on this one, and learn as much as you can with it; and then, by-and-bye, when you have learnt the requirements of a good lathe, you might try to make one. If I were to fill a whole column of "Shop" with directions for you, it would not really be sufficient. You cannot be told how to make a lathe in a few sentences.—F. A. M.

Air Pump.—J. J. J. (*Canonbury*).—A ¾ in. steam pipe should be sufficient for your purpose. A vertical boiler (tubular) 4 in. diameter and 10 in. high should do the work, but I should advise you to use a higher pressure—say, 60 lb.—and expand the steam by cutting off at ½ in. stroke.—F. C.

Sign Writing.—W. C. M. (*Norwood*).—The numbers of WORK in which the articles on Sign Writing appeared (Nos. 1, 2, 4, 11, 13, 17, 19, 23, 30, 34, 44, 45, 47, 49, and 51) are out of print. You should advertise for them in our Sale and Exchange column.

Fire Escape Prize Competition.—A. T., JR. (*Birmingham*).—The responses to this were so numerous that the adjudication as to the prizes has been a long one. This will be made immediately.—ED.

Curves of Ribs of Model Steamer.—A WORKING LAD.—The curves of the ribs of a model steamer may be obtained by drawing, either to the same size or to scale, an exact plan of the deck, and a similar one of the upper side of the keel. The positions of the ribs are then marked on both of the plans. From the former of these the distance between each opposite pair of ribs is obtained, and from the latter the height of each pair above the keel. Thus you will get the two dimensions of each pair of ribs. To get the curve of each pair, a line, A B (see the figure), is drawn on a sheet of paper equal in length to the width, and another, C D, at right angles to this and bisecting it, equal to the length. A curved line is then drawn from the points A and B to the point D, and this will be the shape of the curve of the particular pair of ribs in question. In each case the curves must be drawn by eye, and in the case of ribs in the fore-part of the vessel the bulge is at the lower end, the upper part being almost straight. As the boat is to be only 15 in. long, it will be best to draw the plans full size. The shape of a hull which will do equally well for sailing or steamboat is shown in No. 160 of WORK, Vol. IV., p. 58, Figs. 2 and 3. The straight part of the keel is made first, and the stern-post mortised on to it. The curved part of the keel at the stern is then cut out according to the plan, and fixed in its place. The ribs are cut out of pieces of board, and are secured in their places by tongues. A thin piece of board, cut to the right shape, must then be placed between each pair of ribs to keep them at the proper distance apart while the building is going on, which can easily be taken out when it is finished. Strips of wood, about ¼ in. thick and ½ in. wide, are nailed lengthways across the ribs, beginning at the keel, and working upwards, until the requisite height is reached. These strips may be made to overlap one another by being rebated, or may be made to fit simply against one another. The stern part must be carved, and fitted on to the top of the keel by a tongue-and-groove arrangement. When the building is finished, the whole must be covered by several coats of paint or varnish. As for books on the subject, there is one entitled "Model Yacht Building and Sailing," by E. Biddie, published by Messrs. Norie & Wilson. There are also several publications published by Stevens' Model Dockyard, 22, Aldgate, London. Before buying any book, you should examine it, and see that it contains the information which you require.—A CRAFTSMAN.



Ship's Rib Curve.

Colouring Metals.—M. W. (*Stepney*) and W. P. B. (*Birmingham*).—For colouring metals, if you will look up the following in your back numbers of WORK, you will find far more than can be given in "Shop": In Vol. II., No. 72, p. 324; No. 102, pp. 811 and 814; No. 91, p. 632. In Vol. III., No. 142, p. 602; No. 143, p. 622; No 144, p. 638.—J. B.

Paring Knife.—T. C. R. (*Blindley Heath*).—If I had your knife in my hands, I could much sooner sharpen it for you than I could tell you how to do it. The biggest trouble with you is your misapprehension of the cutting edge. I reproduce your sketch, and will show you where you are wrong (see Fig.) If you grind, and afterwards set, on the edge as shown, and push it from you with a kind of a sideway motion, you will, doubtless, get on all right. I must refer you to back numbers of WORK for the process of gilding edges. I am constantly

Bookbinder's Paring Knife.

writing details of this process. I have not always time to do so, and space is very limited in "Shop." I have no intention to be disagreeable, but querists should really look up back numbers before sending their queries. How simple it would be, for instance, for all bookbinding readers of WORK to acquaint their fellow-workmen of bookbinding matters appearing in WORK. This would save needless inquiries and replies.—G. C.

Ticket Writing.—WALTHAMSTOW.—A series of papers will be given shortly.—ED.

Electric Bell.—W. H. (*Bristol*).—It is evident, from the feeble way your bell rings, you have not enough power. Put on another cell in series, and if that will not do, write again more fully. You need not put anything in the porous pot of a Leclanché—they are sold complete. Let it stand for a few hours after making up the cell before you use it.—J. B.

Vertical Pantograph Milling Machines.—C. C. (*Sheffield*).—Messrs. T. Cooke & Sons, machine tool makers, York, are the makers.—T. R. B.

Hooter.—OUT OF KNOW.—The reason your hooter does not give a clear note is probably because the edge of the bell is not directly over the annular outlet for the steam. It is also too far away; ½ in. instead of 1½ in. would give a better result. The whole thing is badly designed.—F. C.

Model Boiler.—BEGINNER.—Assuming the seams to be not only hammered, but well brazed, your boiler should stand a working pressure of 50 lb. per square inch, if the ends are hemispherical and properly stayed flat ends. You do not state whether it is tubular or how it is fired, so I cannot say if it will supply enough steam for your engine. For the same reason I cannot give you size of safety-valve. Pressure-gauges and other fittings may be obtained from the "Model Dockyard," Fleet Street, London, E.C. You should write there for a price list.—F. C.

Engine for Existing Boiler.—R. M. D. T. (*Frome*).—A vertical inverted cylinder engine would be best. A larger engine at a slow speed will be the more economical. You might put in a cylinder, say, 4 in. diameter by 6 in. stroke, and cut off steam at one-third stroke. You should increase the pressure as you increase the load. Line your fire-door with fire-clay to prevent it becoming red hot. As to the castings, you should apply to some local founder in a small way of business, or write to the "Model Dockyard," Fleet Street, London, E.C.—F. C.

Preservation of Wood Flooring and Ironwork.—BUNKER.—Creosoting for timber is very effective if properly carried out—about 9 lb. creosote per cubic foot of timber. Rotting may also be prevented by immersing the timber in a solution of corrosive sublimate. For ironwork, the protective covering which has best stood the test of years is a paint made of peroxide of iron, coloured paints being put over it as required.—F. C.

Fittings for Model Steam Engines.—W. J. H. (*Market Harboro'*).—These fittings can be obtained from the "Model Dockyard," Fleet Street, London, E.C. Write there for a price list.—F. C.

Covering for Folding Screen.—WILLIAMS.—As you wish to avoid the ordinary scrap-picture covering, you may, if you can paint, cover with that kind of Lincrusta-Walton which artists use as a ground for painting on, or there is an American leather cloth sold on which painting may be done; both these are admirable if you can decorate them yourself. If not, you should apply to the Liberty Art Co., Regent Street, who will supply you with a variety of Japanese or other artistic covering materials.—S. W.

Stamping out Metal Disc.—J. C. L. D. (*Derry*).—You do not clearly state your requirement. If it is only for a rough purpose, and assuming that the metal is malleable, they could be punched out by an ordinary punching machine at a small enough cost. Your best plan is to communicate with the Britannia Tool Company, Colchester, enclosing sketch of disc and the material of which it is made, also its thickness, and the weight you require it to be; on which they will forward price of new or second-hand machine to suit your purpose. Correspondents should be more explicit in stating their requirements, which they should do fully, and, if necessary, enclose a sketch, however rough, giving proper dimensions, so that reliable information may be given.—T. R. B.

Thermopiles.—A. F. (*Bow*).—Thermopiles can be obtained from any dealer in electrical sundries—such as the Electric Stores, 51, Cannon Street, E.C. Their value, in relation to the cost of fuel employed in heating them, may be put down as one-third that of a gas-engine driving a dynamo. That is to say, it will cost three times as much for fuel to work a thermopile as it would cost in gas to work a gas-engine and dynamo generating the same quantity of electricity.—G. E. B.

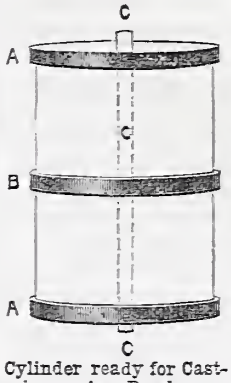
Cement for Carbon.—H. S. (*South Hackney*).—Even if we could hit on a cement capable of conducting the electric current equally as well as carbon, it would never pay to cement broken battery carbons, as the cost for labour would exceed the value of the plates. It is, therefore, impracticable. The zinc plates are easily coated with mercury. Get them clean by washing in dilute sulphuric acid, then pour mercury over them in a shallow dish containing some of the sulphuric acid solution, and brush them with a bunch of fine copper or fine brass wire until the mercury spreads all over the surface. The E.S. dry battery is one of the best for a small coil, if you only wish to use it for a few minutes at a time occasionally. I do not know of a book on the art of swimming. Consult *Chums*.—G. E. B.

Dry Battery.—J. B. (*Accrington*).—The Hellesen, Gassner, E.C.C., and E.S. dry cells are all good forms. The Hellesen and E.S. are powerful and compact cells. I have not had enough experience with these to decide on the best, but find both very good for such light work as bell-ringing, telephones, and small night lights.—G. E. B.

Coil gone Wrong.—T. S. (*Bolton*).—Assuming that the sketch of your coil is a correct one, I do not see how you could expect any evidence of current from the terminals of the secondary wire, as you have no magnet to work the break-hammer. If you do not arrange the contact-breaker to be worked by the magnetised core of the coil, as shown by me in No. 164, p. 118, you must have a separate magnet to work the hammer. If you had made the coil as I directed, you would have got a smart shock from it. Of course you get a shock when the current from another coil is sent through your coil, as the break of the other is working all right. Read the articles on Induction Coils that have appeared in WORK, and make your coil as directed in them, then you will not go far wrong. My book on the subject is published by Whittaker & Co., and the price is 3s.—G. E. B.

Boiler.—W. E. E. (*Manchester*).—Your letter is not a specimen of courteous letter writing. With regard to your remarks on my paragraph, which you call an article, on p. 369, No. 180, paragraph 3, I thank you for your suggestion.—T. R. B.

Garden Roller.—H. H. (*Bootle*).—I am glad to know that you have been successful in making a garden roller from the instructions in WORK, and no doubt other workers will be encouraged to make the attempt, and also materially assisted, probably, by your ingenious use of empty cheese boxes in lieu of sheet iron for the mould of the concrete roller. Your sketch, appended, will explain itself to those of our readers who perused the articles, "Simple Accessories for the Garden (see No. 175, p. 292).—C. M. N.



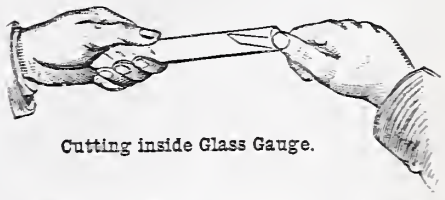
Cylinder ready for Casting — A, Bands on Cheese Box; B, Band made by knocking Top off Lid; C, Axle.

Water Resistance.—WIREMAN.—Get a gauge glass tube. Cement the lower end into a brass foot socket, perfectly watertight. Screw this down to a wooden stand or base, and connect the flange of the socket to a binding screw by a length of copper wire. Fit a rod of brass in a cork stopper to go in the top of the glass tube, and let this rod slide stiffly in the stopper. The rod must be long enough to reach the bottom of the tube, and should have a screw on top for connecting the rod with one of the line wires. Fill the glass tube with water, and slide the rod up or down, as required, to get the desired resistance. This is one of the most simple forms of a water rheostat.—G. E. B.

Shellac in Water.—S. A. L. (*Great Yarmouth*).—The addition of a little common washing soda will generally suffice for common work. For the better class, try 2 oz. gum arabic, 1 oz. borax to 1 lb. shellac, in ½ gallon of water. Bring slowly to boiling point in an iron pot; stir up occasionally till all gums are dissolved. May be used hot or cold.—LIFEBOAT.

Squaring Round Corks.—F. G. (*Liverpool*).—I am not acquainted with any such machine, but see no difficulty in the way of constructing one. Your object is, of course, to reduce all your old corks to one uniform size. First, you will need a brass bed for the cork, its width that of the required square. Half its length would be concave, to hold the round cork; the other half flat, for the second cutting. Second, a clip, the counterpart of the bed, to fit down on the cork and to hold it tightly, by means of a lever or otherwise. Third, parallel knives, set to the width of the bed, having a handle at their upper ends, and their lower ends being hinged to a metal arm, the further extremity of which would work on a pin; the object being to give that kind of cut which is gained in the old-fashioned chaff-cutting box.—S. W.

Cutting Water-gauge Glasses.—W. H. M. (*Cradley Heath*).—To cut these to fit, use a hard steel point on the *inside*, as shown in the illustration. With a little practice, it can be made to scratch a perfect circle, when the piece can be easily broken off. Should a large piece have to be taken off, you might start a small crack at the end,


Cutting inside Glass Gauge.

and then, with a red-hot wire, make it follow it, and so break off a small piece at a time; but, remember, the secret for success is to cut the inside and not the outside, as you have been doing. I do not know of a machine to perform the work, and do not think you will need one when you have tried the proper way.—W. E. D., JR.

Accumulators.—D. C. (*Blackburn*) and H. S. B. (*No Address*).—If you will either purchase or look up in your back numbers Vol. II., No. 101, p. 790, of WORK, you will there find far more information than can be given in the limited space in "Shop." The paper is by Mr. G. E. Bonney. If you have your back numbers, you will also find, by consulting the indices of past volumes, many hints on accumulators in "Shop;" and, should you require more information, I think you could not do better than get Sir D. Salomons' book on "The Management of Accumulators," price 5s., published by Whittaker & Co.—J. B.

Winter Window Plants.—C. H. (*Newcastle*).—If the window is enclosed it will be an easy matter to heat it as you suggest. A tin saucepan, with the lid soldered down, will serve for a boiler. The pipe should start from the top of the boiler, be continued round the window, and re-enter the boiler near the bottom. Half-inch iron barrel will be best for the purpose; lead pipe may be used, but the heat will not radiate so freely. An air pipe must be carried from the highest point of hot-water pipe, above the level of the boiler, and a pipe (syphoned) fitted to boiler for filling it; ¾ in. will be large enough for these.—T. W.

Asbestos.—TIRO.—(1) It is impervious to heat, cold, or water. (2) Bell's Asbestos Co., Ltd., 118, Southwark Street, London, S.E.—T. W.

Bent Iron Work.—M. P. (*Glasgow*).—Whiteley, the Universal Provider, Westbourne Grove, London, W., sells the iron for this work.

Boot and Shoe Making and Repairing.—LEATHER.—You ask if it is possible for a person of average skill to make any kind of boot or shoe at a profit. My answer is, Yes; but, at the same time, I would ask you to be very careful how you commence, as, of course, you will have to master a tremendous lot to compete with other manufacturers that have been in the market a long time, and have learnt how to cater for the public. You ask if you could dispose of them to boot salesmen. Well, that can be done (if you are not a good salesman yourself) by paying some traveller, who has a commission in a different kind of stuff to yours, a little to sell them or take orders from samples for you. A few of the difficult things to overcome would be how and where to buy, and how to judge your leathers; getting a proper set of lasts, and suitable to the work you are going to make; some idea as to what material is necessary, and also what fitting—that is, girth measurements, large or small—for the locality they are for; getting the proper plant, and producing every pair as uniform as possible. I hope you will not think I am one who would try to discourage anyone else at whatever they attempt, for that is not by any means why I write the above; but, you see, as you only tell me you have read my articles (of which, by the way, I thank you for your kind approval), I do not know if you can cut, close, or make: only that you say you are a novice. You need not, I think, trouble much about profit; as you want to make good use of spare time, your wages for the work done would form that for a time, and then economy and quantity of work would soon bring profit. There are a good many leather sellers, etc., advertise in the *Boot and Shoe Trades Journal*, 10 and 12, St. Bride's Avenue, Fleet Street; and the *Shoe and Leather Record*, 30, Finsbury Pavement, London, E.C.; 2d. each, weekly. My advice would be that you should start repairing (and making, if you can) for your friends, or, if you can work very well, try to get work from the tradesmen you deal of yourself, and get them to recommend you. I say this because any man with a little skill can soon rise without much outlay. Only do the work as punctually and well, and use as good leather as you can for what you are going to charge, and, I think, if you are in a neighbourhood where there is any muster of inhabitants, you will not be long with much spare time on your hands.—W. G.

Sharpening Knives, etc.—AMATEUR.—Former questions already answered. Singer's machine is an up-to-date tool, and the best in the market for general purposes.—W. G.

Naphtha for Fake.—W. F. C. (*No Address*).—It is mineral naphtha that is used for making fake. Paraffin is sometimes used, though I like the former best. You say buff balls; you should use heel balls, with about half a white glazing ball to two of hard black heel balls. The material you saw in the bottom of a light boot must have been common black felt, something like that used for roofing, etc. After it is worn it does crack, but it is not right. A hand-sewn boot wants to be flexible. When stiffness is wanted, stouter leather should be used; besides, an inner sole will sooner form its shape to the sole of the foot in wear when a nice soft felt is under it.—W. G.

Is Goat's Flesh Venison?—C. H. B. (*Blackpool*).—The term "venison" is the ordinary speech applied only to the flesh of adult animals of the deer kind. In a broader sense it has been, and may be, properly applied to the flesh of any animal taken in hunting, since it is derived, through the French *venaison*, from the Latin *venor*, to hunt. In neither sense can it be applied to the flesh of the tame goat.—M. M.

Cleaning Kid Gloves.—S. P. (*Hulme*).—Stretch the glove on one of the wooden hands sold for the purpose at glove shops, and sponge it two or three times with benzole, using clean benzole each time. Keep your work away from the fire.—S. W.

Motor Address.—R. A. D. (*South Kensington*).—The address cannot be given in "Shop," but if you send a stamped addressed envelope to the Editor, it will be sent. We cannot, from practical experience, say to which we would give the preference. If you refer to No. 112, Vol. III., of WORK, you will there find a full description of one. We should recommend you to see both at work; you will then be able to judge for yourself which is most suitable: or, failing this, give particulars of what you want them to drive to each maker, and have a guarantee from them that the machine will do the work. You will require a water pressure of not less than 50 lb. per square inch: if more, so much the better.—M.

Paper Pulp Moulds.—W. H. S. (*Southampton*).—An article on the subject he mentions, including a few diagrams, is in progress, and will be submitted to WORK as soon as completed.—G. P.

Paint.—JACKSBY.—To mix about 2 lb. stone-colour oil paint you will require 1½ lb. of genuine white-lead—say, 5d.—one penny worth patent driers or liquid driers, and half a pint of mixed linseed oil and turpentine, 3d.=9d. These are the rough quantities for white paint, and to make stone-colour tints you will require a little of *ochre* and *umber* pigments, ground in oil. Assuming the oilman makes you a pennyworth of each—he will not occasionally—this makes your paint cost, roughly, a shilling, and the total quantity will be some 2½ lb. The oilman will mix the paint for you at 6d. per lb., so that there is no saving with so small a quantity. If, however, you prefer to be your own mixer, break up the lead (purchased ground in oil) and driers into a stiff paste with a little oil. When thoroughly beaten up, thin down to the required consistency with your oil, add your pigments to desired tint, and strain, if for interior work, through a piece of fine muslin or old stocking.—F. P.

Mirrors.—J. B. (*Calderbank, N.B.*).—Apply to Newton, plate glass dealer, beveller, and silverer, New Inn Yard, Shoreditch, London, E. C.—B. A. B.

Box-making Machine.—T. M. (*Cwmbach*).—Messrs. Rhodes & Sons, Wakefield, make machines for stamping up all kinds of small boxes; and no doubt, if you state definitely what kind of box you require, and, if possible, enclose them a sample, they would be able to give you some information as to cost, etc.—R. A.

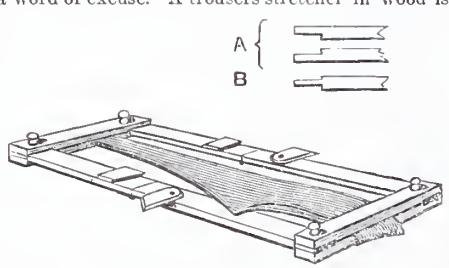
Soldering.—FIDDLER.—You need experience no difficulty in soldering brass screws to zinc plates; I suppose you mean plates of thick zinc, such as engraved name-plates, etc. Proceed as follows:—Scrape the places on the zinc plate where you want to solder the screws; next tin the end of the screw or bolt, or whatever it is that you wish to solder; use killed spirits of salts for this. Now tin the zinc plates on the parts cleaned, using strong spirits, and while both plate and screw are hot, solder them together. You must put a body of metal round, or there will be very little strength in the job. The secret of success is to get the plate well hot; then, if you have properly cleaned and tinned the parts, nothing can prevent them adhering. Used killed spirits for the soldering, and for soldering zinc to galvanised iron, use strong or raw spirits.—R. A.

III.—QUESTIONS SUBMITTED TO READERS.

[Questions in this Section are held over to be answered at an early date.—ED. WORK.]

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Trousers Stretcher.—B. A. B. (*Hampstead*) writes to J. C. K. (*London, N.W.*):—"I accept your reproof, but, while I plead guilty, wish to say a word of excuse. A trousers stretcher in wood is



Trousers Stretcher—A, End Rails; B, Long Rails.

not absurd, for I could, with a little aid from a wood turner, and with the exception of a pair of hinges and some screws—which, of course, must be of metal—make one of beech. I have 'no right to assume KORIC is not a woodworker,' True; but would it not be better if querists gave fuller information as to their wants and capabilities, and even of their preferences? Those who answer questions often have to 'assume' some things which they have no right to. 'I cannot advise him to try to make one in metal.' This I must adhere to; I could not describe how to do the job. But my critic says, 'Why could not anyone who can upset, screw, and drill iron do one of the easiest jobs in blacksmithing?' Why, indeed? I, for one, would be glad to be taught how to do these things; and if my critic will 'assume' that KORIC also wants the same information, I hope he will supply it. However, I will assume that KORIC is a woodworker; if so, he can easily follow my instructions. Obtain two pieces of beech about 42 in. long, 2 in. wide, and 1 in. thick; four pieces about 14 in. long, and the same width and thickness. A pair of strong iron butts and suitable screws will be wanted. Then, by cutting the short rails in about ¼ in. on each side of the long rails, and by obtaining four turned wood thumb-screws, a frame somewhat like an artist's stretcher can be made, having the short ends of double thickness. If the screws pass freely through the two thicknesses and are tapped into the third, the whole thing may be made portable. When fitted, the long rails are to be cut across and hinged, and a pair of strong hooks and eyes, or a pair of dining-table fasteners, will keep the hinged rails straight. If, while the frame is *almost* straight, the trousers are fixed with the thumb-screws, and then the rails are pressed straight and fastened, the trousers will be stretched."

Cycle Tire.—M. (*Bishop Auckland*) writes to CYCLIST (see No. 189, p. 526):—"You will find instructions for fixing tires on p. 521, Vol. III., of WORK."

Hot-water Apparatus for Warming Rooms.—M. (*Bishop Auckland*) writes to W. T. (*Southsea*) (see No. 189, p. 526):—"Try Mr. J. Attwood, engineer, Stourbridge."

Oxygen.—H. B. S. (*Liverpool*) writes to OXYGEN (see No. 192, p. 574):—"OXYGEN wishes to know the uses to which the gas having the same name as himself is put. There are several uses for the gas. First, it is used for giving light, as in the oxy-hydrogen, or limelight; for giving heat, as in the oxyhydrogen blowpipe for autogenous soldering or brazing, etc. It has lately been used for ageing or improving spirits, for which there is a patent out; it is argued that the improvement of spirits is due to the removal of the fusel oil by oxygen, aided by time; and as this is now done quickly by blowing oxygen through the spirits, a treatment of ten days has as much effect as keeping three years. Oxygen is also used in bleaching paper pulp, and, to a certain extent, in the purification of coal gas in a few works. These are all the industrial applications I know of."

Barometer.—F. W. L. (*Wolstanton*) writes, in reply to W. T. T. (*Houghton-le-Spring*) (see No. 189, p. 526):—"With reference to the question as to the construction of a cheap barometer, your correspondent, W. T. T., may make a sensitive and reliable barometer for a few pence if he will get 10 in. of ¼ in. glass tube, and fix one end of it so as to be quite air-tight into an empty ink-bottle (such as are sold at 1d.), pour in a few teaspoonfuls of water, and then put the open end of the tube into another ink-bottle filled with water. The liquid should stand about half-way up the tube, and will be found to rise and fall as the air pressure varies. A scale should be fixed behind to show the variation. A little glycerine in the water will prevent freezing."

Hollow Grinding.—C. K. (267, *Old Street, Shoreditch*) writes, in answer to A. E. B. (*Ashford*):—"I am a hollow razor grinder, and have been established in London over thirty years."

Leather Reviver.—A. C. B. (*Wilmslow*) writes, in reply to J. B. (*Dublin*) (see No. 190, p. 542):—"Replying to your inquiry, I have used a preparation called leathiden for the purpose you mention, and found it more than answered my expectations."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—CARDINAL; C. M. (*Pimlico*); C. M. (*Birmingham*); M. A. N. (*Castleisland*); COTTAGE; J. B. B. (*Liverpool*); W. V. T. (*Newington Green*); R. F. (*Hunwick*); A. W. (*Cambridge Heath*); J. B. W. (*No Address*); A. G. (*Sheffield*); G. P. (*Ealing*); ANXIOUS ENQUIRER; H. R. (*London*); W. B. (*Winson Green*); A. L. & SON (*London*); T. W. B. (*Old Charlton*); H. BROS. (*Settle*); A. W. E. (*Peckham*); F. P. (*Birmingham*); N. F. H. (*Dartmouth*); W. C. (*Coventry*); FRAMES; T. A. B. H. (*Newcastle-on-Tyne*); J. H. N. (*Chester*); PROGRESS A.; J. W. (*Darwen*); 12-BORE; W. C. (*Sheffield*); W. D. (*Highbury*); F. S. (*Withington*); CONSTANT READER; J. McJ. (*Glasgow*); J. B. (*Ashton-under-Lyne*); CHEMICUS; A. T. (*Manchester*); W. A. J. (*Battle*); N. H. (*London, N.W.*); R. D. T. (*Marylebone*); K. B. D. (*Lyne*); A. E. B. (*Newton Heath*); WORKER; W. J. B. (*Londonderry*); CHOPSTICK.

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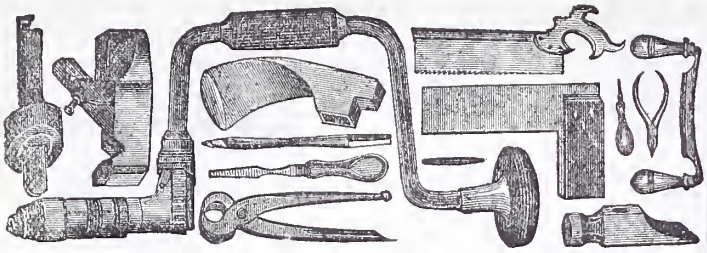

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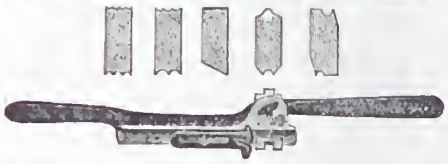

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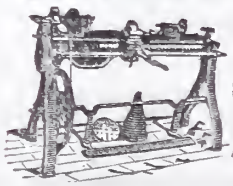

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WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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VOL. IV.—No. 198.] SATURDAY, DECEMBER 31, 1892. [PRICE ONE PENNY.

WORK WORLD.

A METAL closely resembling 18-carat gold is gained by an alloy of 95 per cent. of copper and 5 per cent. of aluminium.

* *

Aluminium is coming into use for cutlery and surgical instruments. It takes a cutting edge, and is said to be harder and more elastic than steel.

* *

The skilled and unskilled workers at Sheerness Dockyard are agitating for the abolition of overtime, piecework, and the present system of classification, and for wages to be paid at Trade Union rate.

* *

The Government has resolved to contribute £45,000 towards the cost of extending the Highland line from Strome Ferry to Kyle and constructing new piers on both sides of Kyleakin Ferry, and the scheme is likely to be carried out without delay.

* *

A new smokeless powder has been tried with a three-pounder Hotchkiss quick-firing gun with the best possible results, giving the projectile a muzzle velocity of 1,935 feet per second. This latest form of smokeless powder is *perfectly* smokeless.

* *

At Yeovil gas-works a strong overflowing artesian well has been struck at a depth of 132 feet 6 inches in rock in the marlstone series. The water immediately rose—in a tube well—to six feet above the ground level, and the supply is copious.

* *

A special commission at Toulon has decided against the use of petroleum as fuel on torpedo boats. Out of ten cans of petroleum experimented upon, eight became ignited from percussion after twelve shots had been fired upon armour-plate protecting them.

* *

The pumice-stone used in commerce is not obtained from active volcanoes, but from deposits in one or two quarters of the world. The best is now found in the island of Lipari, situated in the Tyrrhenian Sea. The island is mountainous, and consists of tuffa, lavas, and other volcanic products.

* *

Vulcanite can be used with advantage for packing rings of piston pumps. It is better in many cases than the ordinary bucket leathers. It can also be made into plugs, cocks, and tubes, for use in an hydrochloric acid process, the acid having no effect upon it.

* *

When balancing a pulley, care must be taken that it balances when "running" as well as when "standing;" otherwise there will be a tendency when running to wobble sideways in the effort to bring two or more heavy parts opposite each other at right angles to the shaft.

* *

Sudden frosts render wood pavement very dangerous; recently, in some parts of London, the wood pavement was covered all day with a coating of ice, while the asphalte paving remained clean and safe, and granite and macadam were damp. Sprinkling gravel over the wood did not succeed in making it safe for horses.

* *

The London Metallurgical Company now produce articles made of "Arcas" silver, which alloy had previously been used for plating only. These articles are of the same intrinsic value as ordinary standard silver, the difference being that the silver is alloyed with cadmium instead of copper. This compound is harder than silver, easier to clean, and has not so much tendency to tarnish.

* *

M. Lepel has been experimenting with a view to test the practicability of obtaining nitric acid from the atmosphere in commercial quantities by means of electric discharges through it. He has lately used a slowly moving atmosphere, varying the pressure and spark through a wide range, and it is reported that a combination reaching ten per cent. of the air used was obtained.

* *

Eckstein, an Austrian engineer, claims to have produced a strong and flexible material as transparent as the ordinary brittle glass. Collodion wool is dissolved in ether or alcohol, and the solution mixed with from 2 to 4 per cent. of castor or other non-resinous oil, and from 4 to 10 per cent. of resin or Canada balsam. The mixture is spread on a glass plate and dried by a current of hot air. Any colour or shade may be given to this substance.

In consequence of the Board of Trade report on the Thirsk accident, the Midland Railway Company have now fixed the hours of signalmen at twelve consecutively in all cases. Where signalmen change, the outgoing official will be held responsible if the relief man is not in a fit condition to work. It is not easy to reconcile these two regulations, as it would seem that in the latter case the "outgoing" man must stay on more than his twelve hours.

* *

Copper-plating sheet zinc for building purposes has been tried abroad with much success. The copper may be deposited by electrical action or precipitated. One part refined verdigris and twelve parts of tartar are dissolved in twenty-four parts of water. The solution is heated to the boiling point, and Spanish white added to precipitate the tartaric acid. The blue solution is filtered off and used as a bath or for the production of a copper-plating paste.

* *

It is stated that the highest speed ever attained on a railway was reached on November 18th by an express train on the New Jersey Central Railroad, U.S.A. The train consisted of four cars—including one Pullman car—drawn by a four-cylinder compound engine of the eight-wheeled type, *i.e.*, four wheels coupled and a four-wheel leading truck. A considerable part of the run was made at speeds of over 60 miles an hour, and several miles were run at speeds of 86 to 90 miles per hour. The highest rate reached is stated as 93·7 miles per hour. The total weight of engine and train was 216 tons.

* *

Piles about 15 in. in diameter have been sunk in Chili, through coarse, compact sand, to a depth of 28 ft. by means of a water-jet. The stratum was with difficulty penetrated by screw piles, and sharp piles could only be driven 14 ft. deep. A pump delivering about 12,000 gallons per hour through a 5 in. pipe would sink two piles, each having a 2 in. pipe projecting about 8 in. below its base. The pile sinks nearly 3 ft. by its own weight, and is then worked by a belt which drives a pulley fixed on the top of the pile. A similar method of pile-sinking was used many years since in connection with the Kent and Leven Viaducts.

WATCH AND CLOCK CLEANING AND REPAIRING.

BY A PRACTICAL WATCHMAKER.

The Lever Watch.

The watches we have hitherto considered have been "cylinder" or "horizontal" watches, and are the ordinary "Geneva" watches of commerce. It is not to be supposed from this that only horizontal watches are made in Switzerland; on the contrary, there are many Swiss levers to be found, as well as English and American. Thus, though there is, speaking broadly, only *one* variety of horizontal watch—that made in Switzerland and the south of France—there are many varieties of lever watches to be met with, which differ greatly from each other. As before observed, there is the Swiss lever, made much upon the same plan as the cylinder watch just described, and differing only in the escapement. Then there is the English lever, built on quite a different plan, though embodying the same principle in the escapement; the American lever (Waltham, Elgin, or other make), which may be said to be in great part a machine-made copy of an English lever; and, lastly, we have that abomination, the "Boston" lever, a Swiss imitation of an American imitation of an English watch, roughly-made, badly-fitted, and more bother to wearers and watchmakers than all the other kinds put together.

It will be gathered from the above remarks that it is the escapement that makes the watch. All watches, wherever made, and however differently planned, are "levers" if they have a lever escapement of some form or other. The general principles of this escapement will now be described, as well as a few of the forms most commonly met with.

Obviously, the time-keeping qualities of a watch depend upon the governing power of the vibrating balance—that is, upon the regularity of the vibrations. If a balance mounted on an arbor (the balance-staff), nicely pivoted, and running in well-polished jewel-holes, with a hairspring of a suitable length attached, be set vibrating and left until it comes to rest, it will perform several hundred vibrations in as many *absolutely equal periods of time.* Each vibration, whether long or short, will occupy exactly the same time. In a watch these conditions of perfect freedom of vibration are impossible. The balance must receive an impulse at each vibration, and must effect the locking of the scape-wheel, or it will be of no service. The question of escapements, therefore, comes to this: that form in which the impulse and locking interferes least with the free vibration of the balance is the best for timekeeping. Some efforts in this direction, as the "duplex" and "chronometer," are beautiful timekeepers, but are so delicate as to be of little use for pocket wear. It has been found in practice that the lever escapement is at once a strong and useful form for the pocket, and sufficiently free and detached to keep very good time when well made.

Looking back upon the "cylinder" watch, we find that when not delivering "impulse," the scape-wheel teeth are "locked" against the cylinder, and act as a kind of brake, retarding it more or less, according to the polish of the cylinder, and the fluidity or stickiness of the oil. This is a constant cause of irregularity. If, after impulse is given, the scape-wheel teeth could be "locked" against some stationary piece instead of the cylinder, the latter would vibrate freely and evenly. This is effected in the lever watch by means of a lever,

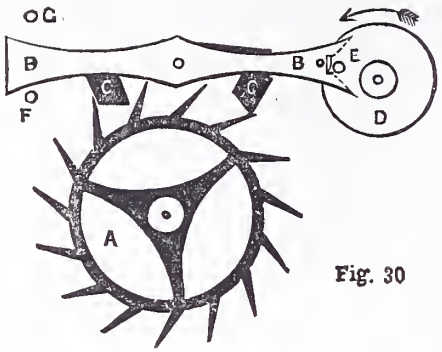
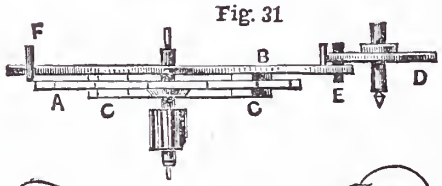


Fig. 30

Fig. 31



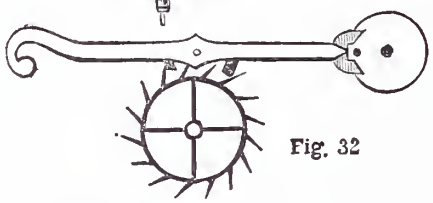


Fig. 32

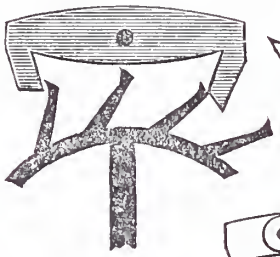


Fig. 33

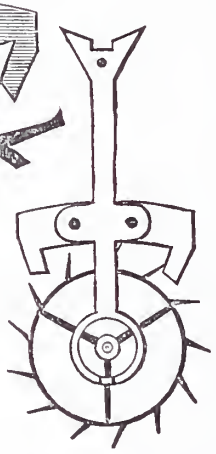


Fig. 34

Fig. 37

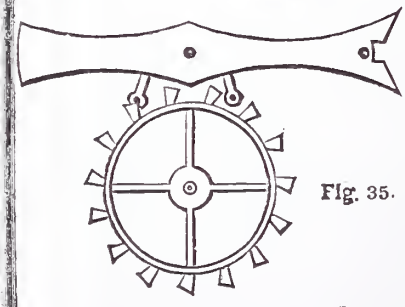


Fig. 35.

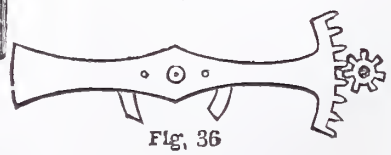


Fig. 36

Watch and Clock Cleaning. Fig. 30.—English Lever Escapement. Fig. 31.—Elevation. Fig. 32.—Geneva Lever Escapement. Fig. 33.—Club Tooth Wheel. Fig. 34.—Straight Line Lever. Fig. 35.—Pin Lever. Fig. 36.—Rack Lever. Fig. 37.—Roller Holder.

which answers the double purpose of transmitting impulse to the balance and locking the wheel. Fig. 30 shows an English lever escapement, a description of which will apply to all other varieties, as far as principles of action go. A is the scape-wheel, having, as usual, fifteen teeth; B is the lever; C the "pallets;" D is a "roller" upon the balance-staff, and E the impulse-pin, upon which the lever acts when giving impulse. This pin is of ruby, garnet, or glass, according to the quality of the watch. The pallets also are either ruby or garnet, to reduce friction and prevent wear. In the figure a tooth of the wheel is "locked" upon the "dead" face of one pallet. The lever was resting on one side against the banking-pin, F; as the roller on the balance-staff came round in the direction of the arrow, the ruby pin, E, entered the notch in end of lever, and is moving it away from the banking-pin. The tooth then passes along the inclined face of the pallet, and gives the lever an impulse, which it passes on to the roller, and the other tooth falls locked upon the "dead" face of the other pallet. The lever then comes to rest against the banking-pin, G. Meanwhile the balance and roller are quite free to vibrate, and as they return under the influence of the hairspring, they unlock the tooth, receive impulse, and again go on quite free of the lever. The balance is quite free, except when unlocking a tooth and receiving impulse. Just below the notch in the lever there is a small brass "guard-pin," to prevent the lever passing the edge of roller between impulses, and so getting on the wrong side. Fig. 31 is an elevation of the same escapement, which will make the action clearer. The letters are the same. Fig. 32 shows the usual form adopted in Swiss levers. Fig. 33 shows the "club tooth" lever escapement, in which the inclines are partly on the ends of the wheel teeth and partly on the pallets. This form is often seen in Swiss watches and American levers, but rarely in English work. In this escapement the wheel is often made of steel instead of brass. Fig. 34 shows the "straight line" lever, in which the scape-wheel, lever, and balance are all in a straight line. It is sometimes used in both American and Swiss watches.

Fig. 35 shows the "pin" lever, a form only occasionally seen, in which the inclines are wholly on the wheel teeth, and the pallets are mere pins. Fig. 36 shows the rack lever, the first form of lever used. In this the end of the lever is a rack, and the roller is not present, but a pinion takes its place. In this form the balance is not really detached at all. It is only found in old English work. Besides these there are the "double roller lever" to be seen in very good English watches, the "two-pin" lever escapement, and the "resilient" lever, all but rarely met with.

Quite apart from the fact that I am an Englishman, I must say that of all these varieties I prefer the plain, unadorned English lever escapement, as shown in Fig. 30, and believe it to be the best form for pocket use, to keep good time, and stand many years of wear.

In cleaning and repairing Swiss watches, great care must be taken not to bend or break the scape-wheel or pallet-staff pivots, as they are usually very fine. As far as mere cleaning is concerned, the previous instructions will be found quite sufficient; but a few hints as to the adjustment of the escapement will be of service.

To set a lever watch in beat, either the

roller or the hairspring collet may be turned round. In handling the roller, brass-nosed pliers must be used. It is pushed friction-tight on the balance-staff.

To Put a New Impulse Pin in the roller, take it off the staff, and put it upon a holder like that shown in Fig. 37. This consists of a piece of iron or steel wire, upon which a piece of brass is fixed near one end. This end of the steel is tapered so that rollers may be pushed on. Having placed the roller upon the tapered end of the holder, some half-inch or so from the piece of brass, hold it over a lamp flame to *warm the brass*, taking care not to let the flame get near the roller. The brass piece holds the heat, and in a second or two after removing it from the flame, the shellac, which holds the broken stump of the impulse pin, will melt, and the pin can be pushed out. The roller can then be removed, and a new pin (full size) carefully fitted. Place it in position, and put the roller once more on its holder. Warm as before, and just touch the pin with the edge of a flake of shellac, pushing it well down. When cool, remove the surplus shellac with a sharp point. Very little heat is required for this operation; too much will draw the temper of the roller.

In replacing the roller, be careful that it is well free of the lever, and on no account handle it with anything but brass-nosed pliers, or the edge will be roughened and cause the watch to stop. No oil must be applied to the lever notch or impulse pin; but a very little must be placed on each pallet face, and, of course, to all pivots.

The escapements of these watches when new are generally fairly correct; but when they become worn, are very difficult to properly adjust. As all the pivots run in jewel holes, it is not easy to adjust the depths. The "bankings" of the lever also are generally against the brass plate, and cannot be properly adjusted. Instead of a guard-pin in the lever, they usually have a projecting piece of steel termed the "dart," which, being made in one piece with the lever, affords no means of adjustment. When once these watches become worn they are a perpetual trouble to all concerned.

SWEDISH WEAVING.

BY COUNTESS HAMILTON AND MISS CLIVE BAYLEY.

The Warp, and How it is Prepared.

The warp is made of cotton for cotton goods, of cotton or linen for linen goods, and of cotton or wool for woollen goods. In the description of each kind of weaving the quality of the particular warp necessary will be mentioned. For woollen fabrics in ancient times linen warps were much in vogue, for being ready grown in the country and ready spun in the household, flax was always at hand; but nowadays cotton has to a large extent replaced the use of linen, as being more economical and almost equally durable.

The weight of material required for linen goods woven on a linen warp ought to be equal in weight both in warp and woof, and the same rule holds good for either cotton woven on cotton or for wool woven on wool. The weaver can always reckon the number of threads in the warp to the square yard (it varies, of course, according to the quality of the warp used); and as each kind of material has patterns particularly suitable to it, we will mention the right number of warps to the yard when giving directions for each style.

The usual method of deciding how much material for the warp is wanted is to count

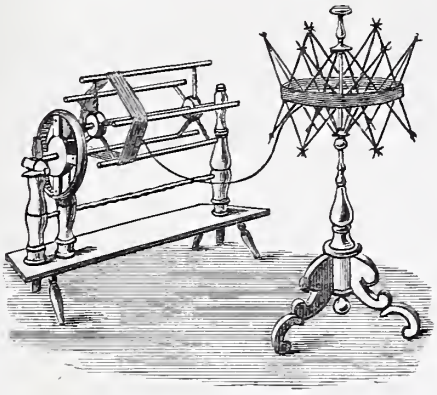


Fig. 11 Fig 10.

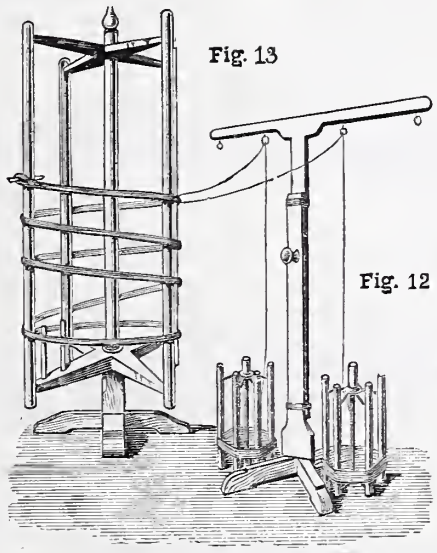


Fig. 13

Fig. 12

Fig. 13A

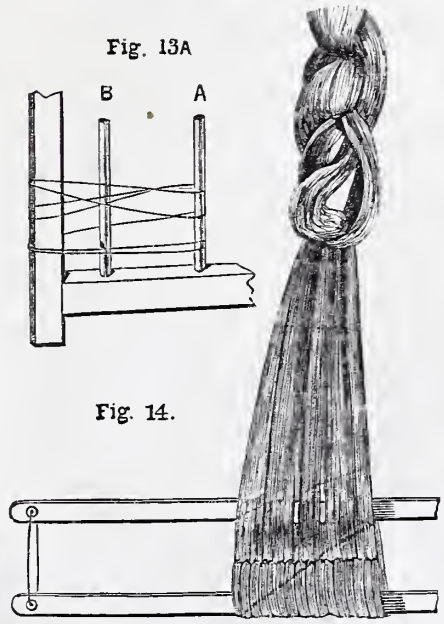


Fig. 14.

Swedish Weaving. Fig. 10.—Swift or Winder. Fig. 11.—Bobbin and Bobbin-stand. Fig. 12.—The T Bobbin. Fig. 13.—Warper or Warping Mill. Fig. 13 A.—Detail of Warper. Fig. 14.—Warp Plait.

the meshes of the reed. Let us calculate that two threads pass through each mesh, as that is the usual rule. Then measure on the reed the width of the material which you wish to use. Then count on the reed how many meshes there are in the piece of the reed which you have measured off. Then divide those meshes by fifty, and for every fifty meshes you take for a cotton warp one skein of cotton. These fifty meshes are called a *bund*, and therefore one skein goes to a bund.

For the odd numbers over from the fifty—as, for instance, in two bunds and fifteen over—you would count two skeins and, roughly speaking, one-third; it is impossible to calculate quite to a thread, and a little margin should always be allowed.

Thus, for instance, if you are working with a reed which holds five bunds—that is to say, 250 meshes to the half yard—and if you wanted to weave a piece of material ½ yard wide and 7 yards long, five skeins suffice; 1½ yards wide and 7 yards long, fifteen skeins suffice; 1 yard wide and 7 yards long, ten skeins suffice; ½ yard wide and 14 yards long, ten skeins suffice; 1 yard wide and 14 yards long, twenty skeins suffice; and so forth.

Further, if you buy the cotton by the pound, the number marked on the cotton is the number of skeins to the pound. Thus, for example, for No. 12 cotton there are twelve skeins to the pound, and for No. 15 cotton there are fifteen skeins to the pound. One bundle contains about 12 lb.; accordingly, you would have 120 skeins in a bundle of No. 12 cotton.

In two-ply English twilled linen thread, which is what is generally used for linen warp, a very much finer reed is used—about ten bunds to the ½ yard (*i.e.*, 500 meshes to the ½ yard). For this thread you would order: 1 yard wide and 2 yards long, ten skeins; 1 yard wide and 4 yards long, twenty skeins.

Woollen warps are so unusual that we will not give further details of these. The details for the woof follow later.

The first thing the weaver has to do, after having bought her warp material (Fig. 14) is to wind it on to the bobbin; or, technically speaking, to "bobbin it." She ties the thread on to the lower part of one of the frames of the bobbin as it is ready placed on the stand. The material for the warp ought to be placed, as has been said, on the winder, close to the bobbin-stand. The worker sits between the two machines, and lets the thread from the winding-stand (Fig. 11) pass through her left hand, while she turns the handle of the bobbin with her right hand.

The worker must begin at one end, winding the wool thickly and carefully on the bobbin, and moving very slowly indeed towards the further end, regulating the movement with the left hand, just as the fliers regulate the filling of the spools in spinning, only in the case of bobbin-winding the thread must never go back over what is already wound.

The ordinary way is to have two bobbins; but it is, of course, quicker in warping to have several pairs—they must necessarily be in pairs, when two threads go through each mesh of the reed. After having wound the cotton, place the two bobbins, or as many pairs as you are going to use, under the T (Fig. 12), and let each thread go through one eyelet-hole in the T. Thus you must have as many eyelet-holes in your T as you have bobbins. Then hold either the two or the several threads in one hand, and turn towards the warper (Fig. 13), on to

which you fasten the threads round the pin at the bottom of the warper nearest the axle, having first knotted all the threads together, so that the pin divides all the threads evenly. Then take the whole skein—closed, as it were—and pass it outside the next pin. Then, still holding the threads in the same hand, turn the warper with the free hand, and let the threads slide gently through your hand on to the warper, guiding them as they pass through the eyelets from the bobbins on to the warper. The threads must run spirally up the warper. You know beforehand how long your warp is to be; you know also how many yards round your warper is. You must, therefore, calculate how many turns you require to make the whole length of your warp. Thus, if your web is to be 20 yards long, and your warper is 4 yards in circumference, five turns will make the right length; if the length is 22 yards, you take half a turn more, and fasten it with a peg. In any case, when the length of the warp is reached, wind the threads round the peg (there are little holes in the warper for the purpose), then turn, and go back just the same way you have come, leaving the empty spaces between the spirals still free, and keeping the threads over what has already been wound.

When you come down the bottom pins again, you let the threads in your hand go outside pin B and round pin A, then inside pin B again, so that they cross each other. This must be done most exactly each time you reach the bottom, for it makes what is technically called the "shade." It is impossible to keep the threads in the right place if this precaution is neglected (see Fig. 13A).

The weaver has already learned to count the bunds to the width required (every bund has 100 threads), and she also knows how many bunds she wants. It is easy to count the number of threads. She has had two threads in her hand, so every time she returns to the bottom pins she has made four threads in the width. She must, therefore, do this (once up and once down) twenty-five times in order to make a bund; or, if she wishes, she can count the number of threads in the shade on the bottom pins, for, of course, every cross makes four threads.

When she has made the right number of bunds, she finishes the warping at the upper peg. She then fastens very firmly the shade at the bottom of the warper, putting a ribbon through both loops of the shade and tying it firmly, so as to replace the two pins when the warp is removed from the warper. When this is tied, she removes the peg at the top of the warper, replacing it by her hand. She proceeds to unwind the warp, at the same time drawing it into long loops, like a chain in crochet, and finally lifts it off the lower pins. She then ties the loop she holds in her hand with ribbon, so as to keep it firm. The warp is now ready to place on the loom.

HOW TO MAKE A HARMONICON.

BY MUNIO.

THE harmonicon is a simple instrument of percussion, and, with a very little practice, some very pleasing melodies may be obtained from it.

It consists of a number of plates of steel, stone, or glass fixed upon supports, and is played by one or two small wooden beaters. These instruments have been in use from very ancient times, and at the present day percussive instruments of metallic plates are very popular in the extreme East.

The harmonicon about to be described consists of a number of plates of glass, which form the notes. These are supported on strong tapes fixed inside a box, which increases the sounding properties.

Twelve notes, from C to G, are shown, but any number may be used. Semitones may also be added by making the box wider, and fixing them in groups of two and three by the side of the naturals.

Fig. 1 is a section showing the inside of the case, with the glasses arranged on the tapes. It will be observed that the glasses gradually decrease in length as they ascend in the scale.

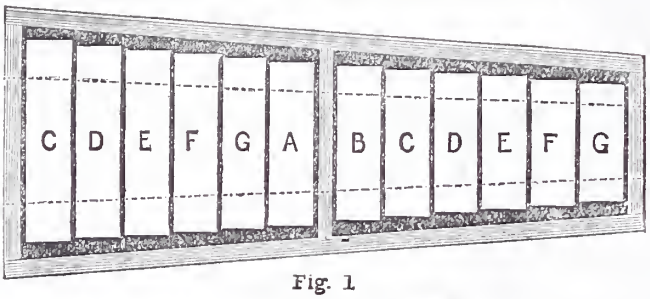


Fig. 1

Fig. 3

Fig. 2

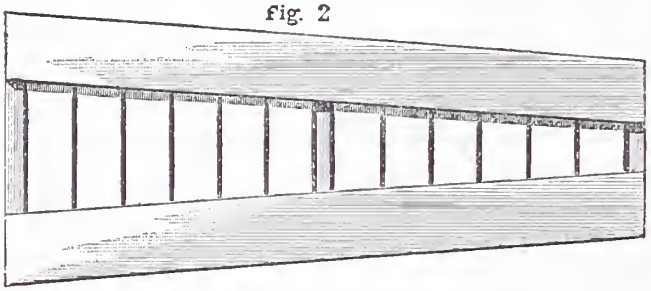


Fig. 1.—Section of Harmonicon. Fig. 2.—Outside View. Fig. 3.—Beater.

The case is made of dry $\frac{3}{8}$ in. pine, planed on both sides, and neatly jointed and fixed together with brads and glue. The length inside is 14 in.; width at the largest end, $5\frac{1}{2}$ in.; and width at the narrow end, $3\frac{3}{4}$ in. Care should be taken to make the bevel equal at each side. For this purpose, draw a centre line, and set off half the width at each side on lines squared from both sides of the centre line. Make the depth of the case $1\frac{3}{4}$ in.; also fix in the centre a bridge for supporting the tapes. This is $\frac{3}{4}$ in. deep, $\frac{1}{4}$ in. wide, and the top should be about $\frac{1}{4}$ in. below the sides of the case. Also prepare two strips for the top of the case. These are each 1 in. wide, and the full length of the case, and are fixed with screws, as shown in Fig. 2.

The tapes are $\frac{1}{4}$ in. wide, and must be strong linen tape. They are fixed in holes made in the ends of the case, and secured by wooden wedges, glued and driven in tight. The tapes must be stretched as tightly as possible, and are fixed to the bridge by small upholsterers' pins. The tapes are fixed $\frac{1}{4}$ in. below the top edge of the case, and 1 in. from each side.

The glasses are 1 in. wide and $\frac{1}{16}$ in. thick. They must be tuned to a piano or other musical instrument. The following is the approximate length of each note:—C, $5\frac{1}{4}$ in.; D, 5 in.; E, $4\frac{7}{8}$ in.; F, $4\frac{5}{8}$ in.; G, $4\frac{1}{2}$ in.; A, $4\frac{3}{8}$ in.; B, $4\frac{1}{4}$ in.; C, $4\frac{1}{8}$ in.; D, $3\frac{3}{4}$ in.; E, $3\frac{5}{8}$ in.; F, $3\frac{1}{2}$ in.; G, $3\frac{3}{8}$ in. Should the instrument be made larger, the notes upwards or downwards will decrease or increase in about the same proportions. The glasses must be laid on the tapes, and when of the correct tone, are fixed by shellac dissolved in methylated spirits. A little applied at each corner will hold them. As soon as they are set, the two strips are fixed on the top of the case.

The beaters are made of hard wood, about $\frac{3}{4}$ in. wide and $\frac{1}{4}$ in. thick, and made wedge-shaped, as shown in Fig 3. A piece of cork is glued on the point. The handle is 8 in. long, of split cane, tapered and smoothed, and glued in.

The outside of the case may be stained and varnished, or painted with ordinary paint and varnished.

EXPERIMENTS WITH INDUCTION COILS.

BY G. E. BONNEY.

GASSIOT'S CASCADE—ROTATING VACUUM TUBES—VACUUM TUBE ROTATORS—HAND ROTATORS—ELECTRIC ROTATORS—DECOMPOSITION OF WATER—HENLEY'S DISCHARGER.

Gassiot's Cascade.—This beautiful experiment, the invention of M. Gassiot, is performed by the aid of similar apparatus to that described in the preceding chapter, using an air-pump and a bell-glass receiver with an open mouth on top of the receiver. To this open mouth must be fitted an air-tight collar of leather, through which passes a metal rod cemented in a glass tube, and ending in a knob at the lower end and a connecting screw at the upper end. A goblet must also be prepared by coating the inside with tinfoil up to within $\frac{3}{4}$ in. of the brim. Place this goblet on a metal plate inside the receiver, and connect the plate with one terminal of the secondary of a good induction coil. Connect the other terminal to the metal rod on top of the receiver, and push the ball of this rod down into the goblet, but not touching the tinfoil coating. Set the coil in action, and proceed to exhaust the receiver. As the receiver becomes exhausted and the vacuum improves, a very pretty effect will be produced. At first a blue light will appear at the bottom of the goblet. As the vacuum improves this light rises, and increases in brilliancy until it reaches a line coincident with the inner coating of tinfoil. The whole interior of the goblet then becomes intensely illuminated, and a continuous stream of electric fire seems to overflow the edge of the goblet, and pour down its sides in the form of a fiery cascade. Suitable receivers, fitted up for this purpose, cost from 10s. 6d. to 25s., and a Tate's double-action air-pump, suitable to this purpose, will cost about £3 3s. But a less expensive apparatus may be employed, such as that shown at Fig. 16, costing 25s. On consulting the price-list of Messrs. King, Mendham & Co., Bristol, I see that they supply a 6 in. Gassiot's cascade, with uranium glass vase, for 5s., and one of 8 in. for 7s. 6d. These are already exhausted and sealed as an

ordinary vacuum tube, and therefore ready for attachment to an induction coil.

Rotating Vacuum Tubes.—The experiments detailed in this and a former paper have hitherto been performed with fixed or stationary tubes and bulbs. A still further variety of experiments may be performed by arranging a tube or a number of tubes on a frame, as tubes of fireworks are arranged to form the well-known Catherine wheel, and then rotate the frame whilst the induced current is passing. Or the tubes may be fixed to a wheel, and this made to rapidly revolve whilst sparks are passing through the tubes. A pleasing variety of arrangements may thus be made with a good selection of tubes, and some splendid colour effects may be produced if coloured tubes are selected and properly arranged.

Vacuum Tube Rotators.—We may not tie the tubes to the spokes of any wheel nearest to hand, and think to secure the effects mentioned in the preceding paragraph. The wheel employed in rotating vacuum tubes must be previously prepared to receive them, and provision must be made for connecting the wires from the induction coil to the ends of the tubes. If the wires were connected direct to the tubes in the ordinary manner, the first turn of the wheel would twist them off and break the connections. The wires from the secondary terminals of the induction coil are, therefore, connected to two binding posts on the base of the rotator, and wires lead from these to two springs, which press against two brass sleeves or rings insulated from each other, and fixed to the hub of the rotator wheel. One wire, or a strip of brass, goes from one of these rings to a clip or connector on one half of the rotator wheel to connect it with one end of the vacuum tube, and a similar arrangement is attached to the other ring for connection to the other end of the tube. When, therefore, the tube or tubes are secured to the wheel by suitable clasps, the platinum wires at the ends are connected to the clips before mentioned, and thus the two ends are placed in circuit with the secondary wire of the coil through the springs, which press on the hub of the wheel whilst it revolves.

It is not necessary to have a wheel. A spindle carrying an insulating hub of hard wood or ebonite, furnished with two rings, and a transverse piece of wood or of metal, fitted with the needed clasps and clips for holding the tubes, is all that is necessary. If the transverse arms are of metal, they must be screwed into the hub and insulated from each other, or held in an insulating tube attached to the hub. Care must be taken here to have the inner ends of the arms at a sufficient distance apart, or separated by enough insulation to prevent sparks passing between them. If this is not done, the high tension current from the coil will leap across the gap instead of passing through the tube. A similar consideration must be given to the insulation of the contact springs and rings. The spindle of the rotator may be revolved by any motive power, but the two generally employed for the purpose are manual labour and electro-motors.

Hand Rotators.—If a spindle with transverse arms, fitted with suitable connections as detailed in the preceding paragraph, is mounted in a pair of standards and furnished with a small grooved pulley, it may be made to revolve at a rapid rate with a bow-string: much the same as fiddle drills are worked, but the direction of rotation will be alternating instead of continuous. To secure a continuous rotation in one direction, it will be necessary to have a wheel actuated by a winch handle, and a band from this to the grooved pulley on the spindle, or a set of such wheels with multiplying arrangements if the spindle is to be driven at a high rate of speed.

Electric Rotators.—The most popular form of vacuum tube rotator is, however, that of a small electro-motor. Any small electro-motor may be pressed into service, providing the rotator itself is fixed on a suitable stand high enough to allow of the transverse arms revolving freely; but special forms are usually employed, such as those shown at Figs. 17 and 18. Fig. 17 shows the ordinary form of vacuum tube rotator, sold at £1 1s. each by

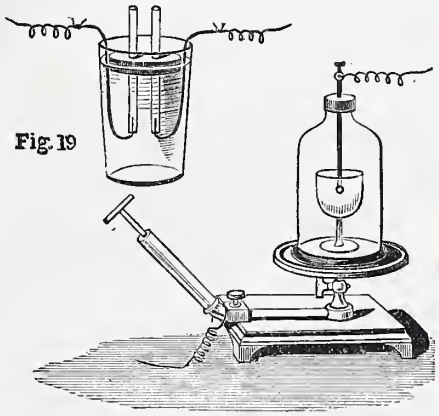


Fig. 19

Fig. 16

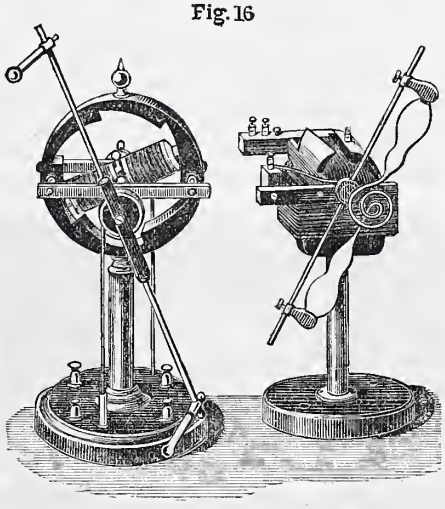


Fig. 17 Fig. 18

Induction Coils. Fig. 16.—Apparatus for producing Gassiot's Cascade. Fig. 17.—Ordinary Form of Vacuum Tube Rotator. Fig. 18.—Bowron's Vacuum Tube Rotator. Fig. 19.—Apparatus for decomposing Water.

opticians and general dealers in electrical sundries. It is of French manufacture, and serves its purpose fairly well. Fig. 18 shows a vacuum tube rotator, made and sold by Mr. G. Bowron, who says of it: "This rotator is an entirely new design. It is greatly superior in appearance and performance to the somewhat cheaper ones of foreign make. The price is £1 1s."

Decomposition of Water.—Water may be decomposed into its constitutional elements, hydrogen and oxygen, by the induced current from an induction coil and a simple home-made apparatus. Procure a thin glass tumbler or a glass beaker of similar size, also a thin disc of cork or a slice off a cork bung, to float on water in the tumbler when nearly full; also two glass tubes similar to those in use for small thermometers, of about 5 in. in length; also two 6 in. lengths of gutta-percha covered No. 18 or No. 20 copper wire. Strip off the gutta-percha from one end of each wire to the length of 1 in.; at the opposite ends warm the coating, strip it back so as to bare 1 in. of the wire, clean this, and solder it to a tip of platinum wire, then coat the whole again perfectly with the warmed gutta-percha to within ¼ in. of the extreme ends. Pierce the bung with two holes, 1½ in. apart near the centre, and fit therein the two glass tubes, with half above and half beneath the bung. Three-fourths fill the glass tumbler with water made acid by adding a little sulphuric acid or some vinegar, insert the platinum tips of the wires in the lower ends of the glass tubes to a distance of 1 in., turn the wires up by the rims of the bung, and float this on the surface of the acidulated water with wires going down each side, and turning up into the glass tubes as shown at Fig. 19. Connect the terminals of the secondary coil with the upper cleaned ends of the wires, and set the coil in action. Hydrogen gas will be given off from one electrode and oxygen gas from the other, and either may be collected from the open mouths of the tubes in the ordinary manner. If the amateur experimenter wishes for a more finished apparatus, and is skilful in glass manipulation, the conducting wires may be insulated in glass fused around the platinum tips, and these may be mounted in a polished mahogany cover, together with the glass tubes for conveying the decomposed gases from the solution. If the bared ends of the conducting wires are not inserted in glass tubes, but left exposed in the solution opposite to each other, sparks may be made to pass between them under water. If only one electrode is used, and a wire from the opposite terminal of the coil is approached to the surface of the acidulated water, sparks may be drawn from the surface, and thus fire may be apparently obtained from water.

Henley's Discharger.—Many of the remaining experiments about to be described are best performed by the aid of an instrument known as the Henley discharger, so named from its inventor. It is well known that the high tension alternating current from a spark induction coil, however small, produces a kind of tetanic effect on the nerves and muscles of animals when made to pass through them. These effects are painful from small coils, and positively dangerous from large coils giving a 1 in. spark and over. If any conductor connected to a spark coil is brought into contact with two parts of the human body, such as the two hands whilst adjusting any part of the coil, a sharp and painful shock is instantly felt. If the conductor is insulated by a non-conducting or a badly-conducting covering, no such shock is experienced. Henley's discharger is an instrument constructed of insulated conductors, arranged for easy and convenient manipulation in directing the high tension current from an induction coil.

In the ordinary form of discharger, two brass rods, terminating in small balls at one end and ebonite handles at the other, are mounted on pillars of ebonite or glass, and so arranged by ball and socket joints as to admit of being deflected at any angle over an insulating table of ebonite placed midway between the pillars. Such a discharger will cost 25s., and is used generally for experiments with frictional electric machines and Leyden jars. To use such a discharger for spark coils, the balls at the ends of the rod should be taken off, the ends pierced with holes to form sockets or holders for

bits of wire, and small set screws inserted transversely, to keep the wires in position.

An improvised discharger may be made from gas-fittings. Get a pair of T's, and mount them as cross caps on the ends of two glass rods 4 in. in length, by means of some good cement. Brass, $\frac{3}{8}$ in., or even $\frac{1}{4}$ in. T's will be better than iron. Next get two brass foot sockets to serve as feet for the pillars, and cement the pillars into them; then screw the feet 8in. apart to a square slab of polished mahogany or other hard wood, and see that the holes in the T's are level and coincident with each other. Next get two brass rods large enough to slide stiffly in the T's, and about 8 in. in length. In one end of each, drill a $\frac{1}{16}$ in. hole to a depth of $\frac{3}{4}$ in., and traverse this at $\frac{1}{4}$ in. from the end by another small hole tapped and fitted to a small thumb-screw. This hole will hold the pieces of wire employed in the experiments. At the other end of each rod, fit a handle of ebonite or hard wood with a ferrule, and pierce the rod near the ferrule with holes to receive the ends of wire conductors from the secondary of the coil and thumb-screws, to hold them in position. Midway between the two discharger pillars, mount a slab of $\frac{3}{8}$ in. ebonite, $2\frac{1}{2}$ in. by 2 in., on a shorter glass pillar, so as to bring the small table about $\frac{3}{4}$ in. below the level of the discharger points. This small table will be used as a support for various substances used in experiments to be described later on.

The two rods of this discharger will be connected to the terminals of the secondary coil by lengths of copper wire, and will then be pushed towards each other until the points are near enough for the sparks to pass between them in air. The rods should, therefore, be made to slide a little stiffly in their T supports. When it is necessary to bring the points of the dischargers to bear upon substances laid on the insulated table, it will be only necessary to insert two platinum wires in the rods of sufficient length, and bend them to the required position.

RENOVATING OLD FILES.

Many a file is cast aside as useless in the amateur's workshop which, if cleaned, would be found a serviceable tool. Files are often used upon miscellaneous work which fills them with grease, old paint, etc., in which the particles of metal become embedded, which not only gives the tool an appearance of wear, but renders it almost useless. Give the file a copious dose of paraffin oil, then wash it in very hot water with a stiff brush, soap, and washing soda; next clean out the cuts with a sharp-pointed awl, etc., apply more paraffin, and brush as before. Then with a hard dry brush and fine emery, or ground coal cinders, brush vigorously across the file in the direction of the cutting, and one may venture to say that it will surprise the owner by its renewed powers. Fragments of hard metal embedded between the teeth must also be picked out.

DESIGN FOR INLAID WORKBOX.

BY FLORENCE HUDSON.

How much trouble and thought does the choice of a suitable present for those we love often involve! It is not its money value that makes one gift more acceptable than another. The gift that is most acceptable is the one that supplies some present need. "The very thing I wanted:" that is what we all wish to hear the recipient say.

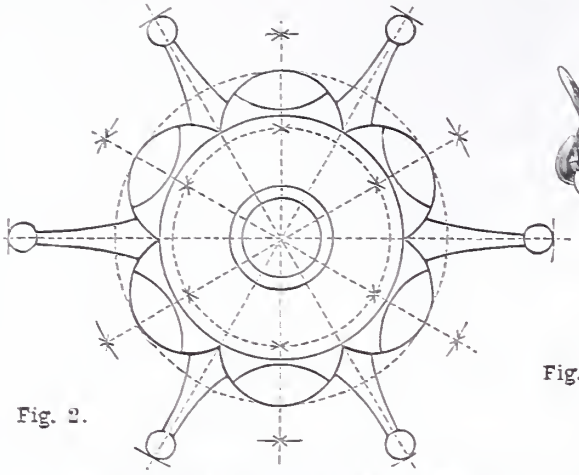


Fig. 2.

Fig. 1.

Design for Inlaid Workbox. Fig. 1.—Marigold. Fig. 2.—Lines of Conventionalised Marigold.

Again, how much more we value our own little gifts, when we receive them, if we can picture our husband, brother, or friend spending his winter evenings fashioning, with his own hands, his little keepsake.

Now, if there is one thing more than another that never comes amiss to a woman, it is a box; *that* she can always find a use for. Therefore, in presenting the accompanying design to the readers of Work, I hope I shall be not only helping to relieve the tedium of the winter evenings of the stronger sex, but also helping to provide a useful present for one of my own sex.

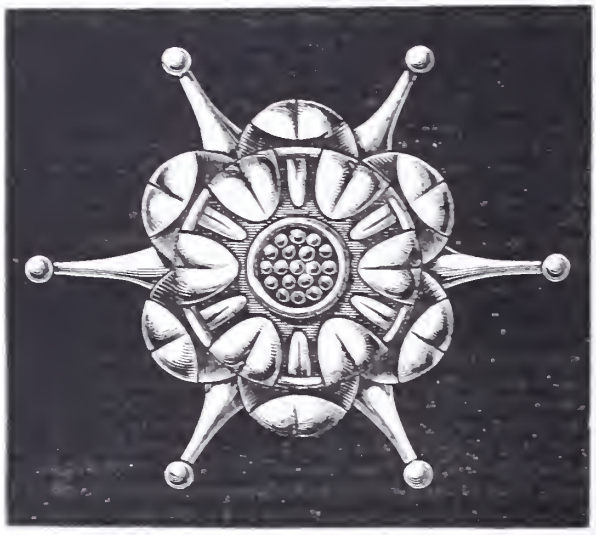


Fig. 3.—Conventionalised Marigold.

The design is drawn with a view to inlaid work, real or imitation, and admits of infinite variety of treatment, as regards materials and the introduction of different tints and colours. It was suggested by the common orange garden marigold, the centre ornament being a conventional rendering of the half-ripe seed, a drawing of which I give, as in nature, in Fig. 1. In designing the front of the box, I have endeavoured to arrange the pattern so that the line of opening (A) should form part of the design, and also the keyhole. I have also left a piece unfinished to show the construction lines, thinking that it will prove useful in working out the design, by showing the bisections and the points from which the arcs were struck. I also give, in Fig. 2, the working lines of the centre ornament of the lid.

May I venture to give another hint? In working out a set pattern, such as this design, success chiefly depends on the accuracy of the repeated parts. Now, with ordinary compasses and rulers it is extremely easy, while taking the greatest possible care, to make a very perceptible error. For instance, you have found the exact radius required for a set of circles. Beginning at one end, you proceed to mark them off with, as you think, the greatest care, and then are much surprised and disheartened to find, when you reach the other end, that you are $\frac{1}{4}$ in. short. Again you try, and this time overlap by $\frac{1}{8}$ in. Compasses will slip, and an infinitesimal alteration in the radius makes a very respectable error when multiplied a dozen times. But the converse is also true: that that very $\frac{1}{4}$ in. which left an aching void will, divided by twelve, escape detection by almost the sharpest eyes. My hint is this—always work to right and left of bisections, or, at any rate, make sure of your largest divisions first. Say that you have to make six circles on a given line. Bisect the line first, then divide each bisection in three equal parts, and then bisect those parts again. You will then have the centres and radius of your six circles; and any slight error being confined to its own circle, there will be no accumulation at one end. Now, please do not jump to the conclusion that I wish to defend slovenly work; far from it. But I know too well, from my own experience, how difficult it is to obtain absolute accuracy. I only desire to help some beginner to make "both ends (geometrically) meet." For instance, in this design (if all four sides are to be ornamented) the worker will find that the short side is not an exact dividend of the long. Roughly speaking, it will take two marigolds, the straight lines of the border and a fraction over. Therefore it will be necessary to start from a central line, and by slightly increasing the radius, or allowing a trifle more space between the flowers, make the pattern fit. The difference is so trifling that it will be imperceptible when at right angles to the front. Although originally intended for flat ornamentation, this design would work out effectively in relief, in wood-carving, or *repoussé* work. I give the central ornament so treated in Fig. 3.

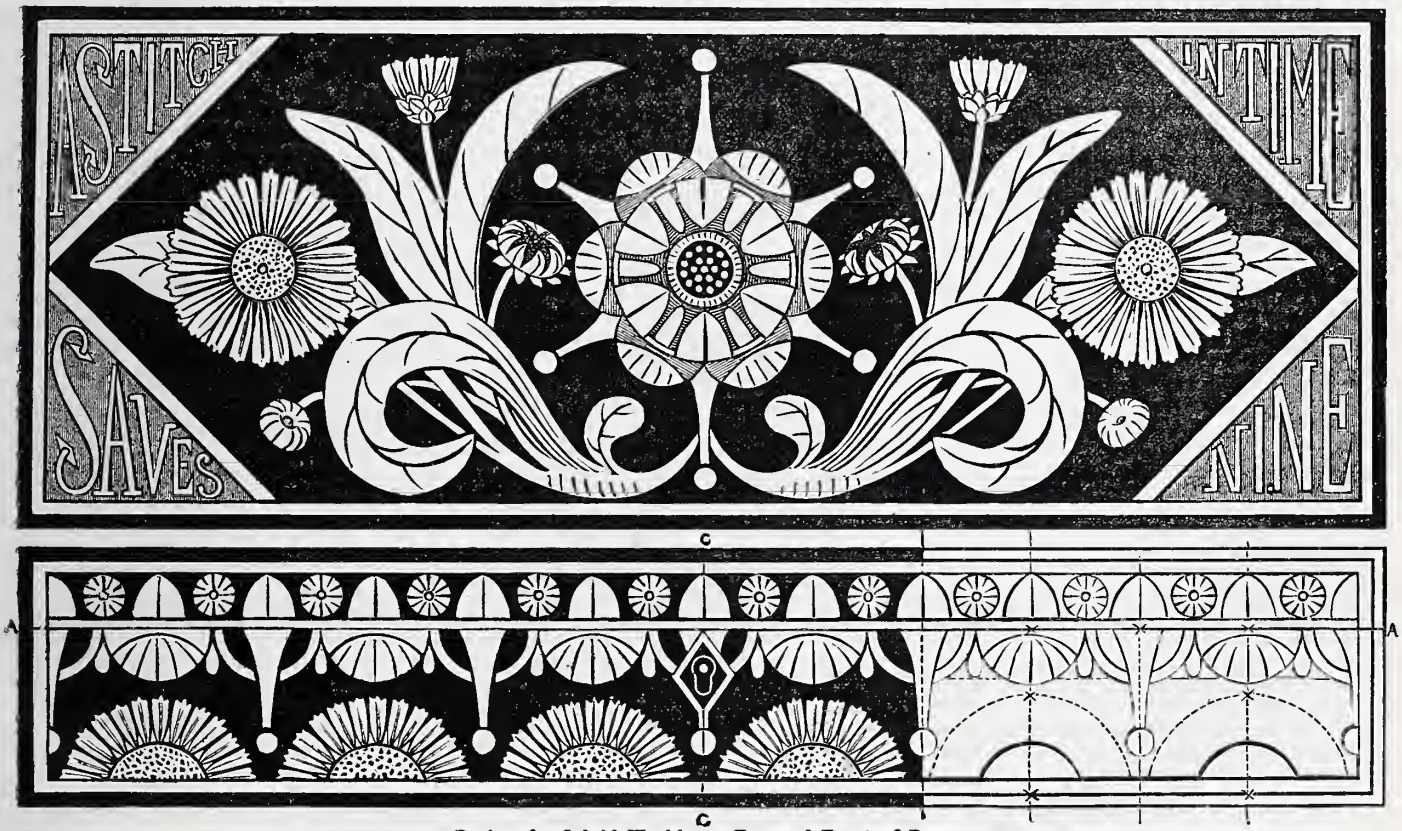
Again, the design on the lid could easily be adapted to painted tiles for window-boxes, for which conventional designs are always more suitable than strict reproductions from nature. The same design would also make an effective stencil pattern to edge a self-coloured dado.

Speaking of imitation inlaid work, I saw some lately that was wonderfully like the real Tunbridge work, which, I was told, was done with various wood stains and Judson's dyes. The outlines were put in first firmly with black paint, mixed with gold-size, to prevent the running of the stains that followed, and the whole was subsequently French-polished.

TESTING ELECTRIC PILES.

It is not an easy matter to compare electric piles of various systems, the types of which are innumerable. Col. Burnham, of Boston, gives this method, which is simple and ingenious :—

An apparatus is attached to the movement of an ordinary clock, composed of two light discs, in which three-quarters of the surface is electrically isolated from the axis, and the fourth part in electric communication with this axis. These discs make one revolution per minute. By joining one of the wires of the pile being tested with the axis, and the other with a spring grazing the circumference of the disc, the pile can be put in *short circuit* for fifteen seconds per minute, and thus two piles can be compared with great accuracy.—*Génie Civil.*



Design for Inlaid Workbox. Top and Front of Box.

SLATING FOR SLATERS.

BY E. D.

Pitch of Roofs—Names of Parts—Method of Determining Lap and Gauge—Preparing—Nailing—Table.

Pitch of Roofs.—The pitch, or inclination of sides, of roofs for slates of different sizes is as follows: For large slates—inclination of sides of roof to horizon, 22°; for ordinary slates—inclination of sides of roof to horizon, $26\frac{1}{2}°$; for small slates—inclination of sides of roof to horizon, 33°.

Names of Parts.—The "back" is the upper surface of the slate; the "bed" is the under surface; the "head" is the upper edge; the "tail" is the lower edge; the "margin," or "gauge," is the part of each course exposed on the upper surface; the "lap" is the distance by which each slate overlaps the next slate but *one* below it; the "gauge" is the depth of the margin.

Method of Determining the Lap and Gauge.—These are more accurately defined as follows:—The "lap" is the distance between the tail of any course and the *nail-hole* of the course next but one under it. The "gauge" is half the difference between the length of the slate (measuring from the nail-hole) and the lap. For example, with "ladies" (16 in. × 8 in.) nailed at the head, 16 in. less 1 in., the distance from nail-hole to head = 15 in., less 3 in. lap = 12 in., divided by 2 = 6 in. gauge, or half the difference, measuring from nail-hole and the lap. When slates are nailed near the centre, the lap is the distance between the tail of any course and the head of the course next but one below, and the gauge is equal to half the difference between the lap and the full length of the slates. Thus, with "countess" slates (20 in. × 10 in.) nailed near the centre, the lap being 3 in., the gauge is $\frac{20 - 3}{2} = \frac{17}{2} = 8\frac{1}{2}$ in.

Preparing Slates.—The slates are first carefully squared to size (except the heads), the edges straightened, each punched with two nail-holes, and the whole sorted, the broken ones being used for eaves, etc.

Nailing Slates.—In nailing slates near the head, the nail-holes are punched at about an inch from the head, and the tails of the course next but one above override the nail-hole by the specified lap.

In nailing slates near the centre, the nail-holes are punched at a distance from the tail equal to a little more than the gauge and the lap added together. For instance, the "countess" slate mentioned above is $8\frac{1}{2}$ in. gauge and a 3 in. lap, $8\frac{1}{2} + 3 = 11\frac{1}{2}$, $+ \frac{1}{2} = 12$ in., or distance of nail-hole from tail.

The latter method of nailing slates is of a more recent date than the other, and is preferable for large slates, as from the position of the nails the wind acts upon the slates with a leverage of only about half its length; moreover, the slating is easier to repair. It has, however, the objection that the breakage of one slate exposes the nail of the slate below it to the weather.

Slates nailed in the centre are the most economical, as fewer slates are required to cover the same area.

Table showing the Sizes and Weights of Slates, and the Number required for Roofing.

Name of Slates.	Size.	Gauge for 3 in. lap nailed in centre.	Number of Squares covered by 1,200.	Weight of 1,200, 1st quality.	Number required to cover one square.	Weight per square, 1st quality.
	Inches	Inches		Cwt.		Cwt.
Singles . .	12 × 8	$4\frac{1}{2}$	2·8	$17\frac{1}{2}$	430	$6\frac{1}{4}$
Doubles . .	13 × 6	5	2·5	15	480	6
Ladies (small).	14 × 12	$5\frac{1}{2}$	5·0	31	240	$6\frac{1}{4}$
,, (large).	16 × 8	$6\frac{1}{2}$	4·$\frac{3}{4}$	25	300	$5\frac{1}{2}$
Viscountesses	18 × 10	$7\frac{1}{2}$	6·0	36	200	6
Countesses .	20 × 10	$8\frac{1}{2}$	7·0	40	171	$5\frac{2}{3}$
Marchionesses	22 × 12	$9\frac{1}{2}$	9·4	55	130	6
Duchesses .	24 × 12	$10\frac{1}{2}$	10·0	60	125	6
Princesses .	24 × 14	$10\frac{1}{2}$	12·$\frac{3}{4}$	70	94	$5\frac{1}{2}$
Empresses .	26 × 16	$11\frac{1}{2}$	15·$\frac{1}{2}$	95	79	$6\frac{1}{3}$
			Squares covered by one ton.			
Imperials .	30 × 24	$13\frac{1}{2}$	2·5		48	8
Rags . .	36 × 24	$16\frac{1}{4}$	2·2		40	9
Queens . .	36 × 24	$16\frac{1}{2}$	2·5		40	8

ENLARGEMENT OF

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Answered in the Next Week's Issue.

The advantage of this shortened time between the receipt of a question and publication of the answer will possibly occasion still greater pressure on the space in "Shop;" but arrangements have been made to meet this satisfactorily.

The increased size, the more rapid production, and the general improvement of WORK will further add to its established worth as

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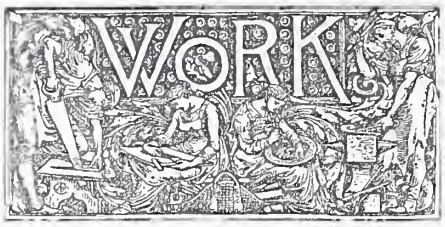

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WORK correspondents are wanted in every Town.

POLYTECHNICS.—The distribution of prizes in connection with the educational department of the Polytechnic in Regent Street was held just previous to Christmas. This institution has the distinction of being the pioneer of a great national movement towards educating mechanics and others in technical subjects. Mr. Quintin Hogg, the founder of the Polytechnic, as it has been known for the past ten years, stated that there were about 7,000 students attending every week, and that the nightly attendance was about 3,000. There were in all 500 classes a week in eighty different subjects, including twenty different trades. In the various day schools there were 800 students. There were nearly forty sections connected with the social part of the institute. The total outgoings were about £34,000 a year, of which £25,000 was contributed by the members, and of that one-third represented the holiday trips. The Polytechnic was nearly self-supporting. In the past, admirable attempts had been made to give instruction of all kinds, technical and other, but it had been reserved for the Polytechnic to blend work, recreation, and moral improvement into one harmonious scheme.

WORKMEN'S WIVES.—Of more importance to a working man, or, indeed, any other kind of man, than a good situation is a good wife. The husband of such a wife is always started off in the morning tidy and clean, with something in his stomach and something in his basket for use later on. He goes to his bench and picks up his hammer with a light heart, knowing that everything is right at home, that his children will be sent off comfortable and clean, and in good time for school, and that a nutritious warm meal and bright fireside will await him on his return home in the evening. With some women it seems not to matter how slender the husband's wages may be; so long as he is in steady work, so long has she a comfortable home for him, and even a few shillings always accumulating to buy a pair of boots for Johnnie or a new frock for Susie. With other women it is just the opposite. Who has not seen it? With £3 or even £4 a week coming in regularly, such women have the knack of finding themselves penniless by about Tuesday. Of course, these women drink. Then they lie a-bed in the morning and let the husband do for himself, with the result that he has to refresh himself at public-houses on his way to the shop. When he returns at night, which is not always at the same time, the unwashed breakfast dishes are still on the table, and the beds are still unmade.

PEOPLE'S BANKS.—A project is now on foot to establish in this country a system of banking which is said to have been productive of much benefit to the industrial classes and small traders of Belgium, Italy, Germany, and Russia. It aims not so much at assisting the workman in storing up his savings, but more especially at providing a channel through which the surplus capital of the country may be distributed in comparatively small advances to reliable and trustworthy workmen and traders. Under such banking arrangements as now exist in this country, the capitalist and manufacturer on a large scale has no difficulty in borrowing money; it is the workman in need of a small advance who finds that, although there may be some millions of capital in the country waiting for profitable investment, it is impossible for him to obtain a loan except at an excessive rate of interest, and he is driven to solicit the aid of the usurious money-lender and pawnbroker. And this is sometimes the case when the applicant is really one who has good security to offer in the shape of buildings and machinery, and requires ready money, it may be, because of the demands of increasing business. Richard Tangye has recorded how he and his brothers found their business increasing too rapidly for their limited capital, and, with their order-book full of contracts, made an application to their bankers for a modest advance. The manager of the bank promptly declined to advance a penny. The proposed banks as described by Mr. Egmont-Hake, one of the promoters, would be founded on the limited liability principle, either in connection with other small banks or with some large central bank. Deposits would be received either as simple deposits bearing interest, or as weekly instalments towards shares. One of the distinctive features of the project is that "certificates" or bank-notes would be issued for 5s., 10s., £1, and higher amounts, payable on demand, and clients would be expected to draw all the cash they required in this paper money. This would naturally be a source of profit to the bank, for so long as the bank-note was in circulation the money which it represented would be employed by the bank in profitable investments. In choosing their clients, the managers would give the preference to honest, reliable people who could show that they were engaged in or could start a sound business, however small, yielding a fair profit. It is obvious that extreme care would have to be exercised in estimating the risks incurred in such transactions, and a reasonable doubt may be felt as to the possibility of providing loans on terms which would be less exacting than those of the "usurious money-lender," without entering into disastrous speculations.

READILY-MADE FERN OR FLOWER TABLE.

BY C. MAYNARD WALKER.

A very old and still prevailing fashion of having a few growing plants in the window of a room is, to my mind, a very desirable one, whether it be in the drawing-room of the rich or the humble parlour of the poor; and thinking of this, one cannot fail to notice the persistence with which the generality of people stick to the ancient and somewhat ugly flower-pot, with its attendant inconveniences in the shape of a saucer to catch drainage water therefrom, and awkwardness of its shape, to say nothing of the

Fig. 2.—Panel.

facility with which the whole affair can be toppled over: this peculiar property being somewhat increased when the well-cultivated plant arrives at a bushy and well-developed stage. If, then, any apology were needed in submitting the above design to the reader, it would be that it attempts to render window gardening on a very small scale much more convenient than with the ordinary flower-pot; and at the same time to provide a piece of furniture—I trust not utterly devoid of beauty. It will be found very easy to make up by anyone who is handy with fret-saw and glue-pot; for they are practically the only tools required, except for the one job of soldering in the top tray. Fig. 1 represents the fern table, as made up by the writer, and the illustration is taken from a photo of the article itself; it measures 35 in. in height by 17 in. across the hexagonal top, and, with the exception of the legs, which are bamboo canes, is cut from ½ in. pine. The construction will not need any very lengthened description, and by those familiar with such work might well be made up from the illustration; but for the sake of those who may be beginners, a few details must be explained. Assuming, then, that the worker has got a sufficiency of ½ in. pine planed on both sides, six panels (Fig. 2) will need to be cut; stick the pattern on to a piece of wood and cut a stock wood pattern, from which the required number of copies should be obtained by anyone of the multiplying dodges well known to almost every fret-worker. It is a good plan to cut the mitres on the ends of these panels before cutting out the outlines, the risk of breaking or spoiling being, of course, so much the less. When these panels are all cut out, lay them face downwards on a flat board or other surface, and support both ends of each panel by small ledges of wood of uniform thickness (ordinary thick matches will do), and then push out the ivy spray flush with the board, and apply some hot glue to the edges of the leaves at the back. Leave these to set, and the panels are now semi-inlaid, and ready for joining to table top, which is made by first gluing together two widths of the pine, and then marking off a hexagon, having sides 8⅛ in. equally; this is done by marking a circle having a radius of 8⅛ in., and with the compasses pointing off this distance all round, the wood being cut true to line between these points. The panels are then glued on; and should the worker be unfortunate enough to make any misfits, they may be partially remedied before painting by fitting up with plaster-of-Paris and thin hot glue. The lower shelf of table is cut from a 9 in. circle, the outer curves being described from the circumference of a 7 in. circle divided into twelve points, a half circle being drawn from each point. There will be eight of the scrolls required, four of which are glued to the inner sides of the legs as spurs, and four on lower shelf, between the legs. The latter are easily bent to the required shape by holding them over the heat of a gas or lamp flame, and bending them with the hands; four equidistant holes are drilled to receive the legs through the shelf and the table top, and a good deal of trouble is saved by temporarily fixing some wire pins at the points where the shelf will rest, to support the same when putting together. To enable the joints of the bamboo to go

Fig. 1.—Fern Table.

through the shelf, the holes are necessarily larger than the smaller part of the cane, rendering a glued joint almost impossible; so an equally strong job, and neater when finished, may be made by joining these together with plaster-of-Paris and glue, which will set harder than the wood, and be easily bevelled off. Care must be taken that the legs are exactly the same length and shape, and the fitting-up should not be

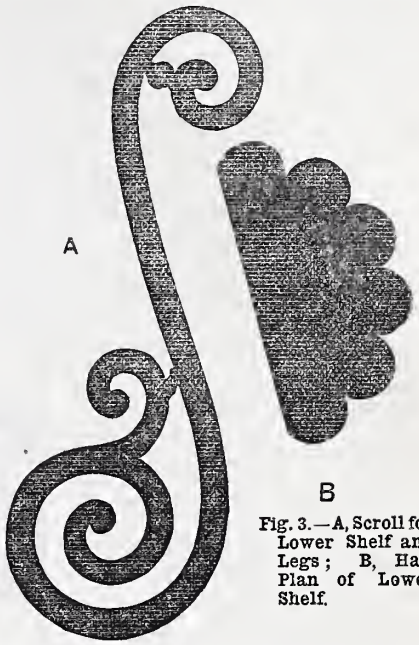


Fig. 3.—A, Scroll for Lower Shelf and Legs; B, Half Plan of Lower Shelf.

done all at once. Fix the legs to shelf and top first, fitting the scrolls and cross-pieces together later on. Use a flat and true surface when setting up the legs. A zinc tray must be fitted to the top, and the joints made water-tight. The whole may then be painted, or Aspinalled, to suit one's taste. When planting the fern, a few small rough pieces of clinkers or coke should be laid upon the zinc, which will provide all the drainage required. Strips of ivy should be under-planted at the same time; the soil should be kept moist, and if the conditions of atmosphere are at all favourable, successful growth should result. I may mention that the fern in the photo is part of one which has been three years in an ordinary bay window, and with the ivy makes an evergreen, and to me pleasing effect. I trust that all who may make up the design may be satisfied with their labours and equally successful.

FILAMENTS OF INCANDESCENT LAMPS.

On several occasions it has been proposed to protect the filaments of incandescent lamps against rapid wear by covering them with a coating refractory and tenacious at the highest temperatures. Silicon, boron, carburets, have all been suggested in turn. A German patent, conceded to Mr. Rotten, regards the same object. The filament is composed of a piece of carbon and an infusible sheath of phosphate or carbo-phosphate of iron, platinum, iridium, palladium, molybdene chrome, manganese, wolfram. This sheath is formed by exposing the filament, brought to incandescency by an electric current, to the steam from substances capable of forming phosphates.—*Moniteur Industriel.*

For the preservation of plants in their natural form and colour, a solution of thirty grains of salicylic acid in one quart of water is recommended by the curator of the Paris Museum of Natural History.

HAND-WORKING OF SPECULA FOR THE NEWTONIAN TELESCOPE.

BY EDWARD A. FRANCIS.

TESTING THE CURVE OF THE SPECULUM (*b*) BY THE AID OF THE TEST-TUBE — SILVERING THE GLASS.

MR. MUDGE, a celebrated telescope maker, thus described his plan of testing specula in the tube:—

"In order to examine my telescope, I made on a piece of copper and on a black ground six lines . . . of gold figures, each line of figures differing in magnitude —from the smallest that could be distinctly made to those of about $\frac{2}{10}$ in. long. . . . Of two instruments of the same power, that which could make out the least order of figures would be the best telescope. Such a plate I caused to be fixed up for experiments against the top of a steeple about 300 yards north of my house; and it will serve to give some idea of the distinctness with which very small figures could be made out at that distance by saying that, in a clear state of the air and with the sun behind me, with a telescope of 18 in. focal length I have seen the legs of a small fly and the shadows of them with great precision and exactness."

Another speculum maker examined the marks on a distant watch-dial; a third the print of an open newspaper; a fourth the sun's reflection in the ball of a mercurial thermometer fixed at 100 yards distance.

"When I view this ball in the telescope," he wrote, "if the figure of the metal (speculum) be good, I see a perfectly round and well-defined artificial star."

The virtue of each of these tests by examination of distant minute objects rested on the fact that in the Newtonian telescope spherical aberration only has to be dealt with. If in the magnified image there appear any false colour (chromatic aberration), the defect cannot be in the specula, but *must be in the eye-piece*, and any remedy for colour must be there applied. So that, assuming a quite flat newspaper sheet to be exposed in broad sunlight at a considerable distance from the test-tube, the speculum will be good if every letter of the print from centre to edge of the field of view be sharply defined. But if, when the letters at the centre of the field are in sharp focus, those at the edge are misty and confused, or *vice versâ*, then the figure of the speculum is defective—that is, of course, assuming the mirrors to be in correct adjustment.

What exactly may be the cause of the defect can be ascertained by the use of screens, made of sheet metal or card, cut similarly to the sketches A, B, and C in Fig. 43.

The screen, A, being placed centrally over the front of the speculum, will shut away all but the edge zone of the reflecting surface. Consequently, the focal image will be formed by rays reflected only from that zone. This image should, with patient care, be accurately focussed, so that every detail of the test object stands out clean cut. Then screen A being gently removed, and screen C substituted, the image reflected by this edge zone will be superseded by one reflected only from the centre. Without disturbing the adjustment of the eye-piece, it can easily be seen if this new image be in perfect focus. If not, the adjustment necessary to bring it into focus will indicate whether the centre rays are longer or shorter than those from the edge. If it be necessary to move the eye-tube outwards, the rays are evidently too long, and *vice versâ*.

A little consideration will show that a speculum having the centre rays longer than those from the edge, when in use in the telescope, will possess the figure either of the oblate sphere or sphere, and must be corrected to the parabola accordingly. If, on the contrary, it be found that the outer rays are longer than the inner, the figure will be hyperbolic, and will need very careful attention to save it. With a parabolic mirror in the telescope the rays would be all of equal length, and the eye-piece, when in adjustment for any part of the reflecting surface, would be in adjustment every part.

These remarks apply equally to the observation of a celestial body, but the distant newspaper is a more simple, and at the same time very severe, test. But the final test must be stellar, and here fresh experiments may be applied.

A B C

Fig. 43.—Perforated Screens for use in the Test-tube.

With a quite perfect speculum, a star, at focus, appears as a minute disc, surrounded with one or more exquisitely fine concentric rings, called diffraction rings. Neither the disc nor the rings have any real physical existence, a star being too far distant to show any appreciable body. Indeed, the larger the telescope used, given equal perfection of workmanship, the smaller the star appears.

At focus, then, a star is practically a bright point, but if the eye-piece be pushed inwards or pulled outwards, this disc at once expands, and by examination of the disc of expansion it may be detected where a speculum is defective.

If the mirror be quite perfect, and the eye-piece be pushed *inwards* for 1 in., and then brought back to focus and pulled *outwards* for 1 in., the area of expansion will in both instances present precisely the same appearance—namely, an illuminated circle with a dark spot (the shadow of the flat) in the centre; but if, when the eye-piece be pushed *inwards*, instead of the dark central spot there be a bright central spot, it may be known that the centre rays are too long, and that the figure is of the oblate sphere or the sphere. Contrarily, if the bright centre appear only when the eye-piece is pulled *outwards*, the edge rays are too long, and the figure that of the hyperbola.

Fig. 44.—Speculum suspended in the Silvering Bath (Section).

The old speculum maker had this advantage in these methods of testing over the modern workman—that he could at any moment, without the labour of silvering, test his bright metallic surface; but a great deal of testing, even in the tube, can be done with unsilvered glass, which reflects with a peculiarly exquisite delicacy the faint colourings of the planets and the sharp light and shadow of the moon. When necessary, a thin film of silver (10 grs. or 12 grs. only) should be deposited for the final testing; and this process of silvering only now remains to be dealt with.

I give that method* which, after much experiment, I finally adopted for use.

The necessary materials are: Potash (pure by alcohol), aqua ammonia, nitric acid, silver nitrate, alcohol (pure), loaf-sugar (pure), distilled (or rain) water.

These are made up into four solutions, in the following proportions:—

(*a*) *The Silver Solution:* Silver nitrate, 50 grs.; distilled water, 2 oz. fluid.

(*b*) *The Potash Solution:* Potash (pure by alcohol), 50 grs.; distilled water, 2 oz. fluid.

(*c*) *Aqua Ammonia.*

(*d*) *The Reducing Solution:* Loaf-sugar, 840 grs.; nitric acid, 39 grs.; alcohol (pure), 25 drs.; distilled water, 300 grs.

Mix, and make up to 25 oz. fluid with distilled water, which may, in town, be purchased from the chemist.

Two glass or earthenware dishes must be provided, each a little larger in diameter than the speculum, and about 2 in. deep.

Cement a piece of wood firmly with pitch to the back of the speculum, so that it may be suspended face downwards within either dish (Fig. 44). The dishes should be thoroughly cleansed.

With nitric acid and a little pad of cotton-wool wash the speculum surface, and then, in one of the dishes, immerse it to a depth of $\frac{1}{2}$ in. in distilled water. Rock the dish slightly. Remove the speculum, and examine the surface. If it be covered with an unbroken film of water it is chemically clean, and may be re-immersed, and left till the other bath is prepared.

Put aside in a phial one-tenth part of the silver solution (*a*), and pour the remaining nine-tenths into the second dish. Add *aqua ammonia* drop by drop. A precipitate will form, and disappear as the ammonia is slowly added and stirred in with a glass rod. Then add the potash solution (*b*). Again a precipitate will appear, and again, drop by drop, ammonia must be added to remove it. But, throughout, the less the quantity of ammonia used the more durable will be the silver film.

The bath being clear, take the tenth part of the silver solution that was set aside, and with great care add just so much as will bring the colour of the bath to a warm saffron without causing any precipitate to appear, for the transparency of the bath must not be destroyed. Add distilled water until the bath is in sufficient quantity to permit the speculum to be immersed to the depth of about $\frac{1}{2}$ in.

Finally, add 4 drs. (fluid) of the reducing solution (*d*), and stir until the colour changes from warm saffron to a pale pink. Then transfer the speculum from the other dish, and lower it into the new bath slantwise, so as to avoid air-bubbles.

The colour will proceed to change from pink to brown, and from brown to black. A heavy film of silver will be thrown to the surface, and in a short time, varying with the temperature, it will be noticed, on moving the surface film with a glass rod, that the bath has become muddy and turbid.

The speculum should then be raised, and

* Brashear's.

ill be found to be coated with an unbroken m of pure silver.

This film should be first swilled gently ith ordinary water, and then, for a time, ith distilled or rain water, but thereafter ot at all tampered with until it be quite ry, when it may be polished lightly with a ttle pad of soft chamois leather, stuffed ith loose cotton-wool, and touched with ie finest rouge. The polishing should be one with a tiny spiral stroke.

The thickness of the silver thus deposited as been calculated to be not more than one wo-hundred-thousandth part of an inch, so iat it demands light handling, but it is urprisingly hard, and will last for years vith proper care.

The flat will, of course, be silvered by the ame process, using solutions made in naller quantity, but of the same proporional strength. The quantities I have iven are for about twenty square inches of urface. The reducing solution is better if nade and kept in stock, but the others will ieed to be each time freshly prepared.

The silvering is best performed in a warm oom, in which all the materials, speculum, vater, and dishes, have been left standing ufficiently long to be of the same temperature.

THE MAKING OF THE BRITISH FLAG.

It may surprise the reader to be informed that one of the rarest sights in this country is a properly designed British flag; yet such is, strange to say, the fact. The weak point of nearly every flag that flies in our streets, on our yachts and merchant ships, on our public buildings, and at our fêtes and rejoicings, is that part of it which, because it symbolises the union of England, Scotland, and Ireland, is known as the "Union." This Union is, of course, properly constructed in all the flags used by the Royal Navy, and in some of those used by the Army; but the Merchant Service uses generally a conventional and meaningless substitute for it, and has become so entirely accustomed to the vicious practice, that mercantile flag-makers have long since positively ceased to keep

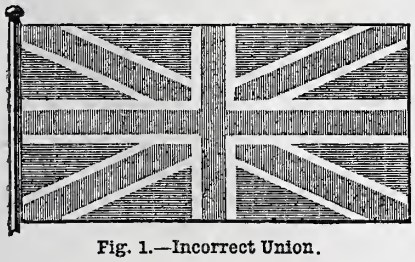


Fig. 1.—Incorrect Union.

correct British flags in stock, and, unless specially ordered to make or procure them, invariably supply incorrect ones.

This anomalous state of things would not be suffered in any country save ours. Every country has its proper pattern of flag, and all other patterns are improper and illegal; and every Government, save our own, enforces the law upon the subject, and insists that people who use and claim the protection of the national flag shall take the trouble to see that the bunting which they fly is of the prescribed design. We are less strict. There has been no recent case of seizure of an improperly designed British flag; and although, in peace time, the matter is not really of any great practical importance, it is somewhat disgraceful that a country possessing so glorious and significant a flag as ours should not be at pains to maintain it intact. In war time the matter would rapidly assume great significance, and merchant shipowners might easily suffer severely for their present

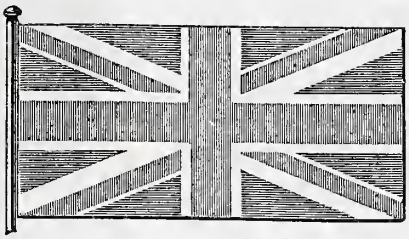


Fig. 2.—Incorrect Union.

laxity. Our men-of-war can only be expected to recognise friendly ships by examining their flags. If the flags be correct, they will naturally claim and receive the protection to which they are entitled; if they be incorrect, the men-of-war will be suspicious. False flags are often hoisted for deceptive purposes, and in war time, a naval captain seeing an obviously incorrect British flag flying, might, in certain circumstances, treat it as a device of the enemy. Such a case occurred more than once in the old wars. In one instance, a French vessel, hoping to deceive a British frigate, hoisted what she supposed to be British colours; but the British captain at once detected in them

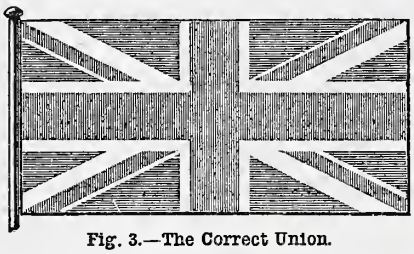


Fig. 3.—The Correct Union.

one of the usual inaccuracies, and, instead of permitting the Frenchman to get away, went after him, captured him, and brought him in triumph into port.

The faults are nearly always in the composition of the Union, which fills the upper near-quarter of every British ensign, be it white, blue, or red, and which, it may be admitted, is a design of some considerable complexity.

Two incorrect forms of this Union are very common, and are shown in Figs. 1 and 2. In these cuts, according to the ordinary heraldic convention, the red portions are indicated by perpendicular, and the blue by horizontal, lines of shading. In Fig. 1 the designer makes several mistakes. He assumes, for example, that the red and white crosses on the one hand, and the edgings of them on the other, are of equal width, and that there is a bald and unmeaning regularity about the four quarters of the Union. This flag (Fig. 1) embodies the forms of error which are commonly made in pictures,

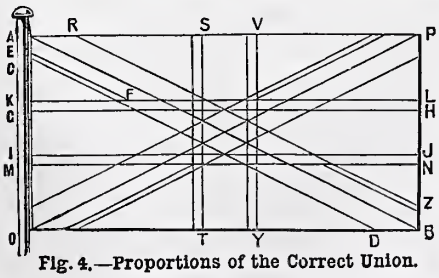


Fig. 4.—Proportions of the Correct Union.

coloured advertisements, etc., and by the most ignorant and incompetent class of flag-makers. Fig. 2 shows the errors which are generally introduced by the flag-makers who supply bunting to the merchant, navy, and to popular festivals and rejoicings. Here the mistakes are not so obvious, though they are just as gross as in Fig. 1. The red and blue crosses, or saltires, are made of different widths; but they are not made of proper proportions, neither are they in their proper positions; and, similarly, the white edgings of the saltires are improperly varied. This Union (Fig. 2) would doubtless satisfy the critical eyes of nine British subjects out of ten, but anyone who will take the trouble to compare it with the real and genuine Union Jack (Fig. 3) will at once see that the two are not alike, and as he more carefully examines them, he will become conscious of a score of little differences between them.

In order to understand what the Union should be, the reader should bear in mind exactly what it is intended to represent. Of this the following is, probably, the true history:—

The original English flag was the red upright Cross of St. George upon a white ground. In early ages, when our kings had pretensions to the crown of France, there seems to have been a favourite French flag, composed of an upright white cross upon a blue ground or field. Whether we ever actually and deliberately incorporated it with our own flag is not quite certain, but one of the theories to account for the broad white edging now surrounding the St. George's Cross in the present Union is that it represents the upright white cross from this old French flag. That, however, is not absolutely established as correct. All that is established is that this particular white edging is of a character and significance different from those of the narrow white edging, or "fimbriation," which is seen elsewhere in the Union, and which is merely a heraldic device for the avoidance of the placing of one colour upon another, it being a heraldic canon that "colour" (red, blue, etc.) must not be imposed upon colour, or "metal" (gold, or yellow as representing it, and silver, or white as representing it) upon metal.

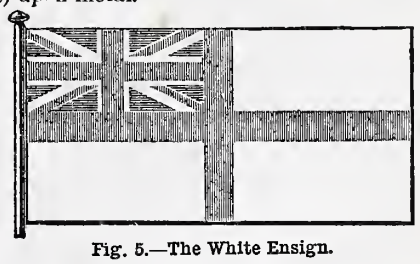


Fig. 5.—The White Ensign.

When the union with Scotland was effected, the problem arose how best to blend our red Cross of St. George (on a white field) with the white diagonal cross, or "saltire," of St. Andrew (on a blue field). The difficulty was met by taking the Scotch flag, and overlaying it with the red Cross of St. George edged with white, and for nearly two centuries (1606–1801), with brief intervals, the result was the Union. When, in 1801, Ireland was also admitted, a further change had to be made. It was decided to adopt, as representative of Ireland, a red diagonal cross, or saltire. This is improperly, though generally, called St. Patrick's Cross. St. Patrick had no cross. The saltire comes from the arms of the family of the Fitzgeralds. This was blended, by a process of

"interchanging," with the white saltire of St. Andrew—that is, that while in one corner of the Union a certain position was given to Scotland, in the diagonal corner the corresponding position was given to Ireland. But since, as has been already said, the imposition of red upon blue is not heraldically permissible, a narrow white edging, or "fimbriation," had to be introduced to prevent the red Irish saltire from coming into immediate contact with the blue Scottish background.

Having thus cleared the way historically, we may proceed to point out what are the proper proportions of the various parts of the Union, and how it should be constructed.

The best way for an amateur to go to work is to begin by making a paper pattern of his Union. All our flags are twice as long as they are broad. We will suppose that the Union is to be of $12\frac{1}{2}$ square feet superficies. The paper pattern must, in that case, be a right-angled parallelogram, measuring 60 in. × 30 in. (5 ft. × $2\frac{1}{2}$ ft. = $12\frac{1}{2}$ square feet). Let A O B P (Fig. 4) be such a parallelogram, and let it be marked out in pencil, like the diagram, in such a manner that—

Distance between parallels			R Z and C D =	6 in.
,,	,,	,,	R Z and A B =	3 ,,
,,	,,	,,	A B and E F =	2 ,,
,,	,,	,,	E F and C D =	1 ,,
,,	,,	,,	A P and K L =	10 ,,
,,	,,	,,	K L and M N =	10 ,,
,,	,,	,,	M N and O B =	10 ,,
,,	,,	,,	G H and I J =	6 ,,
,,	,,	,,	K L and G H =	2 ,,
,,	,,	,,	I J and M N =	2 ,,
,,	,,	,,	V Y and P B =	25 ,,
,,	,,	,,	A O and S T =	27 ,,

This diagram now gives all the necessary proportionate indications for the completed Union, as shown in Fig. 3, but when, previous to being sewn together, the pieces are cut out of white, red, and blue bunting, allowance must, of course, be made for "turning over." This, however, anyone accustomed to the use of the needle will understand. Having been otherwise finished, the Union should have a band of double canvas, about 1 in. broad, strongly sewn to it along the edge, A O; and sewn within this canvas should be a cord, the ends of which hang out at A and O respectively, for attachment to the halyards, by which the flag is ultimately to be hoisted. The relative proportions of all Unions, whether they be for use alone or for use in the cantons of ensigns, should be as given above.

In making British ensigns—*i.e.*, flags with the Union in the canton, or upper near-corner—there is not much beyond what has already been said to be borne in mind. The length of the entire ensign must always be to the breadth as 2 is to 1. The Red Ensign, which is used by the Merchant Service and by ordinary yachts and pleasure craft, has a red field, and in the corner a Union of one-quarter of the superficies of the whole flag. The Blue Ensign, which is used by certain yachts and by the Royal Naval Reserve, is of the same pattern as the Red Ensign, except that the field is blue. The White Ensign, the ensign of Her Majesty's Navy and of the Royal Yacht Squadron, is different, and is shown in Fig. 5. The large red St. George's Cross, which divides it into cantons, should be one-fifteenth of the entire width of the ensign, but the Union is of the same proportions as in the other ensigns. It is scarcely necessary to add that all flags—except special ones, which are occasionally made of silk—should be of bunting.

TRADE: PRESENT AND FUTURE.

*** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

TRADE and the labour market are stagnated, owing to the holiday season, and we therefore publish the following memorandum, which has been clipped from the *Board of Trade Journal*:—The condition of the skilled labour market has remained tolerably steady. Indeed, in a few trades there has been some improvement, and, but for the increasing dulness of the shipbuilding industry as orders are completed and the stoppage of so many mills in the south-east Lancashire spinning districts, a general improvement might have been recorded. The gloomiest feature in the industrial situation is the deadlock in the cotton trade, which gives no indication of an early termination. The strikes of the month have not been numerous, nor, with the exception of that above referred to, have they been of great importance. In all, forty-four have been noted; of those, eight were in the building trades, seven in the coal trade, four in shipbuilding, five in textiles, two in clothing trades, and the remainder in other industries. In all, twenty-two trade unions have sent in returns as to the state of their respective labour markets. These reports show an aggregate membership of 270,288, of which 22,342 are out of work, as against 19,684 in the previous month. The percentage is thus 8·27 as against 7·33 in the previous month. In this, however, is included upwards of 2,000 of the cotton operatives engaged in dispute, so that, but for this, the change upon the figures of the previous month would have been very slight indeed. For the corresponding month of last year the percentage of those out of work was 3·81, and for the corresponding month in 1890, 2·40.

ENGINEERING TRADE.—The Lancashire engineering trade is now showing signs of improvement. Stationary engine builders and machine tool makers are busier than they have been for some time, while boiler makers still have a fair amount of work on hand, although the prices are cut very fine. Locomotive engineers are very quiet, as are also textile machinists. The returns for the past month of the Amalgamated Society of Engineers show a slight decrease in the number of out-of-work members, but the percentage is still high—between 7 and 8. The Steam-Engine Makers' Society remains as before—about $4\frac{1}{2}$ per cent.

IRON TRADE.—A decidedly improved tone has been manifested in the Lancashire iron trade during the last few days, and more inquiries and an increased weight of business are reported. The improvement is confined, however, to the pig-iron trade, the manufacturing branch being still very depressed. Local bars do not fetch more than £5 12s. 6d.; sheets, £7 2s. 6d.

STEEL TRADE.—No change of note is reported in the Lancashire steel trade. Ordinary foundry hematites are 55s. 6d., and steel billets £4 6s. 6d. For good qualities of steel boiler plate, £6 10s. is being obtained without difficulty.

SHEFFIELD GENERAL INDUSTRIES.—The condition of the staple trades of Sheffield is unchanged.

IRONPLATE TRADE.—In Birmingham the strike still continues. All efforts to resort to arbitration have proved futile, the masters being the aggressors.

THE GLASS TRADE in St. Helen's is in a bad state, and many men are out of employment. The Masters' Association has proposed a reduction in wages, to which the men agree, but there is some difference of opinion as to the amount.

BUILDING TRADE.—Building operations in Birmingham and district are being pushed on rapidly in all weathers, in order to complete existing contracts, in view of an expected strike in April next, when the present rules and prices cease. The Master Builders' Association has given notice of a reduction, the operatives notice for an advance, in wages. There are active preparations in the district of Rochdale for a start next year. Though the work is poor, it is better than nothing.

COTTON TRADE.—The sixth week has been reached of the great lock-out in Rochdale and district, and it seems as far off a settlement as ever. The distress in the town has not been felt seriously so far, owing to the determination of the masters to run their mills. Though only half time is being worked, it serves to keep the operatives from starving. In the surrounding towns the distress is awful; the mills being stopped altogether, there is nothing but the society pittance to live upon, and this, in some cases, is being reduced. Soup kitchens and similar institutions are being started on all hands.

SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

*** *In consequence of the great pressure upon the "Shop" columns of* WORK, *contributors are requested to be brief and concise in all future questions and replies.*

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Portable Electric Lamps.—R. H. (*Huddersfield*).—Portable electric lamps, supplied with current from light lithanode batteries and accumulators, can be obtained from Messrs. Cathcart, Peto & Radford, Hatton Garden, E.C. Handy little lamps, with E.S. dry batteries, can be obtained from the Electric Stores Co., Cannon Street, E.C.—G. E. B.

Painters' Journal.—W. R. (*Tunbridge Wells*).—The *Journal of Decorative Art* has been published now for twelve years, about the 1st of each month. The Conference of Painters on Technical Education, to be held in Painter-stainers' Hall next January (see WORK, p. 632), is chiefly the outcome of agitation on the part of those who read and write that journal, which, with many other high-class publications on graining, writing, etc., issued by the same proprietors, have been advertised in back issues of WORK.—LONDON DECORATOR.

Blackboard Paint.—WORK.—Assuming you have a good smooth surface, paint it with two coats lead-colour paint made of white lead, a little driers, and black pigment, and diluted with 2 parts turpentine to 1 part linseed oil. Well glass-paper down between each coat. For the third coat, mix common black and driers, and oil and turps in reversed proportions to the above. Spread the paint very evenly and barely. When dry, take best "ivory black," purchased ready ground in turps, add one-third in bulk of Japan gold size, and dilute to thin working consistency with turpentine only. The last coat must be spread quickly, and nicely distributed; if properly done, it will dry off a nice solid dead black. When it wants redoing up, a coat of thin oil black and then the dead black, as before, is advisable, care being taken that the surface is first quite free from grease.—F. P.

Smokeless Fuel.—COKE BREEZE and YERRUS.—At the time of writing, the trials made are private; in due course the matter will be fully laid before the public.—F. C.

Bicycle Chain.—W. W. (*Putney, S.W.*).—Letting chain simmer in hot tallow will not soften or injure it in the least. Do not let the chain, however, simmer in tallow. It may lubricate it if clean, but if dirty it will not take off dirt, but will, when in use, serve to gather up more dirt and retain all it gets. Soak the chain in paraffin, and use it without any other lubricant.—A. S. P.

Rubber Cement.—P. L. (*Bolton*).—I am not prepared to give a recipe for making tire cement, as makers or repairers of cycles never think of making it; it can be bought so cheaply—1s. per lb., or small boxes for 6d. each, of any cycle dealer. (See WORK advertisements.)—A. S. P.

Gas Burner.—J. R. (*New Brompton*).—I am sorry to discourage you, but I can see nothing in your letter or sketch sufficiently original to patent. There is nothing novel in the idea of carrying a light on one's head. Small electric lamps are much used by medical men, and would be preferable to gas on account of their portability. The substance at the end of the gas burner is known as steatite, and cannot be dispensed with if the burner is used for lighting purposes; but if you merely require it for attaching the tubing to you will get a better pressure by removing it. It would be still better if you removed the burner and elbow and attached a tube cock to the bracket.—T. W.

Painting Doll's-house.—E. K. (*Portsmouth*).—Lampblack, well mixed to a paste with varnish and then thinned with a little turpentine, would do admirably. It would be best to set out your lines first with a blacklead pencil; then buy a cheap carriage-liner's brush—you can get them in "camel hair" for about 1d.—and run in the lines with that. The brush is a very long, thin one, and, when charged, is laid flat on the work and "striped" along. Another way would be to use a very fine lining fitch and a bevel-edged straightedge. You might be able to use the paint with a soft steel pen; try it. If the paint works greasy on the enamel, rub over the surface with a little turps; or dry whiting may answer.—F. P.

Accumulating Vapours.—W. F. B. (*Bolton*).—What you want is ventilation. Bore some holes in the top rail of your sash, and I think you will find that this will get over your difficulty. If it does not, write again, stating full particulars—size of window and shop, quantity of gas used, position of door, etc.—and I shall then be in a better position to advise you.—E. D.

Patenting Improvement.—W. T. H. (*Paddington*).—There is nothing to prevent taking a legal patent for an improvement on an expired patent, provided a proper distinction is made between what is new and what is old. The fact of the prior patent not having been worked would be no bar to the right to obtain one for something which would be better or do the thing in a better manner. It is, of course, of the first importance that the improvement

uld be practical, and that the documents be properly prepared that the law can support right, if it is ever called on to do so; otherwise, is only a waste of time, money, and trouble to pare and put in documents which will not secure s end. If the improvement will make a thing t will do what has to be done better than what now in use for the purpose, it may be worth enting. I should not advise W. T. H. to attempt put in any papers prepared by himself; and refer n to No. 44, Vol I., of WORK, p. 694, where he ll find some facts and information relating to tents of which the public, as a rule, are grossly norant.—C. E.

Circular Saw.—J. A. H. (*Cardiff*).—The question which you have asked me is one on which the ghest authorities hold different opinions, and when men disagree, how can a humble individual like yself pretend to decide? Now I will give you my n ideas on the subject, which are that it is cidedly better, when it can be managed, to have a iving-wheel separate from the fly-wheel; but it ten happens that the fly-wheel is used to drive om on account of its size, so as to give as much ultiplying power as possible. In order to get the ll benefit, it is necessary for a fly-wheel to be rger in diameter and heavier at the rim than e driving-wheel, or to make it run faster; but ese things cannot always be managed, and they e not always when they could be. I do not pre- nd that the above remarks are any settlement of e disputed point, but they are simply my own inions, formed from my own observations and om what I have read of the subject on both sides. —CHOPSTICK.

Saccharometer.—J. A. L. (*Hammersmith*).—I elieve that Allen's saccharometer indicates the pecific gravity. You will find a table showing the ercentage of cane-sugar corresponding to the pecific gravity of a solution of cane-sugar in "Allen's Commercial Organic Analysis," Vol. I., ublished by J. & A. Churchill, at 14s.; also in "Tucker's Sugar Analysis," published in America, ut obtainable from Spon, price about 10s. 6d. or 5s.; and I think, also, in "Spon's Chemist's Pocket- ook," at 7s. 6d. If you do not care to get any of hese expensive books, you had better inquire at ome shop where chemical apparatus is sold if they ave a card with this table printed on it. Some nakers provide such a card. Try Long's, East- heap, where saccharometers are sold.—F. B. C.

Re-blacking Field Glass.—G. W. W. (*Bayswater*).—I can recommend the club cycle enamel, made by the Silico Enamel Company. It dries hard and with a capital gloss, and is sold by most cycle dealers. Remove the glasses, and put on thinly with a camel-hair brush.—R. A.

Brazing.—G. W. W. (*Bayswater*).—The best way to learn brazing thoroughly and properly would be to get into a shop where it is done. I do not know of any book on the subject, but there is an article in which the process of brazing is explained in Vol. I. of WORK, p. 660, which may help you a little. If you want any specific information, I shall be very pleased to give it if you will give full particulars of what you want to braze; state if you are used to tools, and what appliances you can have the use of, as a forge is a necessity for most brazing work.—R. A.

Planing Mahogany.—J. B. (*Old Charlton*).—The difficulty mentioned is felt by all who have to deal with similar woods. Besides the obvious necessity of having well-sharpened and finely-set planes, and if possible having the cutters set somewhat more upright than is usual for soft wood, I know of only one expedient, which is but of very little general utility. It is, however, often resorted to by cabinet-makers. The plan is to size the wood with thin glue, or to varnish it with some hard spirit varnish. It is obvious, however, that such treatment is of a very superficial nature, and, if much wood is to be removed, it is perfectly useless. So far from rendering the use of the scraper unnecessary, this treatment is almost always used as an aid to the scraper. J. B. might try a smoothing plane-iron in the toothing-plane, while for very cross-grained wood, the toothing-plane itself is often the only way to obtain a fair surface. Nothing can, in these cases, prevent the need of scrapers and glass-paper.—B. A. B.

Patenting Improvement.—J. P. R. (*Aberdeen*).—There is no doubt that the plan proposed would do what is described, and might be worth patenting). If J. P. R. will refer to No. 44, Vol. I., of WORK, he will, at p. 694, find information on patents that will be beneficial to him in the matter. Before he attempts to prepare his own documents, let him ask himself what he knows and understands on the subject, and whether he possesses sufficient experience to create and secure a legal right to his invention. If he sees he does not, then he should seek the aid of one properly qualified to obtain the required result.—C. E.

Iron Building.—W. H. C. (*Plumstead*).—Without seeing the bye-laws of your local authority, a satisfactory reply cannot be given; but in most districts, before a new erection is put up, a plan and section must be sent to the local authority and approved by them before it is commenced. If you have not done this, your best plan is to send one in now, and try to have the matter settled amicably. As to putting it on wheels, that might cost as much as the brickwork, and there may be a bye-law which would compel you to remove it after a time.—J. T.

Workshop.—T. H. D. (*Ipswich*).—Fig. 1 is a sketch of the framework of a workshop that I think will suit you. The way it is put together is so simple that I hardly think it is worth while describing it, with the exception of the joints at A A. Fig 2 shows the method of framing the angle of the rails and corner-posts at A A. The ends of the rails are halved, and the pin on the posts goes through the two and holds the corner together. The whole

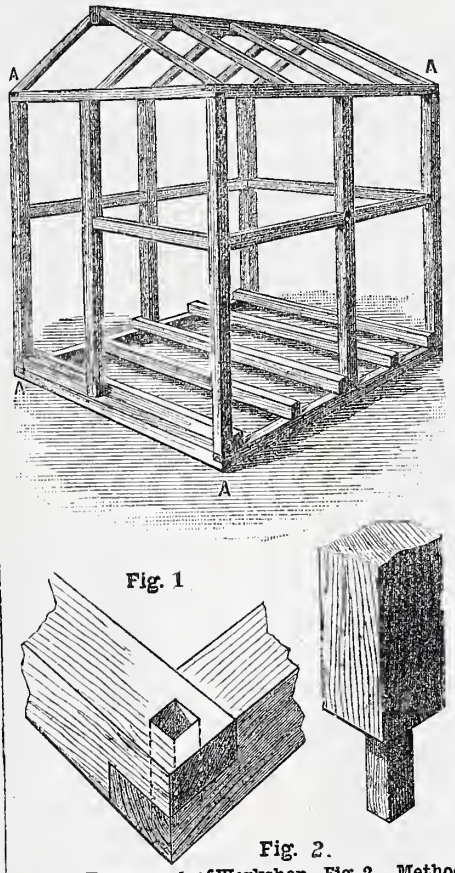


Fig.1.—Framework of Workshop. Fig. 2.—Method of Framing.

should be covered with feather-edge boarding, the roof well tarred, and the rest of the outside either tarred or painted; the inside, of course, can be finished to suit your own ideas. The number and positions of windows and door must likewise be settled by you. Now comes the ticklish part. You want it so as to be easily taken down. The easiest way to make it with the view of taking it down readily would be to make the roof, the four sides, and the bottom in one piece each, so that all you had to do would be to lay down the bottom or floor, erect the walls round it, and put on the roof, much after the style of a "contractor's" office. This arrangement would not do for you, because it would be impossible to get the pieces through any ordinary doorway. The simplest method is to put everything together just as if it were going to be a permanent erection, but use screws that have been steeped in melted Russian tallow instead of nails; then all you need do at any time is to draw the screws, and the whole thing comes to pieces bit by bit, and is easily carried through the house and stowed away. —E. D.

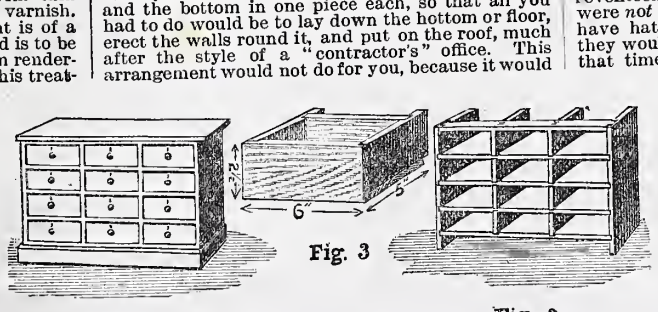


Fig. 1.—Elevation of Nest of Drawers. Fig. 2.—Frame showing Method of Construction—the Top, Back, and Skirting removed for Drawers. Fig. 3.—Method of making Drawer.

Drawers.—A. S. (*Ipswich*).—I give a little sketch at Fig. 1 that I think is about the sort of thing you want. I should certainly make it out of pine, and then you could stain or paint it on the outside to suit its surroundings. Best pine is a little expensive, but it pays for itself, and for an amateur is specially adapted, as it is so pleasant and easy to work. Fig. 2 is the framework, made of ¾ in. stuff, and I think if the depth from front to back is 5½ in. wide it will be sufficient for the purpose you require, and then you can get two widths out of an 11 in. board, pine generally being 11 in. wide. The method of constructing this frame is very simple, and I think the little sketch explains all. The back, top, and skirting are left off for the sake of clearness. Fig. 3 shows the cheapest method of making the drawers. You will notice that I have done away with the dovetails, that are generally such a drawback to an amateur when he makes a little thing of this description. The fronts are rebated at each end the thickness of the sides, and the sides are grooved to take the back and the bottom nails right on the sides and back, the front of drawer being rebated, so as not to show the bottom. If you make the drawers 6 in. long, 2½ in. deep, and 5 in. from front to back, they will be found to be a very handy size. The number you make, of course, rests with yourself. After making the frame, fit in the fronts of the drawers in their respective openings, and number them, and then fit in the sides of the drawers; then, when the drawers are made and come to be fitted into their places, a lot of trouble is saved. I should let the drawers stand in ⅛ in. from the face or front of the frame.—E. D.

Incubator.—G. S. W. (*Dewsbury*).—I regret to hear of your ill-luck, but I think you must look to other causes than the inability of the machine to do its work for your want of success. So far as I can learn it has been rather a poor season for chicks. The only other experience of a maker and user of one of my machines, as described in No. 143, which has come to my knowledge, is—first batch, 9 out of 29; second, 17 out of 26. This, I think, disposes of any idea that the machine will not, if correctly made, do its work. Experience teaches, and as experience is gained, so do (generally) results improve. Your first batch was evidently spoiled by the lamp, but you must have been using common oil, or kept it badly trimmed, for it to smell as you say. There should not be the slightest smell of the products of combustion, and nothing but pure warm air should pass into the incubator. Provided there is perfect combustion no harm can result from the products entering the machine, and therefore I do not see the advantage of any arrangement of flues as suggested. Your chicks being so much behind points to insufficient heat, and in all probability the thermometer is fixed too low. See to this. Did you follow my advice *re* selection of eggs? For some unknown cause eggs with a weak germ, or eggs beyond a few days' old, although often giving fair results with hens, will not hatch in an incubator; but given eggs from healthy and mature birds, larger percentages and stronger chicks can be obtained. Should this meet the eye of other makers of my incubator, I hope they will, at the close of the season, furnish me with statistics of their results, counting fertile eggs only, and keeping each hatch separate. These I will tabulate, and publish, if the Editor will allow space; if not, I will send a copy to each person supplying a statement of his or her results.—LEGHORN.

Incubator.—W. G. (*Guildford*).—If you have faithfully followed the instructions in No. 143, you should find the moisture given off quite sufficient. If you like to try a tray of water beneath the eggs, there is nothing to prevent you doing so, but as others can work the machine as per instructions and get good results, there is no reason why you should not also. How do you *know* the last lot of eggs were all right? If you found them clear after seventeen days' incubation, it is very certain they were *not* all right, and no incubator or hen could have hatched such eggs. Had they been fertile they would, if nothing more, have been addled by that time. Are you using the method of water supply for evaporation described on p. 731, No. 150, Vol. III.? If not, try it.—LEGHORN.

Incubator.—L. E. M. (*London, S.W.*).—Mr. Stevens' address is 7, Selhurst Road, South Norwood, S.E. (see advertisement in No 149).—LEGHORN.

House Painting.—E. J. (*Barnsley*).—Coloured matter, such as "ochre" and "lime blue"—which you are possibly acquainted with—are properly known as pigments. When such pigments are mixed with white substances, the results are known as tints. When colours are mixed with black, the results are shades. —LONDON DECORATOR.

Electric Light for Workshop.—RANGOON.—Three 8-c.p. lamps will be sufficient to light a workshop measuring 10 ft. by 5 ft. The current to light these can be obtained from a small dynamo, driven by a small gas, hot air, oil, or steam engine, or by a water motor. Don't attempt man or boy power, or lighting with current from a battery, as both are mere drudgery. I cannot give an estimate of cost.—G. E. B.

Goldbeaters' Skin.—PROGRESS.—The brush used is a badger-hair softening brush—such as grainers use. The hair is about 4 in. long, and the brush about 4 in. wide, and, being the softest bristle that can be obtained, its value is about 10s. 6d.

Should any reader be able to give information as to the manufacture, he will probably do so in "Shop."—LONDON DECORATOR.

Strawboard Pulp.—S. (*Kettering*).—It would be better to communicate with an expert and get him to produce a sheet of paper, or other article contemplated, from the waste strawboard you have. A small quantity would suffice, and the cost would not exceed £5. Paper stock merchants would give you a fair price for the material. Again, without a continuous supply no one would care to put down plant.—F. G.

Graining, etc.—S. P. (*Newport, Mon.*).—WORK has already contained exhaustive series on all branches — "Plain and Decorative Painting," "Graining, Gilding, and Sign-writing." Marbling has not yet been treated, although long promised. It is not an easy subject to handle in black and white. The "Painters' and Grainers' Handbook," 2s., Brodie & Middleton, 79, Long Acre, and a manual issued by Crosby Lockwood & Co., 7, Stationers' Hall Court, are also good value. But the cheap and up-to-date painters' handbook has yet to be issued. Write to 76A, Mosley Street, Manchester, for list of their publications, and mention WORK.—LONDON DECORATOR.

Telephone.—R. C. H. (*Nottingham*).—In answer to your query for connections for six rooms, I could not give them in "Shop" for want of space.—W. D.

Modelling Wax.—T. E. (*Cretown*).—Beeswax, 3 parts; Venice turpentine, 1 part; colouring matter, to taste: melt in earthen pipkin, and stir with tallow candle. Some merely melt hog's lard with the beeswax, and add colour. Wax ready prepared may be purchased.—M. M.

Regilding Frames and Varnishing Pictures.—J. H. (*Wellington*).—Get No. 121, in which is an article on Picture-frame Gilding and Regilding; also get No. 51, in which is full elementary information about gilding materials, tools, processes, etc. Pictures are varnished by laying the varnish evenly over the surface with a broad, flat, soft brush, sold for that purpose. For oil paintings mastic varnish, which is quick-drying and easy of removal, is considered by competent authorities to be best. Water-colour pictures are not usually varnished, but are protected by glass.—M. M.

Electric Bell.—SEYBOR.—For an 8 in. bell the core will be 1 in. diameter, 4½ in. long, and the ends 2½ in. square. The wire should also be thicker—say, No. 22 or 24 B.W.G.—J. T.

Jeweller's Solder.—J. A. (*Thirsk*).—The following table of solders, from Gee's "Practical Gold Worker," will doubtless be of some service to you:—

	Fine Silver.	Copper.	Spelter.	Fusing Point.
Hard Solder	16 parts	3½ parts	½ part	1866° Fahr.
Medium ,,	15 ,,	4 ,,	1 ,,	1843° ,,
Easy ,,	14 ,,	4½ ,,	1½ ,,	1818° ,,
Common Hard	12½ ,,	6 ,,	1½ ,,	1826° ,,
Common Easy	11½ ,,	6½ ,,	2 ,,	1802° ,,

To solder filigree and similar light work, first get the joints perfectly clean, then moisten them with a solution composed of borax dissolved in clean water to form a flux for the solder. Use easy running solder, made into clean filings with a clean file, and sprinkle the solder filings over the moist joint. The prepared joint must then be carefully heated with a suitable blowpipe flame until the solder runs.—G. E. B.

Electric Light for a Room.—A DESPERATE AMATEUR.—Three 10 c.-p. lamps will be required to properly light a room 12 × 12 × 15 ft., and the lamps must be placed 8 ft. above the floor. The current for these lamps may be obtained from a dynamo direct or from a battery of accumulators charged during the day with current from a suitable dynamo All primary batteries, whether liquid or gas, are messy and troublesome. Chlorine gas is specially objectionable in a house. As you cannot run a dynamo from your engine at night, you must charge a battery of accumulator cells during the day. A small gramme or a Manchester dynamo with drum armature, shunt wound, with an output of 150 watts—that is, one giving a current of 6 ampères at a pressure of 25 volts—will just suit your purpose. The number of accumulator cells required will be governed by the voltage of the lamp selected, as you must reckon on one cell for each two volts required to light a lamp. As you will only need the light occasionally, one of the small type accumulators will do.—G. E. B.

Model Manchester Dynamo.—H. J. C. (*Axbridge*).—I fail to see any fault in the construction of your dynamo as described in your letter. It should furnish enough current, easily, to light 10 c.-p. lamps. By working it as a motor you have reversed the poles, and must now run it in the opposite direction to get current from the machine—that is to say, supposing it ran from left to right as a motor, it must now be run from right to left as a dynamo, and you must alter the brushes to suit the altered motion. I suppose you have them on a rocker, although you do not say so. If they are on a rocker they are easily altered, and must then be adjusted until the best lead has been obtained by actual trial.—G. E. B.

Telephone Transmitter.—ANXIOUS.—If you do not care to make the transmitter described on p. 572, Vol. I., read the excellent note on the subject by Mr. W. Duff on p. 45, Vol. II. The same author has written a good deal on the subject in Vol. I. Have you read all he has written? Several good carbon transmitters are described in Poole's "Practical Telephone Handbook," price 3s., published by Whittaker & Co.—G. E. B.

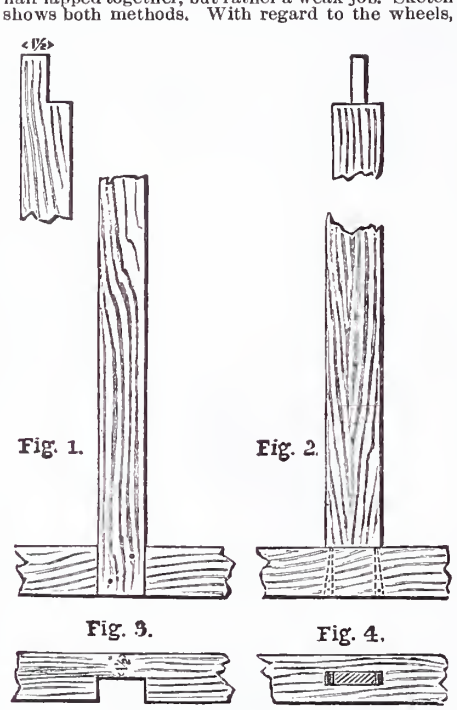
III.—QUESTIONS SUBMITTED TO READERS.

[Questions in this Section are held over to be answered at an early date.—ED. WORK.]

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Polishing Oak Bookcase.—W. D. (*Newington*) writes, in answer to Doc (see No. 185, p. 462):—"Get 2 oz. bichromate, and dissolve in half a gallon of boiling water. When cold, use the stain freely, wipe dry, and well brush with a hard brush. To wax the polish, get 2 oz. wax; dissolve in a jar by the fire, and when dissolved add half a pint of turpentine. It is best to cut the wax up small. Rub over the bookcase, and wipe off and brush with a hard brush. It is not necessary to use filling. Work so polished is called open grain, or antique. It is suitable for a bookcase. If your bookcase is not so bright as you would like it, write again. The wax and turpentine must not be kept too near the fire."

Fowls' House.—EDDEFRA writes, in reply to B. W. L. (see No. 185, p. 462):—"The frames would be strongest if they were tenoned and mortised together, but would be soonest done if they were half lapped together, but rather a weak job. Sketch shows both methods. With regard to the wheels,



Figs. 1 and 3.—Half Lap Joints. Figs. 2 and 4.—Tenon and Mortise Joints.

it depends on the nature of the ground they would have to travel on and the size of the house. Narrow wheels, 1½ in. to 1½ in., would do for a yard or firm ground, but 2 in. and above for a grass field. The diameter of them is not particular—12 in. would suit; which would mean the frame of the sides to come below the floor 12 in., to allow the bearings to be fixed to them."

Model Engine.—M. (*Bishop Auckland*) writes to G. S. (*Guernsey*) (see No. 189, p. 526):—"You can procure castings, finished parts, and complete model engines from Mr. Lee, who advertises in WORK; he also supplies clockwork for model boats."

Ribbon of Bruges.—G. D. C. (*Brixton Hill*) writes in reply to A. C. G.'s (*Hampstead*) (see No. 178, p. 350) inquiry as to the making of ribbon of Bruges:—"I beg to submit the following: Dissolve 1 oz. of nitre in 16 oz. of water; in this solution well soak narrow tape (the ordinary tape), and afterwards thoroughly dry it. Prepare a tincture of the following: Gum benzoin, 1 oz.; grain musk, 10 grains; gum myrrh, 2 drachms; balsam of Tolu, 1 drachm; freshly powdered orris-root, 1 oz.; otto of roses, 10 drops; rectified spirit, ½ pint. Macerate the ingredients in the spirit for a week, then filter. Dip the nitrified tape in this solution, dry, and repeat the operation two or three times, when the ribbon will be ready for burning. I do not know whether A. C. G. requires this form for making the ribbon for sale or for his own use. If for the latter, I might add that it would be more expensive to make than to buy the article ready prepared, unless a large quantity was required, as, doubtless, he will be charged at least 6d. a grain for the musk (cost on market, 115s. to 150s. per oz.), 1d. per drop for the otto, and 1s. 9d. or 2s. for the spirit."

Sensitive Metals.—H. B. S. (*Liverpool*) writes to J. W. (*Old Kent Road*) (see No. 190, p. 542):—"The most sensitive metal for conducting heat is silver, but the most easily melted metal is mercury, as it is liquid at ordinary temperatures. Mercury regularly expands with equal increments of heat between certain limits. Its rate of expansion is one-one hundred and seventy-third of its bulk for each 1° Centigrade. It is, on this account, very valuable in the manufacture of thermometers. Another metal very susceptible to heat is fusible metal—an alloy of tin, lead, and bismuth in certain proportions, as follows:—

	Newton's Metal.	Rose's Metal.	Lichtenberg's Metal.	Wood's Metal.
Bismuth ...	8	2	5	4
Lead	5	1	3	2
Tin	3	1	2	1
Cadmium ...	0	0	0	1
Melting point	94·5° C.	93·75° C.	91·6° C.	60·5° C

All the specimens melt at a lower temperature than boiling water. They may be made by melting the required quantities in a crucible heated in an ordinary firegrate; the alloy may then be cast in a mould or run out on to a stone floor."

Printing Press.—E. POUTEAU (44, *Warden Road, Kentish Town, London*) writes, in answer to AMATEUR PRINTER (see No. 192, p. 574):—"If AMATEUR PRINTER or others write to me, I shall be most pleased to send them a sketch of a printing press which can be made very cheaply by anyone able to handle a plane and saw."

Polish.—M. L. (*Naples*) writes, in answer to WALNUT (see No. 182, p. 414):—"Before polishing, rub your material with 'siccative oil' (I do not know exactly what it is, but it is known by this name in Italy and France), and expose it, when still moist, to the sun, if you have any—*we have*. It will darken considerably. Change its position every few minutes."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—PLASTER: J. A. (*Aberdeen*); DYNAMICUS; C. H. S. (*Brotton*); A. B. (*Bromley*); T. A. (*Terrington*); H. W. (*Dundee*); STUDIOSUS; A. A. (*Johnstone*); AN ENGINEER; H. N. (*Smethwick*); J. B. M. (*Southport*); R. D. T. (*Marylebone*); J. W. F. (*Birmingham*); C. R. K. (*Finsbury, N.*); T. P. (*Highgate, N.*); M. F. (*Pollockshaw*); FOLLOWER OF "WORK"; T. R. (*Lowestoft*); THE FORCELINE CO. (*Lambeth*); W. S. (*Carr Bridge*); J. F. (*Slamannan*); ONE IN A FIX; M. S. W. (*Edinburgh*); GASOLINE; W. T. (*Birmingham*); E. N. (*Hackney*); A. D. (*Bideford*); J. W. (*Shaw*); T. M. (*Jarrow*); PROGRESS; D. T. (*Glasgow*); J. S. (*Sunderland*); OLD TIPTONIAN; L. S. (*Guernsey*); F. C. R. (*Plymouth*), V. B. (*Great Yarmouth*); W. J. B. (*Londonderry*); MAIN S.; AMHURST; H. T. T. B. (*Guadalming*); W. J. H. *Birmingham*); J. C. (*Oakfield*); MAGIC LANTERN; F. K. & CO. (*London, E.C.*); C. J. J. (*Scarborough*); J. W. C. (*Belfast*); ALBERT; FOX; F. L. (*Tunstall*); FOOT FELLOWS; A. H. R. (*Scotland*); J. C. D. (*Birmingham*); READER OF "WORK."

*** *Back Numbers of WORK. All Numbers from 1 to 104, also all Parts from 1 to 24, and Vol. I., are out of print. A few bound copies of Vol. II. are still obtainable from the publishers.*

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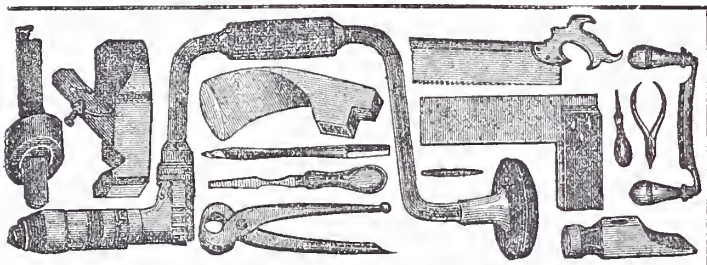

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WORK

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VOL. IV.—No. 199.] SATURDAY, JANUARY 7, 1893. [PRICE ONE PENNY.

WORK WORLD.

A STEEL-WIRE rope, six miles in length and weighing thirty-five tons, has been made at the Deptford Wire Rope Works, Sunderland. It is intended for the purpose of colliery haulage.

* *

Oak for decorative purposes is produced by fumigating the material with ammoniacal vapour, which effectively produces the dark colour desired. The ammoniacal liquid does not touch the wood, the vapour only being passed into the air-tight chamber in which the material is placed.

* *

Two vessels have been booked by two Tyneside firms to the order of the North German Lloyd Steamship Company, this work having previously gone to the Clyde. Sir W. G. Armstrong & Co. will build one, and Messrs. Wigham Richardson & Co. will build the other, and engine both vessels.

* *

The increased cheapness of nickel, owing to the large output of the Canadian mines, is leading to a more extended use of this valuable metal. Only lately it was mentioned that the French Government proposed to use 400 tons in nickel coinage. Austria is also about to follow her example.

* *

An arc light between mercurial electrodes in vacuo is very brilliant but rather unsteady at the positive pole; when the intensity is very nearly equal to that of an ordinary arc light, no variation is observed. The temperature is not high, and the negative pole is hotter than the positive.

* *

Fifty-two years ago a patent was granted to the brothers Elkington, of Birmingham, for plating and gilding by electricity. Now the quantity of silver deposited by electricity is said to be between 50 and 100 tons in the course of a year, a fair proportion of which is used in the Midlands.

* *

Eminent chemical authorities have stated that aluminium would resist the attacks of nitric and sulphuric acids, whether dilute or concentrated; it is now reported that experiments made by Monsieur G. A. Le Roy have shown that the pure metal is rapidly attacked by strong nitric and sulphuric acids, even in the cold. This precludes the use of aluminium in manufactures in which these acids take part.

* *

A machine for threading spokes for cycles has been recently perfected by Mr. A. Stevenson, of Paisley. With this new machine it is claimed that the spokes are threaded in half the time ordinarily taken; and whilst only boy labour is employed to work it, the results are more uniform. The cost of the machine is to be about £2, and our contributor has promised to send drawings of it for publication.

* *

A photograph of a small stream of water has been taken by electric light and exhibited by Professor C. V. Boys. The photograph shows that the stream—apparently solid to the naked eye—was resolved into a beautiful and regular series of drops. The effect on a fountain of playing or singing was to change its appearance to that of one, two, or three separate streams, but a photograph taken as a tuning fork was struck demonstrated that the water was disposed in a regular series of drops.

* *

Mr. Hornby, of Queen's College, Oxford, propounds a theory as to the nature of "flexible sandstone." This stone, Itacolumite, is found in India, and may be bent like a sheet of cardboard or metal. Mr. Hornby maintains as the result of his microscopical examinations that the flexibility is due "to rough ball-and-socket joints between the grains." Visitors to Agra are often imposed upon, and purchase a composition, made by the natives with gum and sand, thinking this is genuine sandstone.

* *

It is announced in Berlin that the works of Frederick Krupp and the gun manufactory of Gruson, near Magdeburg, have been amalgamated. Krupp, as is well known, possesses the secret of the manufacture of the best steel for heavy guns, while the Gruson works have hitherto produced the best armour-plating in Germany, and also the most effective armour-piercing projectiles of hardened steel in the world. The combination of these two powerful establishments is, therefore, calculated to give Germany a new advantage over other countries in preparations for naval and military warfare.

* *

Herr Alwin Nieske, of Altherzburg, states that cement may be rendered waterproof by adding ten per cent. of acetate or palmitate of alumina. The cement may be also made refractory by adding chromate of magnesia to it. If the cement is to resist moisture, and also to be refractory to fire, a mixture is made of about equal parts of cement mortar with the palmitate and a chromic magnesia prepared from oxide of chromium, 32 to 42 parts; alumina, 18 to 22 parts; magnesia, 18 to 20 parts. The mixture is wetted with water and formed into briquettes, which are calcined and pulverised ready for use.

* *

The Metallic Tube and Flask Company of Birmingham are using a new method of making weldless cold-drawn steel tubes. The steel is of special quality and is received from the works in the form of sheets. Circular discs are cut out of the sheets and pressed into shallow cups, which are then passed through dies of decreasing size, thus reducing the diameter and increasing the length of the cups until they assume the shape of tubes with one end closed, which latter is cut off after the final drawing operation is completed. The tubes are made of any size, from $1\frac{3}{4}$ inches down to $\frac{1}{16}$ inch diameter.

* *

A new process for purifying iron and steel from sulphur has been invented. For this purpose about equal parts of calcium chloride and lime are mixed and ground to a powder. The mixture is placed on the bottom of the ladle and the molten iron run in; it then melts, and passing up through the fluid metal carries with it practically all the sulphur which the iron contains. The inventor states that the cost of materials is about 6d. per ton of iron treated. From experiments performed with this material it was found that from 73 to 100 per cent. of the sulphur present was removed, according to the length of time that the mixture remained in contact with the iron.

STENCILS FOR WALL DECORATION.

BY A LONDON DECORATOR.

In previous volumes of Work I have briefly reviewed the claims of modern wall coverings; the mission of decorative colour in our homes, and similar kindred "every-day" aspects of decorative art. I now purpose supplementing the article on Stencilled Ceiling Decoration (Work, No. 188) with a few examples of wall decoration of a kind suitable for the ordinary cottage or villa. Although those of my readers who have carefully studied the above-mentioned papers on theory and technique will be better prepared for planning and executing these wall treatments than those who have not, I shall hope to direct the practical efforts of the latter to fairly successful ends.

This design shows a representation of a simple plaster cornice, having a stencilled fringe border beneath it, and also of a skirting with a base border on the wall. These ornaments are of the simplest kind, and suggestive, by their regular repetition of simple forms, of Greek decoration. The arrangement of base and frieze borders is most suitable for bedrooms and parlours; but a deeper frieze is preferable for the latter if skill and other circumstances permit. In the article on Ceiling Decoration to which I have previously alluded, directions were given for enlarging small designs, and converting them into stencil patterns. To this I must refer any unpractised reader; but I will again draw attention to the disconnected formation in which stencil ornaments must be drawn. *Ties*, or connecting links, in stencils should be so arranged that no subsequent making good is necessary, and in this respect the novice must give every care to his enlargements.

Assuming the two stencil patterns to be prepared, I will briefly review the method of application. In the first place, with regard to colour. Bedrooms are undoubtedly best treated in light tints, and although it is usual to treat a sunny room with cool tints, and *vice versâ*, the bedroom is used so little during hours of sunshine that the tint applied to its walls is chiefly a matter of individual fancy. But, supposing we here want a cool but cheerful room, we therefore decide on a greeny-blue tint. This latter will be the dominant colour-sensation of the room. We may then further proceed on these lines. The ceiling, D, is tinted "ivory" or cream white, preferably a tint of *raw sienna* (not of *chromes*, which are too bright). This will "throw up" the colour of walls by force of *colour contrast*.

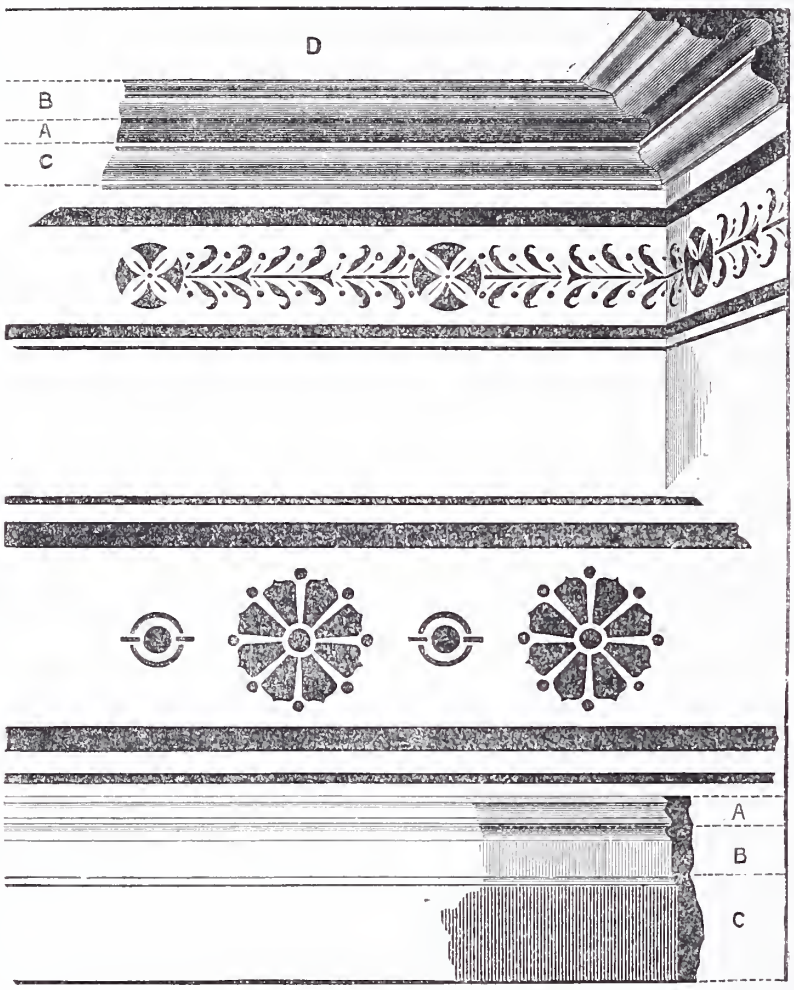
The wall colour—a medium tint made from white stained with blue, a little green, and a little umber—is also put on the top section of cornices. In the cornice cove we put a dull "old gold," and a darker shade of wall colour forms its base. These three colours I advise for the woodwork—namely, the panels of B, same as wall; the moulding A, "old gold;" and the remainder of woodwork C, a much deeper tone of wall colour.

Now concerning the ornamentation:—It is intended that the lines be "run in" at the last with a bevel-edge lath and a hog-hair lining fitch; but it is well to make the stencil wide enough to cover the place for lines, and to cut a little piece of each line on the pattern. These portions, when stencilled with the ornament, give us perfect guides or "keys" for running the lines. I have suggested that 6 in. and 8 in. be the width respectively of the frieze and base borders, between the thick inner lines. This, however, can be increased or diminished at pleasure, so long as the *proportions* are not materially disarranged. The ornament and lines may be in either the stile colour C—a darker tone of the wall colour—or in "old gold," same as mouldings. Should a more striking contrast be desired between pattern and ground, then the ornament may be a "nut brown," or that colour for lines, and deep grey or "old gold" for use with stencils.

It is impossible in the space of a brief paper to deal fully with the material. A few lines thereon may, however, be useful. Distemper of the ordinary kind is cheap, bright, and sanitary, and for bedrooms will answer admirably. If "Duresco," "Calcarium," or "Alabastine" is used, the makers of these "patent" distempers will advise as to the proper tints, or my readers can receive brief selections through "Shop." If cost and time do not stand in the way, good oil paint is most serviceable and sanitary; but in either case the stencilling should be done in "flatting" paint, and the ceiling is always best distempered.

The woodwork oil colours may not match the distemper tints accurately—this is on account of the different natures of lead and whiting—but pains should not be grudged in the effort. If we desire to varnish the woodwork, the palest "copal" is necessary; otherwise, our greys will be turned into dirty greens, and the whole colour-effect spoiled. But white copal varnish is costly; therefore, if we want a durable woodwork, and especially if we have American walnut furniture in the room, the door, skirting, etc., may all be finished "walnut brown," and varnished with ordinary oak varnish. If buff and salmon tints are desired for the room, then the woodwork and decoration had better be in darker tones—"terra-cottas;" the ceiling or door panels cream or "ivory."

The lines and ornament I have given in black, that they may the better be copied. When executed, the relative depth between ground and ornament will not be so extreme, and is better represented by the values of skirting. But it is better to make a little too much contrast than not enough.



Stencils on Greek Lines—A, Moulding Colour; B, Panel Colour; C, Stile Colour; D, Ceiling—"Ivory" Tint.

THE ART OF STAIRCASING.

BY GEORGE F. CHILD.

Open-string Staircase.

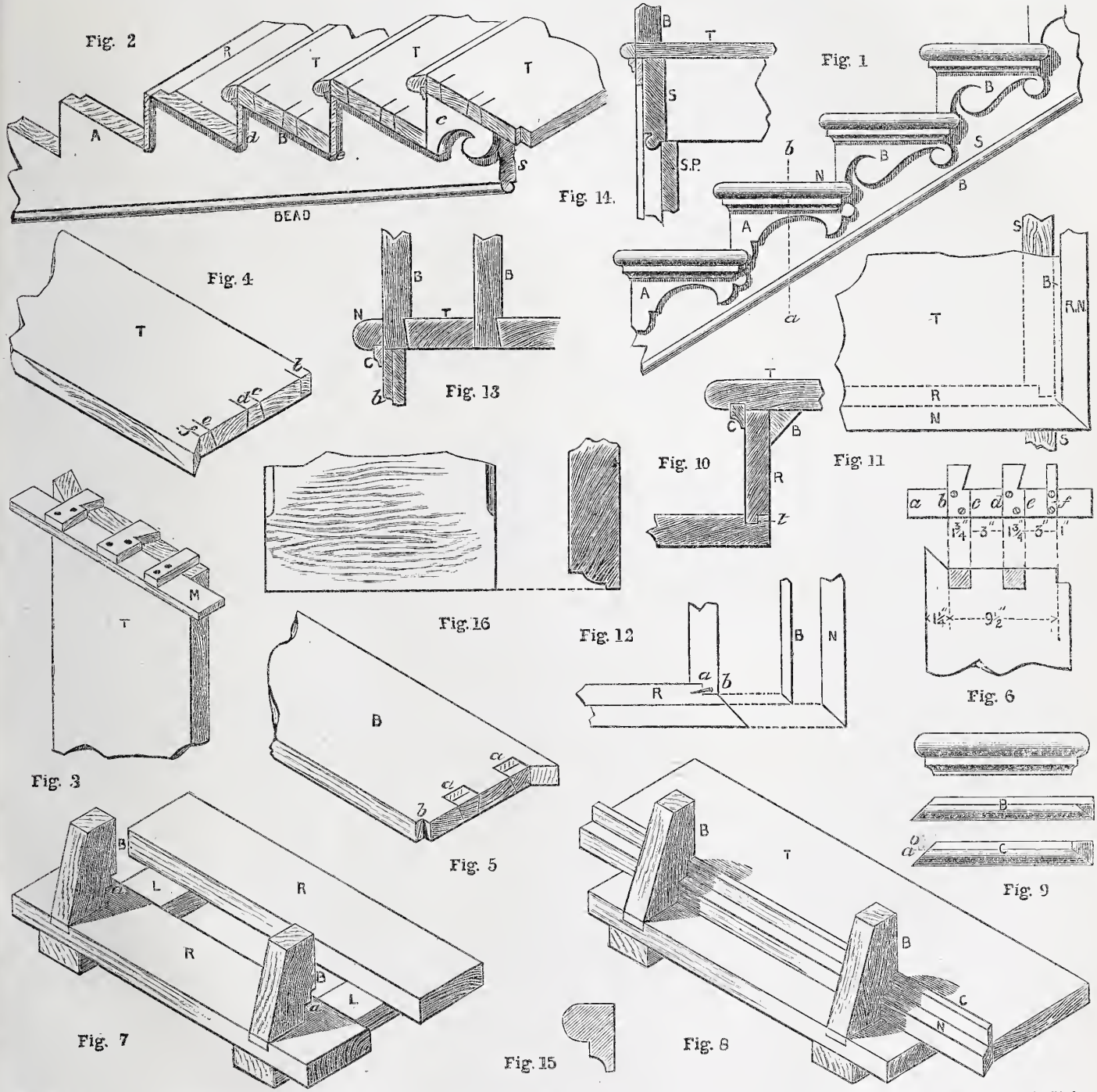
Introduction — Open-string and Brackets — String Showing Various Parts — Preparing the Treads — Template for Balusters — To Apply the Template — Cutting Treads for Balusters — Cradle for Gluing-up Steps — Gluing-up Steps — Nosings and Coves — Return Nosings — Section of Step — Plan of Angle of Step — Cutting Risers — Sections — Putting Stairs Together — Fitting Brackets and Nosings.

Introduction.—In the preceding paper we had an example of an open-string staircase, with two newels on the landings; now, as there are various processes in the construction of a flight of stairs of this kind that require very careful attention, we propose explaining in this paper the methods usually employed to ensure a good job. It is believed (this by the way) that there has never before been such a course of articles upon staircasing compiled, and explained so fully, as we here present to our readers; and being the result of personal experience, they should be of great assistance to the novice.

Open-string and Brackets.—In Fig. 1 we have the part elevation of an open or cut string, complete with nosings and brackets. At A A is shown a form of bracket that may be called continuous, on account of one joining the other. A bracket

of this description is often adopted where expense is an object, it being easy to work, and allows the nosing to be *returned* in *itself*. Brackets are usually about $\frac{3}{8}$ in. thick, and are fixed immediately under the treads, which project over the string, and finish *flush* with them. At B, B a different form of bracket is shown, which may be called superior to that at A. This bracket, finishing each in itself, causes the nosings to be mitred, and to return $\frac{3}{8}$ in.: this being the thickness of the bracket, which does not pass under the nosings at this point, therefore the nosing must pass on to the string itself. It is a good plan to plane up and thickness a piece of board (pine by preference, it being easy to work), and cut out the brackets with a saw; after a sufficient number are sawn out, they may be cramped together, and worked up with "hollows and rounds" of various sizes, finishing up with glass-paper. This is to be preferred to working each up singly, as it takes less time and ensures all being alike. Of course, *portions* of the bracket "B" cannot be worked in this manner, as the planes will not work far into the eye of the scroll, but this can easily be done afterwards.

String showing Various Parts.—Fig. 2 is a portion of the string showing various stages of the work. At A is seen the string itself, as notched or sawn out ready to receive the steps. B illustrates the *tread* and *riser* in position, *d* being the mitre on the *riser* (under which the *tread* below passes), which projects the thickness ($\frac{3}{8}$ in.) of the brackets, and is mitred to it; *e* is the portion of the tread passing *over* the outside of the string; *c* shows a part of the bracket



Staircasing. Fig. 1.—Elevation of String—S, String; A, A, B, B, Brackets; N, Nosing; *a b*, Section Line. Fig. 2.—Details of String and Steps—A, String; R, Riser; T, T, T, Treads; B *e*, Projection of Step over String; *d*, Mitre on Riser; *s*, String Section; *c*, Bracket. Fig. 3.—Application of Mould—M, Mould; T, Tread. Fig. 4.—T, Top Side of Tread—*b*, *c*, *d*, *e*, *f*, showing Cuts for Balusters, etc. Fig. 5.—Under Side of Tread—*a*, *a*, Cuts for Balusters; *b*. Cut out for String. Fig. 6.—Template—*a*, *b*, *c*, *d*, *e*, *f*, Clear Distances for Balusters, etc. Fig. 7.—Cradle for gluing-up Steps—R, R, Rails; L, L, Ledgers; B, B, Blocks; *a*, *a*, Notches for Nosings. Fig. 8.—Tread in Position for gluing—T, Tread; B, B, Blocks; N, Nosing; C, Cove. Fig. 9.—Nosings—B, Returned in itself; C. Mitred in return. Fig. 10.—Section of Step—T, Tread; R, Riser; B, Block; C, Cove; *t*, Tongue. Fig. 11.—Plan of End of Step—N, Nosing; R N, Return Nosing; S S, String; R, Riser; B, Bracket. Fig. 12.—Mitre on Nosing and Bracket—R, Riser; B, Bracket; N, Nosing. Fig. 13.—Section of Step to show Balusters, B, B—T, Tread; N, Nosing; C, Cove; *b*, Mitre on Riser. Fig. 14.—Section on *a b* (Fig. 1)—S, String; S P, Spandril; T, Tread; B, Baluster. Fig. 15.—Section of Nosing. Fig. 16.—Sketch of Cove Plane.

nailed in position ; *s* being a section of the string.

Preparing the Treads.—In setting out the steps to length, we must remember that they *pass over* the thickness of the string and $\frac{3}{8}$ in. beyond, also $1\frac{1}{4}$ in. for the returned nosing ; this $1\frac{1}{4}$ in. represents the thickness of the tread, which is usually taken as the projection of nosing over the riser. The treads are now set out for the return nosing by squaring them across, at a distance equal to the projection of nosing from the end ; they are then marked for the mitre with a *mitre square* or a bevel set to an angle of forty-five degrees, after which the piece is cut out clean, leaving the tread as at Fig. 5. The tread must now be ploughed on the *under* side to a depth of $\frac{1}{4}$ in., with an $\frac{1}{2}$ in. plough-iron ; this is to receive the piece ($1\frac{1}{8}$ in. × $\frac{1}{2}$ in.) for the cove, or small moulding under the front edge of step.

Template for Balusters.— Having proceeded thus far, we have next to prepare for the balusters ; the first thing, then, will be the making a mould or template by which to mark the treads. Plane up a piece of stuff about 14 in. × 2 in. × $\frac{3}{8}$ in., also two pieces equal to the size ($1\frac{3}{4}$ in.) of the balusters ; these last pieces should now be cut in the form of a *dovetail* on one end and equal to the thickness of treads. Also a small piece is required about 1 in. wide. Now from the pitch-board obtain the width of the tread, from *inside* of nosing to *outside* of the next riser above, which we will take as $9\frac{1}{2}$ in. ; now deduct the thickness of *two* balusters ($3\frac{1}{2}$ in.) from this, dividing the remainder (6 in.) into two parts. Fig. 6 will best illustrate our meaning. At a short distance from one end screw one of the strips on to the long piece, as from *a* to *b*. Now mark 3 in. from this and screw on the other, as *c d*, again marking off 3 in., *e f*, and fasten on the 1 in. piece *inside* the mark.

To apply the Template.—To apply the template, place it upon the *end* of the tread, with one edge of the *first* strip close up to the mitre, as seen at Fig. 3 ; now mark round the strips with a pencil, and square the marks down the face of tread equal in distance to thickness of baluster ($1\frac{3}{4}$ in.).

Cutting Treads for Balusters.—Our next proceeding will be to cut in for the balusters. This is managed by running a saw down the marks made on the *face* of the tread, being careful not to pass beyond the $1\frac{3}{4}$ in., or it will be visible after the balusters are fixed. This process is plainly seen at Fig. 4, T being the top side and B (Fig. 5) the under side of tread. The parts *a*, *a* on the under side are next *partly* cut through with a mallet and chisel, the pieces being completely cut out, when the balusters are fixed, after the stairs are in position ; the small piece *b* is cut out to allow the tread to pass over the string in front of the riser above, as this gives the width of tread.

Cradle for Gluing-up Steps.—At Fig. 7 is shown a very useful appliance for gluing-up the treads. As it is obvious that the risers should be at right angles to the treads, every care must be taken to ensure this result ; hence the use of the cradle. To make the cradle, prepare two pieces of stuff, R, R, about 3 ft. long, 4 in. wide, and $1\frac{1}{2}$ in. thick ; also two similar pieces, L, L. Now cut two other pieces as B, B, sawing out the notches *a*, *a* to a distance equal to the nosing and cove. Nail R, R and L, L firmly together, and let the pieces B, B into R as seen, being sure that the face of each is perfectly square with R, R; also nail these in.

Gluing-up Steps.—Having first glued in the pieces designed for the coves, place the tread *face downwards* upon the cradle, as at Fig. 8. Now fit each riser in its place by "shooting" the edge until its face coincides with B, B; also fit three blocks in at the back, *being sure they fit*, as upon this depends their usefulness. Having fitted all the risers, glue each to the tread, with the blocks behind, and place them on one side to dry. The risers should now be worked to their proper width, to be obtained from the pitch-board.

Nosings and Coves.—The nosings should be worked with the nosing-plane described before ; the coves are also worked with a special plane, as shown in the sketch (Fig. 16).

Return Nosings.—The return nosings will depend upon the bracket selected ; they should first be worked as at Fig. 15 : that is, the nosing and cove in one piece. If the bracket is to be as A (Fig. 1), the nosings must be returned as at B (Fig. 9) : that is, returned in itself ; if as B, C will be the plan ; in this case a mitre is cut on *each* end and a small piece glued on the return ; *a b* shows the thickness of the bracket.

Section of Step.—Fig. 10 is a portion of the step when worked ; T is the tread, C cove, B block, and R the riser. The riser is sometimes tongued into the next tread, as here shown at *t*.

Plan of Angle of Step.—At Fig. 11 T is the tread, S the string, N the nosing, R N return nosing, B bracket, and R the riser.

Cutting Riser.—R (Fig. 12) is the riser, as cut out for string and bracket ; it is cut in this manner (and the string to correspond) to save the necessity of thicknessing the string, which would be the case if "*a*" was cut back.

Sections.—Fig. 13 shows a portion of tread with balusters in position : T tread, B baluster, *b* bracket, N nosing, and C cove. Fig. 14 is a section taken at A B (Fig. 1), S string, S P spandril, T tread, and B baluster.

Putting Stairs Together. — In putting "open-string" staircases together, we have to guard against the chance of wedging them up *out of square;* to prevent this fault arising, it is advisable to place each step in its proper place in the wall string, and firmly screw each riser into the next tread below. If this is properly done, and the ends of the steps all kept "fair," it is scarcely possible for them to be out of "true." Having wedged the steps into the "wall string," the "cut string" should now be placed in position with a piece of stout "quartering" placed against the nosings ; "cramps" are now applied, drawing the string tightly up into each step. It will be seen from Fig. 2 that the "risers" being placed on the top of the "treads," the cramp is sure to draw the steps firmly down. The "string" can now be nailed through the face into each riser, as the bracket will cover all up as at *b* (Fig. 12). A few nails can also be driven carefully into the treads on the "*skew*," and blocks should be glued at the back of each step and string. One of these blocks, often made by splitting a piece of square timber, is shown in Fig. 10, marked B.

Fitting Brackets and Nosings. — All brackets should now be fitted and bradded on, taking care that they are *fair* or *flush* with the portion of treads projecting over the string, as the nosings will be nailed on top of these. The return nosings should not be fixed permanently, as they have to be removed to fix the balusters ; therefore, two nails should be only driven partly home, so that they may be easily withdrawn with the pincers.

BOOT AND SHOE MAKING.

BY WILLIAM GREENFIELD.

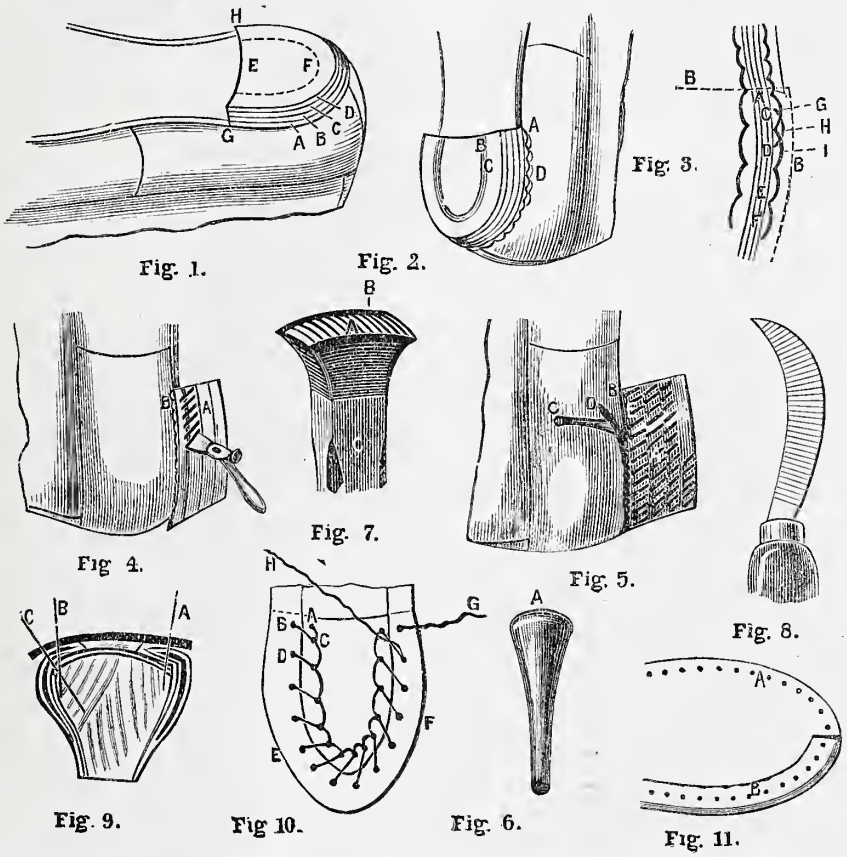
THE WAY TO GET THE HEEL READY TO SEW DOWN—HOW IT IS SEWN DOWN — THE WAY TO MAKE THE SEAT (SEWN SEAT)—THE WAY A PEGGED SEAT IS MADE.

The Way to Get the Heel Ready to Sew Down.—In WORK, No. 194, page 594, the split-lift was left pegged in its proper place on the seat. Now, when the top of this is rasped nicely and rough, it must be pasted, and the first entire lift put on grain side upwards, first roughing and pasting the flesh side. It is well, until having learnt to judge the size each lift should be, to place a piece of paper over the split-lift, getting a straight edge of it against the breast, holding it there with two fingers of the left hand. Then, with a piece of coarse sand-paper in the right, stroke the edge of the paper over the edge of the split-lift, until the edge of the paper and pattern of the heel is worn asunder. If the heel is to be square, this pattern will do for roughing out all the lifts. These should be a little larger than the pattern, unless the heel is going to be a smart (hollowed) heel ; in which case each one may be a little smaller than the other. For present purposes, there will only be wanted two whole lifts to make the heel, as in Fig. 1, A being the sole and seat-pieces, B the split-lift, and C and D the first and second whole lifts. In putting on the first lift, about five pegs can be inserted midway between the centre and edge, as was done in the split-lift ; the top of them cut off with a portion of the lift. Then the top is well rasped until nearly all the grain is off ; and when it has been trimmed round to the shape of the remainder of the heel the second lift can be roughed, the two pasted, and the second fixed in its place on the heel, and kept there by putting in, permanently, two $\frac{3}{4}$ rivets at E and F, or two sole tacks that can be withdrawn after the sewing down has been done. At the breast of the heel the first lift should overhang the ends of the split-lifts a little, and the second should overhang the first, and so on, until the top piece is on, and the heel is the height required. I have shown how to cut a channel, and one must be cut some distance in this top lift, as shown by the dotted line. It need not be deep, and if the knife be held the reverse way and a second cut made an eighth of an inch from the other, it will cut a V-piece out, and form a nice groove for the stitch to lay in. The sole and sole-piece should be rubbed round with the bone at G to H, to open it a little from the seat stitches, so that they may be clear. Then see that the seat and lifts are not too dry.

How it is Sewn Down.—It is held on the knees, as it is in the diagram (Fig. 2), with the heel towards you, and the lifts to the left, and held very firm by the strap. The heel thread should be stouter than the sewing thread—about four or six strands more will be sufficient. The heel awl is an instrument something like the sewing awl, only nearly straight. It is used in a large-sized sewing-awl handle, and the blade will want to be dipped into soap before it is used to make each hole. It has a thick substance to go through, and for this reason the bristles on the thread also will need to be good. To make the first hole, the awl must be put in at A (Fig. 2) and brought out at B. To show you the exact place in the sole that the point of the awl is to be put, I give in Fig. 3 a section of the welt and seat. Supposing B and B (the dotted lines)

to be the heel, the first hole is made exactly over A. This done, one end of the thread is drawn through, and it is then halved. The second hole is made in the same way over C, and brought out at C in Fig. 2; and in making this hole, as with all the rest after the first, the awl must not touch the seat stitch (Fig. 3), or the wriggling of it would cause the stitch to be burnt or heated enough to impoverish it of its wax, and make it somewhat rotten. After the hole is made, just the point of the awl is placed under it, to raise it to be in a line with the mouth of the hole, so that the thread may well run through the two. This is done by putting the two bristles in one after the other, and then pulling the two ends through at once, pulling very hard on both sides; the third hole made in the same way by putting the awl in at D, and the former process repeated. This, it will be seen, will make a stitch as at H, that loops out of G into I; and when it is drawn tightly in as before, it will be seen that it draws the upper leather to the sole leather, and so holds the heel on; and this is repeated until the whole of the stitches that lay on the upper leather are sewn down—each hole following as at E and F, and so on. The stitches in both these diagrams are shown loose to illustrate the position of each, and each one should fall into the groove on the top, the last stitch being finished off with a knot. Each time a stitch or so is set the heel should be hammered down on the top of the stitches, at A C (Fig. 2), in order to keep it in its place. When the heel is sewn all round and the ends cut off, it can be firmly and well hammered down all over.

The Way to Make the Seat (Sewn Seat).—Although this is a sewn seat, which I have explained above, the making of it is not practically commenced until it has, as there described, been sewn down. Now, as the leather is damp and workable, it is the time to make the seat; and after it has been hammered on top, the stitches A, D (Fig. 2) should be rubbed down well with the bone; it can then be pened up with the pene end of the hammer, and it will need to be done most carefully, for all these stitches here must be covered by the leather in this process. It will be seen by A (Fig. 4), that in commencing, the pene of the hammer must only hit the heel at the bottom of the split-lift and the top of the sole and sole-piece. This is done to get the leather that is directly over the stitches as near to them as possible. When this has been done all round the heel, turn the boot round again, and commence at the extreme edge, B, holding the boot in the position shown; and when getting round towards the back, throw the toe between the knees. The hammering does not want to be hard, but sharp and frequent, and continued all round the edge of the heel in various rows, as at A (Fig. 5), and leaving no part untouched. Then it can be slightly hammered down with the other end of the hammer. The next step is to hold the boot in a firm place upon the knees (as at Fig. 5), and just start to cut the rough edges of the seat at B with the point of the knife; and to save it from slipping into the upper, the handle of an old metal spoon will be found very handy.* This is placed on the upper, as at C, moving it along with the knife to cut off the rough edge, D. This is trimmed up, so that E is left firm and solid, and well covering the stitch. The next start is made upon the other corner of the seat; and this, by running the seat-breaker† round. The guard B (Fig. 7) is put against B (Fig. 5), only at the other corner, and taking sweeping strokes in one direction only three or four times, until the seat is smooth and even all round. If not, the lumps must be cut off with the knife, and the breaker used again. This makes the edge E all right; and now the edge B must be rubbed round with the welt file,‡ and the heel can be allowed to dry. It can then have the remainder of the lifts put on.



Boot and Shoe Making. Fig. 1.—The Seat, with Sole, Split-lift, and two Lifts ready to sew down. Fig. 2.—The Stitch buried in the Lift, and how the Stitch is caught up. Fig. 3.—Section, showing how the Stitch is set and where the Hole is made. Fig. 4.—The Leather made to cover the Stitches by the Pene End of the Hammer. Fig. 5.—The Seat trimmed without cutting the Upper. Fig. 6.—Metal Guard, made from the Handle of an old Spoon. Fig. 7.—A Seat-breaker. Fig. 8.—Welt File. Fig. 9.—Section, showing how a Pegged Seat is made, with the right and wrong way of driving the Pegs. Fig. 10.—The proper way to sew the Seat down for a Pegged Seat. Fig. 11.—The Position of Pegs on Seat and Split-lifts.

The Way a Pegged Seat is Made.—If the seat is to be pegged, this must be decided upon before the boot is lasted, as it is necessary to skive the stiffener much thinner and more tapered than is the case if the seat is to be sewn. Otherwise it is the same as at Fig. 7, page 181, No. 168. With regard to the inner sole, it is not fitted and holed as before described, but left quite square and plain to the edge, as far as the heel is coming; only the waist and fore-part holed, as C. Even when the seat portion is left its full substance, it will be found that the centre is higher than it is at the sides, unless the bottom of the last at the heel is very flat—which it should not be, or it will perhaps feel very uncomfortable to the heel in wear. I have explained how to make a "split-lift," and a thin pair must be made to go on just round the edge of the inner sole (on top) about half inch wide. The substance they should be must be decided by the amount of drop that the last has at the edge, as you want to get the top as near flat and level as possible. It can be pegged on with a few short fine pegs. This is done so that in pegging the seat the sole and all the upper leather and stiffener should lay quite flat. The pegs must go straight through each substance, instead of on the slant; for pegs that do not go through everything, inner included, are never solid, as they tend to yield to any strain from top and bottom. This can be easily seen by looking at Fig. 9, which is a transverse section of the heel (seat, upper, stiffener, inner sole, split, and sole), with the right side with the split, and the left without. The difference can be seen between a peg that is driven through, as the line A, and the one at the line B. To get the same effect upon the leather on the left as the line A, the peg would have to be driven as the line C, which is not to be compared with A for strength. The inner sole prepared, the top can be lasted round the seat as before described, with this exception: that the upper must come over towards the centre fully three-eighths more than what is really needed for a sewn seat. Bought tops are generally quite large enough to admit of this, without making the golosh too low at the back; but, if not, then you must make them sewn. The upper is sewn down to the inner sole, but not as it was for a sewn seat. There are several ways of doing this; it can be felled round, one end being round the edge of the upper, or the stitch can be set, first on the sole side and then on the upper; but that is not quite solid enough for my liking, as everything must then depend upon the

* If the handle of an old metal spoon is hammered out thin and flat (as A, Fig. 6), it makes a nice guard to the knife for several purposes.

† A seat-breaker; A is the cutter, B the guard, C the handle (Fig. 7).

‡ A welt file for smoothing the welt, etc., made with cross-cuts on one side only (as Fig. 8).

pegs; therefore, I shall not illustrate these, but only the best method, which is as follows:—Hold the boot as you did for the sewn heel, with the heel towards you (as Fig. 10). The sewing awl is put in at A, and the point must come out at B, and a thread put through and halved. The next time the awl is put in, it must be at C, and come out at D; this is a little on the slant, and the remainder of the holes can follow the alternate dots on either side in like manner. Now, the way the stitch is set is like this: the end that is hanging out of B is held in the left hand, and when you have made the hole C D, the end that is at A is put into C; B is then put under the thread that is going to form the stitch on this side, between A C. The thread A is then pulled out at D with the left hand, and the thread B pulled through under the stitch A C. This, it will be seen, will draw the upper well over at B. The next stitch is set in the same manner, which will, of course, draw D over, and so on right round. Each time a stitch is set it can be hammered down on top, and also at the side; this beats the stiffener in its place, and helps to make the edge of the line E F nice and square, to form the seat upon. By this diagram being turned the other way up, it can be seen by the last stitch that if the two ends G and H are tied together it will make a good finish, that the whole is a solid and smooth seam, and that the top is nice and flat to receive the sole. The sole and sole-piece is put on as I said before, only that it is pared nearer to the upper, leaving about a sixteenth all round; then a row of fine pegs (just long enough to go through the inner sole) put in, as near to the edge of the sole and sole-piece as you can (as shown by A, Fig. 11); but they must reach the edge of the inner sole and just go through it. The proper awl to use is a straight fine awl, like an ordinary bradawl, only fine, and in a short stumpy handle; and if the leather be too hard for it to be forced in by hand pressure, it can be held in its place with the left, and be driven in with a hammer in the right. The tops of the pegs must be cut off, rasped, and pasted, ready to receive the split-lifts, as shown in my last article. When the split-lift is put on, it must have a row of pegs put round, as shown above, only they must not be quite so near the edge, as shown by B F. The first lift is treated in the same way, and, with these exceptions, all is the same, as with a sewn seat; and so in my next, after giving a brief account of pegged and spring-waist, called flexura waists, I shall show how to finish building the heel, and not leave you till "all the stuff is on."

Toothed Wheels with short teeth usually run much easier and smoother than those with longer teeth. The teeth should be also so pitched that the tooth of the driving wheel does not touch that of the driven wheel until the line of centres has been passed. The difference of motion between this, and that which ensues when the driver touches the driven tooth, is similar to that noticeable between trailing a stick and pushing it along the ground. The teeth should be carefully set out by means of a rolling circle, and the pitch of the driving wheel made about half per cent. coarser than that of the driven wheel. When the driven wheel has the coarser pitch, the pushing action will occur, and any slight irregularities in the surfaces of the teeth will cause much jarring and vibration.—F. C.

HOW TO MAKE AN IMPROVED BIRD-CAGE.

BY J. WHITFIELD HARLAND.

It is proverbial that pets, especially birds, invariably come to grief and a tragic end, the manner of their death being "cats." In their interest, I once designed and made a cage which effectually protected them from the feline race; and, presuming that amateurs and others might desire to do the same, I submit the present design.

The improvement consists in a double set of wires, at a distance of, say, 3 in. apart all round, to prevent pussy, after fascinating her destined prey, getting her claws far enough to be dangerous, and maintaining thereby a respectful distance between them.

The design itself, as shown in the illustrations, is octagonal in plan, is semi-Gothic in style, two storeys in height, and stands upon a square base, which projects 3 in. all round beyond the wires of the inner caging, whilst it has double eaves to its roof, each of which carries a separate caging. At one end of the base is a drawer front, with a pull in the centre, attached to the false bottom of the cage, allowing it to be withdrawn for cleaning, and fastened, when closed, by a button. At front and both ends are projecting bays in both storeys. These are to serve as enclosures for baths, seed-boxes, and nesting spaces, and are projected from the cage to avoid droppings falling into them. In the lower storey they are entirely of wood, and consist of a framing, roofed with wood, and filled in at front and sides with thin wooden louvres; and in the upper storey are almost solid wood, with trefoil apertures fitted inside with wire gauze, but framed and panelled as shown. At the back, *i.e.*, to the left in the drawings, there are no projections, thus permitting a full view, thence, of the interior. The double roof of the cage is of the kind known as hip and gable; the wires of the outer caging being vertical, whilst the inner wires are laid horizontally. The ridges and rafters die into a framed square base, for ornamental ventilator, into which they are mortised, which also receives the ends of the upper wires of inner caging roof, so far as those coming opposite are concerned. The ventilator above is framed together, fitted with louvres, and the horns, or awms, are left long enough at each corner to slide into the square base tightly.

The general construction is as follows:—Select some hard wood—preferably "Honduras" (a cedar, which in some parts of the country is called "bastard mahogany"), which is very little liable to warp as oak does—and first make the base of the dimensions shown in the plan by "concealed-dovetailing" it together at four corners, having first stuck the mould, *a*, on its face (see sectional part of Fig. 1). Then stick a bull-nose on edge of the top piece, *d*, and mitre it, and plant it upon the upper edge of the base-mould, *a*, fixing it to a strip, *c*, glued and screwed to *a* by screws and glue from its under side. Then plane up a flat piece, *b*, and glue and screw it to lower edge of *a* from below. This completes the base, except that the four corners (see plan), which are the difference between the octagon and its containing square, marked *e e*, should be floored by thin triangular pieces, of the size shown, and the false bottom drawer-front. This latter may be made by sawing the mould, *a*, right through with a very fine tenon-saw before planting on the pieces, *b*, *c*, and *d*, on one side of the square, afterwards fixing their ends only to other part of frame, so as to allow the length sawn away to slide between *b* and *d*, to act as the drawer-front. The pieces, *b*, should be made wider on the two sides right and left of the drawer, to act as runners, or separate runners fixed, with strips planted on to form rebates, to keep the sides of the drawer in square line with front, such sides being mere $\frac{1}{2}$ in. strips nailed on upper side of the $\frac{1}{4}$ in. false bottom of cage. Before covering this bottom with very thin sheet-zinc, it should be coated with a solution of alum, and both it and all inner parts of the base, cage, etc., should have a coat of shellac dissolved in naphtha or methylated spirits, especially in all joints, however close. This prevents the tiny parasites from finding harbour in the cage and multiplying, to the destruction of the birds. In the base and lower part of cage it will not do to trust to glue alone, on account of the unavoidable moisture. All parts should be also screwed.

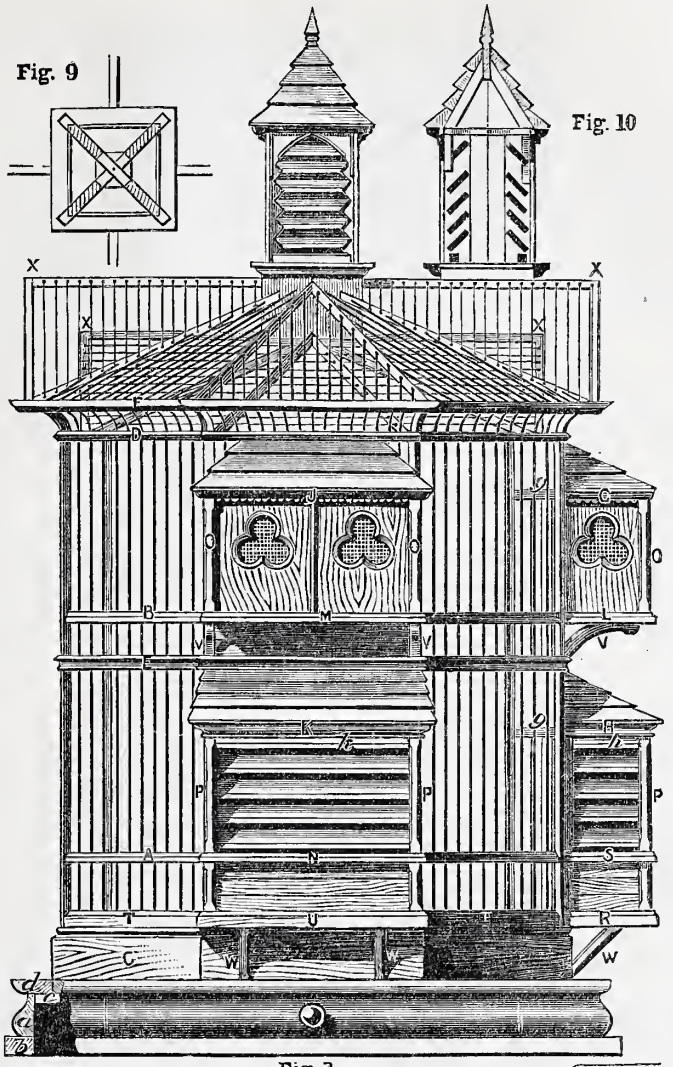
The eight uprights forming the outer cage should be carefully got out exactly the same length and thickness, out of $\frac{1}{2}$ in. × $\frac{3}{8}$ in. stuff, to the section (Fig. 4). The lower ends should go right down the full depth of the plinth, C (Fig. 1), which is octagonal, and be screwed to their places, from inside, to it. This plinth should be $\frac{1}{4}$ in. thick, with a small bead and hollow worked on its upper edge (see Fig. 8). This should be mitred, the angles being blocked together inside flat part. The lower edges of the rails, A, B, and of the mouldings, D, E, should now be marked off on the eight uprights on both sides, then, scribing thickness of the rails above the mark for them, notch the sides to nothing at back and to front edge of the sides, as shown in section (Fig. 5), the part left white being the notch, which enables ends of rails to be exactly square. The mouldings, E and D (Fig. 6), are made wider—viz., $\frac{1}{2}$ in. × $\frac{3}{8}$ in.—finished so as to project beyond face of uprights, there to mitre, the hinder part to be squared for notches, as before, into uprights. When these are all fitted to their places, before gluing up, the six uprights should be marked and mortised for the cills and heads of the projecting bays (right through that part of face which is square to them only) into the notches made for rails, A, B, and to the other side for heads, G, H. These mortises should only be $\frac{1}{16}$ in. × $\frac{1}{8}$ in. These side heads, G, H, should be mitred to the front heads, J, K, externally, and should be scribed to, and cut to fit, the rails, A, B, in one case, and the cills, in like manner to the uprights themselves, in the other case, all dying into the frame of outer cage. The posts, O, O, O, and P, P, P, should be of $\frac{3}{8}$ in. square stuff, stop-chamfered, as shown, the latter being mortised for receiving tenoned ends of cills, S, N (part through only), and at top for the head-rails, *k*, *h*. They should be grooved for $\frac{1}{16}$ in. panels in O, O, O, and for louvres in P, P, P, above N, S, and below for panels from R to S, and from U to N on the sides next to them. The under sides, inside edge, of cills, L, M, should be rebated $\frac{1}{4}$ in. wide, $\frac{1}{16}$ in. deep, for $\frac{1}{16}$ in. flooring to be afterwards nailed from below with very small wire nails, filed off if they project through to inside. The rails, A, B, L, M, N, S, are $\frac{3}{8}$ in. × $\frac{1}{4}$ in. Heads, G, H, J, K, are $\frac{3}{8}$ in. square before moulding. The bottom rails, T, T, U, R, are $\frac{5}{16}$ in. deep by $\frac{3}{8}$ in., mitred at the bays and bevelled to die into principal uprights, as may happen. The mitres to posts, P, P, P, to be recessed to $\frac{1}{16}$ in., and the posts must be recessed also, that the rails may be planted on recessed part of posts, leaving the mitred portion

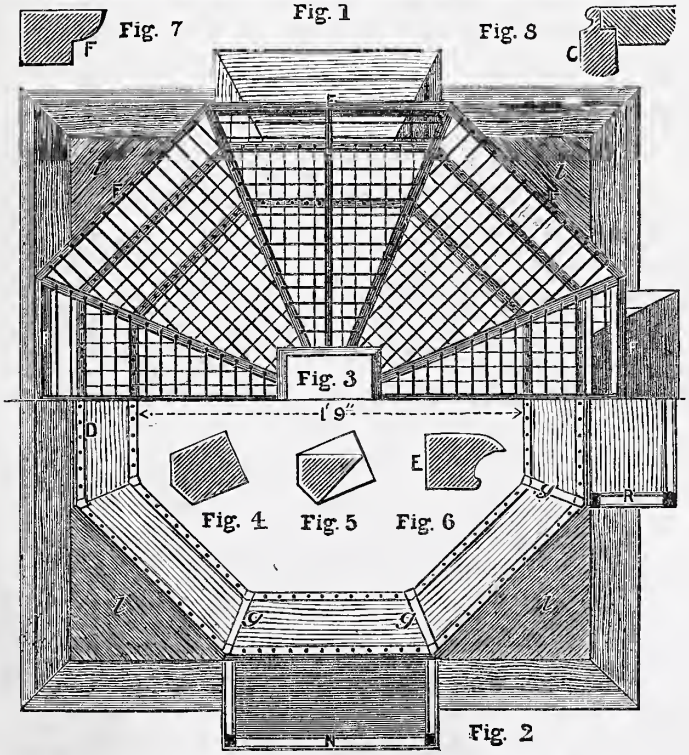
projecting beyond them, as shown. The under sides of the mouldings should be slightly notched, to receive the hip-rafters of bays ($\frac{1}{4}$ in. square), at their points of intersection. The plinth, C, should next be rebated at top edges to receive a filling, similar to the flooring of space in base below (already explained), to cover the angles of the octagon exterior to the contained octagon, so that the rails, T, T, U, R, may rest on its diagonal edges, and its eight sides be in rebate, the top flush with upper edge of the plinth (see Fig. 8). This being done, the framing of the outer cage, excepting roofs and bays, may now be glued up, and held together till the glue is dry by string, tightly tied round at top, middle, and bottom by way of cramps. The panels and louvres being made whilst the glue sets hard, the curved cantilevers cut out and chamfered (V, V), the straight struts made, chamfered, and housed on under side of R, the flooring of bays fitted roughly, the hip-rafters got out and bevelled to proper angle, the bays may then be glued up ready for fixing to the carcase.

The inner cage, being intended solely to keep the birds away from the outer cage, may, and should be, very light. The eight uprights may be of the same section as the outer cage, but thinner (or be $\frac{1}{4}$ in. round), and should be secured at foot to the filling (before described) of the top of plinth framing; at top they may be halved into their corresponding roof-rafters. One rail will suffice at the height of E. A plate at top, level with D, should go all round, halved at angles, and nailed to the uprights with wire nails.

If the cage be intended for larks, etc., instead of wiring the roof of inner cage, it should be filled in solid, and the lower storey should be discarded, the rail, B, being dropped to the height now occupied by A; otherwise, they would kill themselves by attempting to soar.

We now come to the roof construction, having so far only gone as high as the eaves-plate, D. Get a moulding, F (see Fig. 7, which is a section of it), and mitre it so that it will be larger (as shown in roof plan, Fig. 3), and saw out eight curved cantilevers for the angles, which must be nailed to the plate, D, and also to the eaves moulding, F, which they support. The wires of outer cage should be also bent to the same curve after they have passed through D and before they pass through F. Into the square box, which serves as the base of the ventilator, mortise the four ridges of outer and four ridges of inner cage, X, X. Next make the four pairs of gable-rafters for each casing, and fix them to outer ends of ridges.





Improved Birdcage. Fig. 1.—Elevation of Cage. Fig. 2.—Half Plan. Fig. 3.—Half Roof Plan. Fig. 4.—Section of Upright. Fig. 5.—Ditto, showing Notching. Fig. 6.—Section of Rail, E. Fig. 7.—Section of Eaves Moulding, F. Fig. 8.—Section of Plinth, C, showing Rebate and Filling. Fig. 9.—Plan of Ventilator. Fig. 10.—Section through Centre of ditto.

Then get out and fix the valley-rafters, housing their higher ends into the base of ventilator, and note that the valleys of inner casing will be cut to an angle, to nail under the said base. Note also that the feet of the eight outer roof-valleys and the gable-rafters, rest on, and are nailed to, the eaves moulding, F, whilst those of inner roof rest upon, and are fixed to, the lower plate, D, thus maintaining the distance between them. Before fixing the roof in place, we must not forget that some protection is needful to fence off the entrances to the bays between the two cages. This is provided for by fitting and fixing the pieces marked *g*, *g*, from the inner to the outer posts, and wiring the space between them.

For instructions as to wiring, I refer readers to information on the subject which has already appeared in WORK.

The inner roof should be wired purlinwise—*i.e.*, horizontally; the outer one vertically (see roof half-plan, Fig. 3, and elevation, Fig. 1).

This design would look well in ebonised wood, with gilt wire, or in French-polished mahogany, with nickel-plated wires; or it might be enamelled any colour, to suit surroundings.

ALUMINIUM SOLDERING.—For sheet aluminium soldering an iron-tin solder may be used with a flux composed of resin, neutral chloride of zinc, and grease. The metal should not be cleaned or scraped unless it is absolutely necessary to do so, in which case alcohol or essence of turpentine should be used for the purpose. For 5 per cent. aluminium bronze, tin solder may be employed, but this is not possible with the 10 per cent. alloy, in which case a preliminary copper-plating is recommended. If it is difficult to dip the ends to be plated directly into the solution, pieces of blotting-paper soaked in a solution of $Cu\ SO_4$ may be laid on them, and a current passed. The flux mentioned above may be used. Another solder which is recommended is one consisting of copper, 56 parts; zinc, 46 parts; and tin, 2 parts, applied with borax. Tests showed that with these solder plates of aluminium soldered together edge to edge, a tractive effort of from $16\frac{1}{2}$ tons to 18 tons per square inch was required to pull them asunder; if the edges overlapped, $22\frac{1}{4}$ tons per square inch were needed. Pieces of cast aluminium bronze, if placed in sand moulds, can be joined together autogeneously by running in some of the molten metal. If this operation is properly carried out, the joint is indistinguishable from the rest of the casting.

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DANGEROUS WORK.—The Home Secretary, Mr. H. H. Asquith, has issued another notice in the *London Gazette* in regard to dangerous workshops and work. It schedules chemical works, quarries, and a large number of explosive substances. But, important as it is, this is only a preliminary order. It asserts jurisdiction. It does not regulate procedure. The practical steps must be subsequently taken. By Section 8 (1) of the Factory and Workshop Act, 1891, it is enacted that "Where the Secretary of State certifies that in his opinion any machinery or process or particular description of manual labour used in a factory or workshop (other than a domestic workshop) is dangerous or injurious to health, or dangerous to life or limb, either generally or in the case of women, children, or any other class of persons, or that the provision for the admission of fresh air is not sufficient, or that the quantity of dust generated or inhaled in any factory or workshop is dangerous or injurious to health, the chief inspector may serve on the occupier of the factory or workshop a notice in writing, either proposing such special rules or requiring the adoption of such special measures as appear to the chief inspector to be reasonably practicable, and to meet the necessities of the case." Mr. Asquith now certifies that in his opinion such processes carried on in factories and workshops, or parts thereof, as the manufacture of earthenware, the manufacture of explosives in which dinitro-benzole is used, chemical works, and quarries are dangerous or injurious to health.

VULCANISED INDIARUBBER. — It would be difficult to find material of more heterogeneous composition than the so-called vulcanised indiarubber. Chemical examination is simply useless in this connection, but some physical experiments of value have recently been conducted by Lieutenant L. Vladimiroff at the St. Petersburg Technical Institute. These experiments lead to the following conclusions :—(1) indiarubber should not give any sign of superficial cracking when bent to an angle of 180° after five hours' exposure to a temperature of 125° Centigrade ; (2) rubber that does not contain more than half its weight of metallic oxides should stretch to five times its original length without breaking ; (3) caoutchouc, free from all foreign matter except sulphur, should stretch seven times its length before rupture ; (4) the extension measured immediately after rupture has taken place should not exceed twelve per cent. of the original length of the test piece ; (5) softness may be determined by measuring the percentage of ash formed by incineration, and by this the different grades of rubber may be determined ; (6) vulcanised rubber should not harden under exposure to low temperatures.

SHEFFIELD STEELMASTERS AND ALUMINIUM.—A statement has been going the rounds of the technical press that Dr. Meyer of Berlin had invented a process by which aluminium could be produced at a cost of twopence per pound. Upon this discovery statements have been based as to the ultimate employment of aluminium for the multifarious objects for which steel is at present used—obviously not a favourable prospect of the trade interests of Sheffield. However, experts in the manufacture of the metal do not accept the statement with regard to the German invention, and they declare that no development of the electrical processes at present used for smelting the metal from clay can reduce the cost of production to less than 1s. 6d. per pound. Moreover, aluminium is not fitted in any way to contest with steel the position of general utility as a constructive material which belongs to that metal. It only comes into competition with brass and copper, and its principal extended use of late years has been as an alloy with iron and steel to impart special properties to them. In this latter use the researches of Mr. R. A. Hadfield of Sheffield have shown that aluminium is a less valuable agent than others now employed, such as manganese, chromium, and nickel. The annual output of aluminium, notwithstanding the advances made in its production, is only 520 tons, of which 150 tons are produced in England. The single use into which aluminium has come into competition with steel has been in the building of light electric and petroleum launches, and it is quite possible that the torpedo-boat of the future will be constructed of this material instead of steel. Metallurgists are, however, agreed that aluminium could not be rolled into plates, or cast, or forged, so as to meet the requirements of shipbuilding and engineering. The talked-of reduction in price, even if it is actually imminent, need not, therefore, involve any evil to Sheffield industry.

WOOD PAVEMENT OPHTHALMIA.—Wood pavement fumes are responsible for even greater optical changes than mere ophthalmia or disease of visional powers—it is said they change the colour of the eyes. If the theory be correct, the inference would be that those who desire to have blue eyes should select a quarter where granite blocks are used for pavement ; those wishful for black eyes would naturally choose asphalt-paved streets ; while people who like old mahogany-coloured eyes should get as near wood pavement as possible.

BENT IRON WORK, AND HOW TO DO IT.

BY J. H.

Lantern and Floral Ornaments.

Lantern Framing — The Panelling—Floral Ornaments—Leaves—Varnishing.

Lantern Framing.—An alternative method of making lantern framing is shown in Figs. 72—74. The frames are made differently from that shown in the last article. First, there are two rectangular frames, A, A, made with flattened corners. On the edges of these two other frames, B, B, are soldered, so forming an angle iron section. Four corner strips, C, are bent round into double scrolls, as shown, and these are riveted to A, A at *b*. Upper and lower scroll-work, D, E, is formed, and also twisted shafts, F. C, D, and F are riveted together at *c*. D and a portion of C and F are shown enlarged in Fig. 73. Above there is a circular plate, G, with ring attachment riveted into it. The plate is riveted to D. The lower scrolls, E, are riveted to C and F, and are themselves connected at the bottom with a ring, J, riveted to them. This completes the main framing. Thin bent iron will do very well, the parts being well tied together, unless the lantern is of large size, in which case iron of about $\frac{1}{16}$ in. in thickness should be made use of.

The Panelling.—The centre panelling on each face is formed thus: Two rings of thin iron, K, L (also seen partly enlarged in Fig. 74), are made by bending, and soldering or brazing. Between these a zigzag pattern, M, is fitted, and secured with clips, *d* (one clip at every second or third point of contact of the zigzag with the rings). Within K a disc of coloured glass is inserted, and held with clips, *e*, bent round as shown, and simply pressed against the opposite faces of the glass. The ring L is fastened to C, C with clips at *f*, *f*, and also to the scroll-work, N, as shown in the enlarged view (Fig. 74). A bottom is inserted in the latter like that shown in Fig. 70 of the last article.

Floral Ornaments.—In a previous article I have alluded to and illustrated plain floral ornaments. I will conclude the series with another example or two rather more elaborate.

Fig. 75 illustrates various forms of dentition and construction, which, however, only embody a few out of many designs possible. Of course, in these ornaments there must be a good deal of conventional or formal treatment; but the main thing is good effect, and this can be obtained in such forms and by variation in colour. Some conventional forms of petals are shown in this figure. These are made from sheet copper, tin, or iron. If made of copper, they are left of their natural colour; if of tin or iron, they are blackened with a dead-black varnish. The original circles from which the rays of petals are cut are shown by the dotted circumscribing circles. In each case there are five petals, and the circles are therefore divided into five equal parts, which correspond with the divisions between the petals, or else with their centre lines—it does not matter which. In the figure A and B are similar, but B is cut more deeply than A. C and D are of different types. In each of these instances a single circle of petals only may be used to form a flower, or, alternately, several such may be superimposed, with their cleft portions alternating. In this case the upper sets of petals should be cleft more deeply than the lower ones, or else be cut to smaller circles. Three, four, five, or six may be superimposed in this fashion with good effect. Some amount of concavity must be imparted to each disc and to each separate petal, the amount being varied according as they are in an upper or lower series—more in the upper, less in the lower—or according as the flowers are required to appear—full-blown or partly opened. A round-faced steel punch is used to impart their concavity, the metal being laid upon a block of pitch or of compo, such as is used in *repoussé* or raised work. Observe that a hole is punched or drilled in the centre of each circle. Through this the petals are secured in their superimposed positions, copper or iron wire being passed through the holes. A central boss is required in this flower to represent the disc of the composite flowers, or the ovary-case, etc., of other orders. This may be formed neatly by soldering an ordinary rivet-head, like those used in model work, upon the end of the copper or iron wire; or a spot of solder may be run upon the end in the centre of the petals, and rounded up neatly. In the case of flowers with long projecting stamens and anthers, these may be formed with small nails, or with pins soldered into the boss representing the seed-case. Other ways will suggest themselves to those who work in ornament.

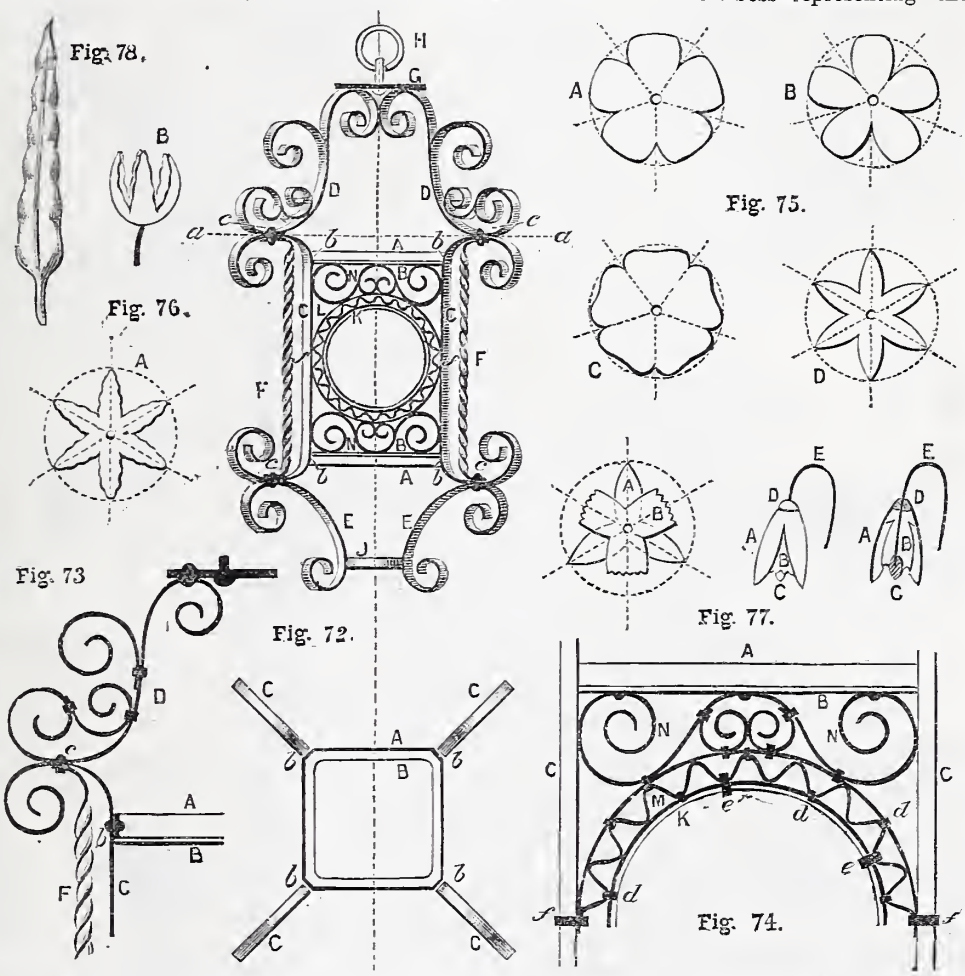
Another form of floral ornament is shown in Fig. 76. It is formed by cutting deep petals with waved edges, A, and turning these over as shown at B. An ovary and stamens will be formed in the manner just described.

Another ornament is shown at Fig. 77. Petals A and B are cut separately into conventional outlines, and are bent or dished into concave forms—seen to the right hand; the one to the extreme right being a section, the central figure giving an external view of the flower. A pistil, C, is formed with solder or other suitable means, and a calyx, D, similarly. The latter, if made of solder, serves to secure the copper wire, E, in the centre of the petals.

Leaves.—Conventional leaves have been shown in previous articles. A narrow lanceolate form, suitable for combination with floral ornament, is shown in Fig. 78. It is cut from copper, or tin, or iron, and such amount of waviness or concavity as is required is imparted on a pitch-block, as in the case of flowers.

A good variegated effect is sometimes obtained by using, in combination with iron, strips of brass and copper. These are more easily cut than iron. The sheets are sold in any gauge, and most coppersmiths will cut off pieces of any size asked for. Brass is about 10d. per pound; copper, about 1s. 1d.

Varnishing.—There is a glossy face on all new sheet-iron; but in time this will become rusted, and the edges, being clean cut, will soon rust. So the practice is to paint all iron-work when finished with a preservative coating of varnish. This is always a dead-black, of which there are several preparations sold. Judson's Black is one; drop black, ground into fine powder and mixed with gold size, is another



Bent Iron Work. Fig. 72.—Lantern. Fig. 73.—Detail of a Portion of Lantern Framing. Fig. 74.—Detail of a Portion of Panelling. Figs. 75, 76, and 77.—Floral Ornaments. Fig. 78.—Leaf.

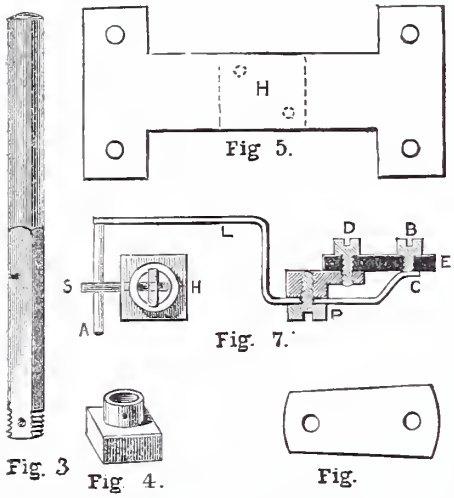
AN ELECTRIC HAMMER.

BY G. E. BONNEY.

THE PISTON AND HAMMER—THE ANVIL—THE REGULATING GEAR—MOUNTING THE INSTRUMENT—BATTERY POWER FOR WORKING THE HAMMER.

HAVING, in the first part of this paper, shown the general action of solenoids, and described the framework of the little instrument employed to practically demonstrate this action in an amusing and instructive manner, we will now give our attention to the remaining parts of the instrument.

The Piston and Hammer.—The piston (Fig. 3) must be made of a rod of soft iron $3\frac{1}{4}$ in. in length by $\frac{1}{4}$ in. in diameter. Take a light cut over this, to make it a loose fit in the bore of the cylinder. About $1\frac{1}{4}$ in. must be filed flat on both sides, to loosely fit the guiding-hole in the disc beneath the cylinder, the remaining 2 in. being left round. A thread should be cut on the lower part of the piston, to fit in the screwed socket of the hammer-head, and a transverse fine hole should be drilled through the end



Electric Hammer. Fig. 3.—Piston. Fig. 4.—Hammer-head. Fig. 5.—Base of Frame and Anvil—H, Position of Anvil. Fig. 6.—Shape of Ebonite Insulator. Fig. 7.—Sectional Plan of Regulating Gear—A, Lower Prong of Regulating Fork; B, Contact Screw; C, Tip of Contact Spring; D, Screw holding Ebonite Insulator to Lug; E, Ebonite Insulator; H, Hammer-head; P, Pivot of Regulating Lever; L, Lever; S, Striking-pin.

to take a lock-pin (as shown at Fig. 7), and thus prevent the hammer from unscrewing, this same pin being left long enough to form a striking-pin for the regulating gear. The hammer-head (Fig. 4) may be of iron or of steel, $\frac{1}{2}$ in. × $\frac{1}{2}$ in. × $\frac{1}{4}$ in. in thickness in the squared part; a small round socket, $\frac{3}{8}$ in. in diameter by $\frac{5}{16}$ in. in height, standing above this, turned out of the same piece of metal. The hole in this socket should be tapped to fit the screwed end of the piston, and be fitted with the striking-pin of brass above mentioned. The hammer-head may be larger and heavier, if so desired; but in this case a stronger current of electricity will be needed to lift the hammer.

The Anvil.—In Mr. Bowron's instrument the anvil is represented by a block of brass, forming part of the base of the frame. If the frame is cut out of sheet-brass, as before suggested, the base-plate may be cut out of the same material to the shape shown at Fig. 5, and the anvil (consisting of a block of brass $\frac{3}{4}$ in. in length by $\frac{1}{2}$ in. in width, and $\frac{1}{2}$ in. in height) be fastened to the base by set-screws from the under side, or by brass rivets passing through the block. The feet of the frame will rest on the base-plate of this block, and screws will pass through both, to hold the frame and base-plate together on the wooden stand of the instrument.

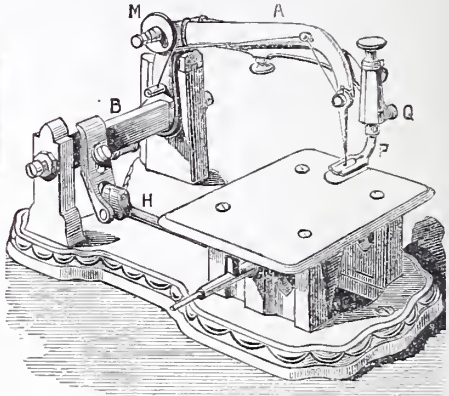
The Regulating Gear.—Supposing the bobbin mounted on the frame, and the piston, hammer, etc., placed in position: if, now, we send the current from two pint bichromate cells through the wire on the coil, the piston will be sucked up into the solenoid, and will remain there as long as connection is maintained with the battery and wire. On disconnecting the wire, the hammer will fall by its own weight on the anvil. We want some arrangement to break contact automatically, and cut the battery out of circuit when the upward stroke is completed. This is done by means of the regulating gear about to be described, which is an automatic contact breaker.

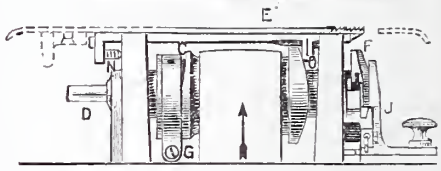
To a lug on one of the legs, is fastened (by means of a brass set-screw) a piece of ebonite or of ivory, shown full size at Fig. 6. In the narrow part projecting from the legs is fixed another brass set-screw, with its platinum-pointed tip on a level with the ebonite surface on the opposite side. To this screw is fastened the conducting wire from one of the binding-screws on the base-board. A piece of steel spring, such as a clock-spring, carrying a steel fork at one end and cut to a point at the other (as shown at Figs. 1 and 7), is pivoted on a set-screw passing into the leg of the frame. The longer end of this lever, carrying the steel fork, is bent to pass around the back of the hammer-shaft, with one limb of the fork resting on the anvil below the striking-pin, and the other limb $\frac{3}{4}$ in. above the pin. The shorter end, with its point tipped with platinum, is bent so as to let its platinum tip rest on the platinum-tipped screw when the hammer-head is resting on the block. The whole arrangement is shown in section at Fig. 7.

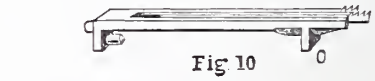
Now (after this has been made and fixed to the hammer) let us see what will happen when the battery is again connected to the instrument. The current will now pass through the wire coil to the small bolt holding the end of the wire to the frame, then by one of the legs to the pivot of the bent lever, and by the lever to the platinum-tipped screw connected with the binding-screw on the wood base. The hammer will now be drawn up, and its striking-pin will strike the upper limb of the steel fork, lifting that end of the lever, and moving the opposite end from the platinum-tipped screw to the ebonite plate. The circuit is at once broken, and the hammer falls, the striking-pin in its descent depressing the lower limb of the fork, and lifting the opposite end of the spring in contact with the screw. This action goes on rapidly (at the rate of 300 strokes per minute), and the consequent movement of the hammer resembles that of a steam-hammer.

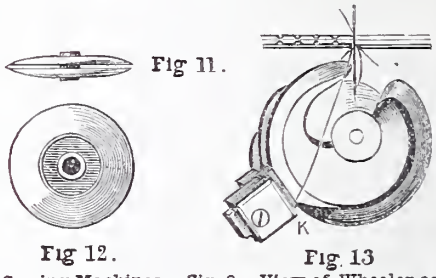
Mounting the Instrument.—The instrument may now be mounted on a base-board of polished oak, teak, walnut, or mahogany, 4 in. × 3 in. × $\frac{1}{2}$ in., and furnished with two brass binding-screws. I prefer the telegraph pattern of binding-screws for these and all other small instruments, as these screws take a good grip on the connecting wires without cutting them.

Battery Power for Working the Hammer.—This must be arranged to suit the wire wound on the coil of the solenoid, or this must be wound to suit the battery power to be employed. With two layers of No. 22 on the bobbin, a low-resistance battery, giving a full, strong current equal to that obtainable from two pint bichromate cells in series, must be employed to get a full stroke. If the hammer is to be used with cells of the Leclanché or Gassner type, that is, bell-ringing batteries, the bobbin should be wound with a finer wire—say No. 24 or No. 26—and a larger number of turns must be laid on—say from four to six layers or more—and not less than three medium-size cells in series be employed. These types of battery are, however, unsuitable for solenoid working, even with fine wire wound on the bobbin, as full magnetic effects are best obtained from strong full currents.









Sewing Machines. Fig. 8.—View of Wheeler and Wilson Sewing Machine. Fig. 9.—View of Mechanism under Cloth Plate. Fig. 10.—Feed-bar. Fig. 11.—Side View of Bobbin. Fig. 12.—Front View of Bobbin. Fig. 13.—Rotating Hook and Brush, showing Position of Needle and Sewing.

SEWING MACHINES AND THEIR MAINTENANCE.

BY CYCLOPS.

THE WHEELER AND WILSON STATIONARY SHUTTLE SEWING MACHINE—DESCRIPTION OF MACHINE—FORMATION OF STITCH—TENSION OF TOP THREAD—TENSION OF BOTTOM THREAD—FEED MOTION AND STITCH REGULATOR—POSITION OF NEEDLE AND NEEDLE-BAR.

Description of Machine.—This machine, which is a general favourite for manufacturing purposes in northern provincial towns, is unique in its appearance; and the arrangement of its mechanism differs in a marked degree from that of any other system of sewing machine.

As will be seen from a general view of it given in Fig. 8, it consists of two portions; the rear consisting of two pillars, between which the rocking-arm, A, is pivoted by a cross-bar, B; and the front, consisting of a square table under which are the pulley, C; shaft, D; feed arrangement, E; and hook, F (Fig. 9). The pivoted cross-bar carrying the rocking-arm receives its motion from an eccentric, G, on the shaft, by means of a connecting-rod, H.

Unlike most other machines, the work travels from left to right instead of away from the operator, and the needle, instead of being straight, is curved.

The Formation of the Stitch in this machine is peculiar. It is a combination of the hook principle of the Wilcox and Gibbs machine and the under thread shuttle arrangement of other forms of machine. A good idea of the way in which the stitch is formed may be obtained from a glance at Fig. 13.

The under cotton is wound on a spool or metal bobbin of the form shown in Figs. 11 and 12, by fixing the bobbin on the projecting end of the shaft or spindle, and running the machine while the cotton is wound on or in the spool. This bobbin is placed, when charged with cotton, in the hollow face of the rotating hook, and kept loosely in place by the slide ring shown at J (Fig. 9). This ring is provided with an adjustable stop, which causes it, when pushed right up, to hold the bobbin loosely in its place, the object of this being to allow the loops of the top thread to pass completely round it.

On the descent of the needle (see Fig. 13) the point of the hook catches in the loop of thread and conducts the loop rouud the bobbin until it arrives at the point K, when the brush retards its movement and holds it back until the hook has caught the next loop; it then liberates it to perform the same operation with the new loop.

Readers will see that it is extremely difficult to illustrate this ingenious movement without a lot of diagrams showing the hook, needle, and thread in several positions, and, as space in WORK is so limited, we must try to fathom the mystery by a study of Fig. 13, which will not be found so very difficult after all.

Tension of Top Thread.—We have shown, from what we said in our remarks on the Wilcox and Gibbs machine, that it is necessary to have a tension on the thread. In machines where two threads are used, it is the rule to have both tensions adjustable, so that the operator may to some extent so regulate it as to give to the sewing the desired degree of tightness. But in this machine the bottom tension is fixed by the position and pressure of the brush, and the distance apart from the bobbin of the adjustable ring-guard, both of which it would be inconvenient to alter; so that the whole of the tension adjustment is obtained by the tension pulley, M (Fig. 8), round which the cotton is turned on its way to the needle. The tension consists of a steel pulley, having on its edge a milled groove in which the cotton lies, and by which it grips and revolves the pulley as it is drawn through the needle. The tension is obtained by screwing up a milled nut, which presses a spring against the pulley and thus prevents its free movement to any desired degree.

The Bottom Thread Tension.—The tension on the bottom thread is, as we have already explained, obtained by the pressure of the brush on the cotton as it passes round the hook. This, when once satisfactorily set, needs no further adjustment until incapacitated for its work by wear, when it can be taken out, cut straight, and again adjusted to the hook.

Feed Motion and Stitch Regulator.—In all sewing machines the feed motion and stitch regulator must necessarily go together, for the feed motion pushes the work along when freed from the needle, and the stitch regulator regulates the distance of that push.

The feed arrangement is shown at Fig. 9, and a separate drawing of the feed-bar at Fig. 10. The cam which operates this feed is a combination of edge and surface cam; that is, the forward movement of the feed-bar is given by the front face or surface of the cam, which is at right angles to its axis—the spindle; and the upward movement is given by the edge of the cam. The feed-bar slides in grooves across the top of the bearings carrying the shaft, and a spring, N (Fig. 9), placed against the left-hand bearing, presses it to the left, keeping the dropped piece, O (Figs. 9 and 10), pressed firmly against the face of the cam. An eccentric disc with a little handle attached is placed under the top plate in such a position as to come in contact with the end of the feed-bar, and by turning it backward and forward the play of the feed is regulated, thus increasing or diminishing the length of the stitches.

This arrangement is shown, with the top plate, in dotted lines, in Fig. 9.

Position of Needle and Needle-bar.—The position of the needle in respect of the needle-bar or arm, as we have indicated by what we said on the formation of stitch, is such that the eye of the needle should be exactly $\frac{1}{8}$ in. below the point of the hook when the hook is close on the needle (see Fig. 13). The needle-bar or arm should be adjusted by the pivots, between which it swings, so as to allow the needle to be nearly touching the inside of the hook, but not quite.

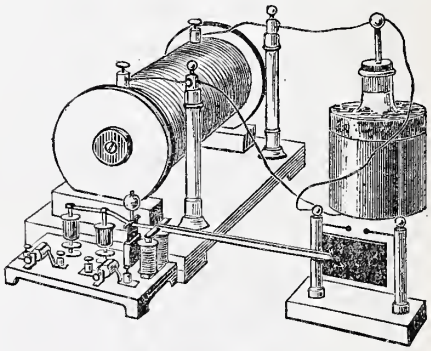
In our next paper we shall deal with the well-known Singer sewing machine, with reciprocating shuttle, and in its consideration we shall have a good opportunity of contrasting it with the two principles we have already described.

SPARK PHOSPHOROSCOPE.

EVERYONE is acquainted with the Phosphoroscope of Becquerel, the ingenious instrument by means of which a portion of a phosphorescent substance can be strongly lighted and studied after the lapse of a very short time, *e.g.*, the fraction of $\frac{1}{1000}$th of a second; in most instances, whereas all trace of the excitative light has disappeared, the substance under study still emits a brilliant light. The apparatus of Becquerel is intended to utilise the light of the sun; but it is interesting to study the phosphorescence excited by the light of an electric spark with an abundance of ultra-violet rays. For this purpose, a Mr. Lenard has invented a phosphoroscope which everyone can make with the ordinary resources of a laboratory.

Fit to the armature of a Foucault interrupter working a Ruhmkorff coil a wooden rod of 50 centimetres, with a piece of thin, blackened pasteboard at its extremity (see illustration). In the oscillation of the interrupter the paper will alternately cover and uncover the limits between which the spark appears: the apparatus is regulated in such a manner that the spark is produced at the instant when the space is about to be uncovered. The spark is made brief and brilliant by a condenser inserted in the secondary of the coil. The substance to be examined is placed very close behind the spark, so that it is uncovered very shortly after the emission.

In these conditions various curious phenomena can be observed. The short duration of the spark makes the screen appear to be at rest, and some $\frac{1}{1000}$ths of a second later a luminous substance is seen behind the spot it occupied, in such a way that at first sight one might imagine that the screen is opaque for the spark and transparent for the phosphorescent light. It is evident, however, that such is not the case, and that the observer is the object of one of the many optical illusions due to the persistency of luminous impressions. Let us make a brief digression. Some years ago we frequently found (more rarely nowadays) dynamo machines the brushes of which gave sufficient sparks to make the neighbouring objects clearly distinguishable. These sparks are produced at the instant when the brush passes from one plate to another in the collector; between one spark and the next the coil has turned one of its sectors, and presented the other identical with that just seen. We always see, then, the coil in



Spark Phosphoroscope.

the same position, so that it seems stationary; but if we move the brush the sparks follow it, and the coil seems to move slowly backwards and forwards with the angular speed with which the extremity of the brush describes the circumference of the collector.

Some substances, the various carbonates of lime for example, act in a manner almost similar in the apparatus of Becquerel, and in that of Mr. Lenard; some are more favoured in the first. On the other hand, arragonite crystals, invisible after solar lighting, give a slight reddish light after the spark. The duration of the phosphorescence is so short in uranium glass that the first parts uncovered are very luminous, the others much less. Glass gives a violet light; it can easily be demonstrated that it arrests part of the active rays. Let us put into two watch-glasses pastils of sulphuret of cupric calcium of the same size, respectively, covered with a sheet of quartz and a sheet of glass of 3 millimètres; the first, being thirteen times further from the source than the second, will give the same phosphorescence. The effect of the spark after the sheet of glass is then only about $\frac{1}{170}$th of the total effect, admitting the quantity absorbed by the quartz to be insignificant, as has long since been demonstrated. As for the glass, its transparency, which makes it so valuable, is due to the fact that the small part of the spectrum in which our eye is sensible to light is also that which it does not absorb; it arrests nearly all the short waves and many of the long. The Phosphoroscope offers us, as we just said, a very simple method of demonstrating this.—*La Nature.*

TRADE: PRESENT AND FUTURE.

**** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

THE WATCHMAKING INDUSTRY at Prescot, near Liverpool, is being extended considerably. The Lancashire Watch Co. have just completed the section of additional buildings and machinery for the entire manufacture of English watches. This company already employs 600 or 700 workpeople, and these will now be increased to 2,000. Over £90,000 has been spent in the above works, and the opening will be made the subject of great rejoicing on the part of the workpeople, a dinner and tea being amongst the good things provided.

ENGINEERING TRADE.—The recent slight improvement in the condition of the Lancashire engineering trade is not being maintained, and, except in a few instances, scarcity of new work is generally reported. The locomotive building branch is particularly badly situated, and it is many years since so little work was in progress or in prospect.

IRON TRADE.—A distinctly noticeable improvement characterises the Lancashire iron trade; and while there is quite a fair amount of inquiry for pig iron, prices have a very decided tendency to harden. Forge qualities scarcely fetch more than 43s., but in foundry qualities 44s. and 44s. 6d. have been obtained. In manufactured iron, only a small business is being done, and £5 12s. 6d. is about the average selling price. Lancashire sheets are £7 2s. 6d. to £7 5s.

STEEL TRADE.—The steel market continues to be very much depressed, and hematites are slightly weaker, ordinary foundry qualities being obtainable at 55s., and steel billets at about £4 7s. 6d. In plates, good boiler-making qualities are now being quoted at £6 10s.

METAL TRADE.—Only a slow business is reported, especially in steam fittings, and list rates for both brass and copper tubes have recently been reduced ¼d. per lb.

GLASS BOTTLE TRADE.—For some time past the masters have been talking of demanding a reduction of wages; but the crisis came last payday (23rd ult.), when upwards of 2,000 hands tendered their notices against the proposal. There are a number of branches in the trade—viz., Rotherham, Kilnhurst, Swinton, which includes Mexbro', Conisbro', Barnsley, Castleford, Ferrybridge, Hunslet, Wakefield, Thornhill Lees, Stairfoot, Blaydon, Newport, and London. The men have a strong society, and are well organised; and besides, they are connected with an international union, and its funds amount to close upon £30,000. The amount in dispute is 2s. per week on ordinary wages, nothing being said about overtime.

SHEFFIELD TRADES.—Before Christmas there was the customary show of activity in most of the local industries, seasonable novelties being most in demand. In cutlery there have been heavy shipments for South America, and there are further urgent orders. The silver trades have improved, but there is no urgency in this case; therefore the usual holidays have been observed. Cammells, of Sheffield and Workington, have again wrested an order from the Belgians, to the extent of 2,000 tons of steel rails. Inquiries for railway material have further slackened down. Hematites are still depressed, and Bessemer billets, for use in the local trades, sell slowly. Crucible steel is also slowly falling off, the improvement in the manufacture of Siemens-Martin and Bessemer productions gradually taking the place of the better brands of steel. In other branches there is little or no alteration.

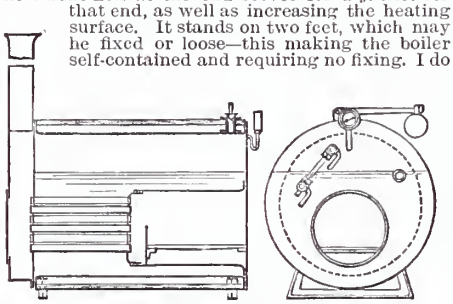
COTTON TRADE.—The great lock-out continues to be the chief topic of conversation in all parts of Lancashire. Hardly a day passes without house-to-house collectors being seen, some working in companies, and with a band of music to assist to draw custom; and no means is left undone to assist those locked out. A settlement of some kind would be welcomed most heartily by all, whether masters, men, or outsiders. The Secretary of the Masters' Federation maintained that the Federation had throughout been most reasonable in its demands. It was quite true that, two years ago, the operative spinners got a 5 per cent. advance, and that the strippers and grinders and female blow-room hands a 10 per cent. advance. This advance was made by the Oldham Masters' Association at a time when legitimate profits were not being made; the profits then were coming from lucky cotton speculation. Mr. Tattersall concluded by saying "That the state of the cotton trade warranted a greater reduction in wages than the one proposed."

SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

I.—LETTER FROM A CORRESPONDENT.

Engine and Boiler.—H. J. C. (*Gloucester*) writes:—"I have watched with keen interest the evolution of your ¼ horse-power engine and boiler, and more especially the boiler, for this is the stumbling-block of a great many. I have studied the boiler from its several points of view, and I think there are one or two things that might be improved. In the first place, the fire-door of a vertical boiler is always a difficult subject, and in this case it appears to be cut partly in the single part of the fire-box and partly in the double part of the boiler, which, of course, makes a very difficult joint round the fire-door. In the next place, the tubes are placed vertically, so that the lower half of the tube is under water while the top half is under steam and hot air, so that the latter half gets very nearly red hot, which sets up an unequal expansion, and very soon makes them leak; and, as I have had an experience of about five years with a boiler of this type, I think I can well decide against vertical tubes unless covered with water. In the next place, the feed water passing through the fire is not good, for in good practice it should enter the boiler as near the water level as possible. I think the boiler, generally, from an amateur's point of view, is rather a difficult one to construct; and, from remarks I have heard, I think it hardly meets with a *general* approval, and so I think it would be as well to have an alternative design. With this end in view, I send you a rough sketch of a new design. I think this boiler has several advantages over the vertical type. In the first place, it gets over the difficulty of the fire-door, and, as the tubes are always under water, the chances of any leakage due to unequal expansion are avoided; and, as it has a flat front, it is much more convenient to screw fittings to. The shell of the boiler might be lagged with wood, while the smoke-box at the end serves for a jacket for that end, as well as increasing the heating surface. It stands on two feet, which may be fixed or loose—this making the boiler self-contained and requiring no fixing. I do



Boiler for ¼ Horse-power Engine.

not like the idea of fixing sections of pipe into brickwork, as suggested by F. A. M. I think a small boiler should always be portable. If this suggestion should meet with your approval, I should have much pleasure in making detailed working drawings and full description of the same."—[F. A. M. writes on the above:—"I am glad you are giving your mind to the boiler question, and I think a very good boiler could be made in the way you propose. Your criticism of the vertical boiler is just, and each point is already anticipated, as you may have noticed, in my remarks upon it, except your objections to the vertical tubes. Now, vertical tubes are certainly apt to leak, but they can be, and are frequently, made tight; therefore I should be inclined to attribute the failure of yours to the method of fixing. Before you send a working drawing of your proposed boiler to WORK, I should advise that you make one and try it thoroughly. I cannot see how an amateur can properly rivet the plates, etc., and cut and bend them to shape. I still think the proper thing for him to make himself would be a boiler made of pipes screwed together and built into a furnace of brick, which the amateur could easily put up himself."]

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Iron Bridge and Girder Work.—T. U. (*Manchester*).—You seem to have a difficulty in understanding the drawings; I should therefore advise you to join some local class in which mechanical drawing is taught. In the first volume of WORK there appeared a series of articles on "Wrought Iron and Steel Girder Work," which might help you; they appeared in the following issues:—No. 8, p. 117, No. 11, p. 167, No. 12, p. 186, No. 15, p. 229, No. 21, p. 325, No. 24, p. 375, and No. 26, p. 407. There are also some papers, which commenced in No. 173, p. 266, on "Iron Bridge Modelling in Cardboard," from which you might derive some assistance. There are numbers of books on the subject to choose from, but to read them you require some knowledge of algebra and geometry. Messrs. Lockwood publish a little book, price 3s., with title "Materials and Construction," which shows how to calculate and design iron bridges.—F. C.

Enamel for Bricks.—H. R. H. R. H. (*Ashby-de-la-Zouch*).—The ingredients are calcined flints, felspar, lead ashes, etc., the colours being formed from various oxides. Thus red is obtained from red oxide of iron, yellow from chromate of lead, blue from oxide of cobalt, green from oxide of copper, black from oxide of manganese, etc. The exact quantities must be found by experiment, as what would be suitable for one kind of clay would not be suitable for another. You could calcine the flints in a kiln, but, as they have to be ground very fine, unless you have suitable machinery you could not do the grinding. The flints are those found in the chalk. If you want to experiment on a small scale, you could procure the ingredients from some of the potteries, or from Doulton & Co., Lambeth; but if you want to make them for sale, you had better engage a competent man, or you may soon lose a lot of money in experimenting. You will find some very good articles on clay modelling and plaster casting in Vol. II. of WORK, entitled "The Mechanical Processes of Sculpture."—M.

Steel Sheets for Tin Plates.—W. H. T. (*Westminster*).—You cannot do better than write to Messrs. W. Jessop & Sons, Limited, Brightside Works, Sheffield, sending a sample of what you require; the above firm, rolling thin stuff for the steel pen trade, would, no doubt, readily supply your needs as regards the steel sheets themselves. With the pickling or cleansing process, I fear you will have to do that for yourself; that, however, need not be a very difficult matter, hydrochloric acid being the base. Look through Spon's manufacturing recipes for the proportions. Tin-plate manufacturers have all these facilities, but I very much question if they would assist anyone outside the trade. If you are unable to get the sheets "pickled," you might write to Messrs. Cocker Brothers, Limited, Wire Drawers, Nursery Street, Sheffield, asking them as a favour if they would clean for you a few sheets of steel.—N. M.

Telescope.—E. U. (*Wimbledon*) has made a "4 ft. telescope with a lens at each end," which has "answered his purpose very well." He now wants to make a more powerful one—6 ft. or more—but "at a rather cheaper rate." Now, seeing the first had simply a pasteboard body, a 4 ft. object-glass, a simple eye-piece, and consequently no focussing arrangement, it is difficult to see how a larger and much superior instrument can be made at a cheaper rate. In the first place, he asks what lenses he will require. The first thing will be the object-glass of 6 ft. focus, but nothing is said of the diameter of the same. Now, it must be understood the light-grasping power—viz., the diameter—must bear some relation to the magnifying power, viz., the length of focus. To largely magnify with a small degree of light would be to lose all definition. I cannot lay my hand on a catalogue that gives prices for lenses of 6 ft.; the nearest is Wray's 66 in., 4½ in. aperture, £22. Lancaster gives in his catalogue a 60 in. of 4 in. aperture at £10 10s.; another of 3½ in. diameter, focus not stated, £6 10s. These, of course, will be achromatic. Common lenses can be purchased much cheaper. A 3 in. object-glass of 50 in. focus, with lenses for eye-piece, can be procured for 5s. 6d. of Lancaster, of Birmingham, and others. If E. U. had stated what kind of an object-glass he has used, I should be in a much better position to give information. As to the eye-piece, an article of mine which appeared a few week ago, under the heading of Eye-pieces, will give all necessary information. Another article which also appeared on a Four-draw Telescope will supply all information on mounting both object-glass and eye-piece. My advice to E. U. is, if it be a question of cheapness with efficiency, to purchase, say, an object-glass (achromatic) 2½ in. diameter and about 30 in. focus, for about £1 5s., which price would include two lenses for the eye-piece. Much better work can be done by this than by a 6 ft. chromatic, which would have to be stopped down probably to one-half its aperture to cut off the marginal rays. Some focussing arrangement is a necessity, not simply to adjust the instrument to objects of varying distances, but to suit various eyes.—O. B.

Air Gun.—YOUNG SPORTSMAN.—This piston spring gun to ensure the due pressure of the valves was described in WORK, No. 98, p. 749. For a powerfully acting gun this is the most effective plan, as far as I know. I am sorry I cannot furnish a reliable sketch to work from, not having any such mechanism to refer to and measure. Try and get a look at one.—J. C. K.

Electric Bell and Indicator.—J. B. (*Widnes*).—If you wish to ring one bell from ten different rooms, and have an indicator with ten holes in it to indicate the ten different rooms, you may easily plan the whole arrangement on a sheet of paper, and then lay the wires according to plan. Map out the outlines of each room, or put ten connected squares on the paper. In one of these put marks to show the positions of bell, battery, and indicator, the latter in the form of a square divided into ten partitions. Now select a division on your map to represent the most distant room of the house from the bell, and put a small ring in it with a dot in the centre to represent the push. From this, draw a main line passing through each room to the bell, then to battery, then to one hole of the indicator, then a return line back direct to the push. This will represent the connections for one room and the main line of wire. For the next and rest of the rooms put a push in each room, draw a line from each push to the main line, and run a separate return line from a separate hole in the indicator to each push. This rule will hold good for all rooms, however few or many.—G. E. B.

Output of Accumulators.—W. T. D. (*Manchester*).—Measure the surface of positive plate

immersed below the acid, and estimate six ampère hours for each square foot of plate. This will give you the ampère hour capacity of the accumulator or the quantity of current obtainable from it when fully charged. The 15-plate cells are advertised to give 330 ampère hours, but accumulators should not be worked until fully exhausted. If your lamps require 60 volts pressure (and I suppose that is the voltage required, as you use 32 cells in series), the supply of current will be at the rate of ·8 ampère per hour, and you should get at least 375 hours' work out of your battery. At the rate of 1 ampère per hour you would only get about 300 hours' work out of the battery. If the lamps are arranged in several groups in parallel, the output of current will be at a faster rate, and the cells be more speedily exhausted. The best book on the management of accumulators is "Electric Light Installations," by Sir David Salomons, price 6s., published by Messrs. Whittaker & Co.—G. E. B.

Motor for Lathe.—ZETETIC (*Harrogate*).—As I have not received your former letter, and you do not find an acknowledgment of it in Section V. of "Shop," I fear it must, as you suggest, have miscarried. If you will kindly repeat your two or three questions relative to a motor for a polishing lathe, they shall receive attention. If your question related to an electro-motor for a polishing lathe, let me tell you in advance that such a motor, driven by battery power, will be a nuisance, unless it is only required for very light work, and occasional use for short periods. If, however, the motor can be connected to an electric light main, or to a similar source of electrical power from a dynamo, the use of such a machine is a luxury, as there cannot be any source of power equally clean, safe and convenient.—G. E. B.

Incubator.—J. H. S. (*Leeds*).—The size of case for machine of 100-egg capacity would be about 24 in. by 18 in. The capacity of any receptacle is easily arrived at by dividing the superficial area by 4=result the number of eggs it will hold. Having never made anything larger than that described in No. 143, I cannot say definitely what variation in fittings would be necessary. You would certainly want a larger lamp, and I should advise a larger evaporating tray. A larger damper would also be necessary. A 200-egg machine of the same design should work satisfactorily, although some deviations from the original might be necessary, which could only be determined by actual experiment. If you do make a larger machine, please let us know how you succeed, for the benefit of incubating readers of WORK generally.—LEGHORN.

Soldering Aluminium.—H. S. G. (*Fulham*).—It is a pity you cannot understand the paragraph; it is perfectly clear. If you understand soldering with powdered resin as a flux you should comprehend the analogous process wherein chloride of silver is used. The solder is melted, "as usual," by a soldering-bit or a blowpipe.—F. C.

Phonograph.—PHONO.—In the phonograph described by me in WORK the cylinder is not removed and replaced with others. It is the strip of tinfoil which contains the record, and this can be removed and replaced by others. Provision is made for holding these in the drawer in the baseboard. A cylinder of cast iron or brass would do, in fact, better than plaster-of-Paris, as this is liable to chip in the working. PHONO and others must not confound this instrument with Edison's phonograph. It was given to the readers of WORK as a scientific toy; if they want one of these *perfected* instruments they must look elsewhere.—W. D.

Circular Saw.—WORKMAN.—The diameter of circular saw required to cut ½ in. boards depends upon the depth of spindle bearings from the top of wood table. A saw from 8 in. to 9 in. diameter would be quite large enough to be driven by treadle. My advice to WORKMAN is to abandon all thoughts of such a toy. A hand saw has the advantage over a circular saw driven by treadle for such work. The machine would not only cost a deal more than a good hand saw, but the work would be more tedious. With the circular saw it would be hard work, while with the hand-saw three or four pieces may be placed on each other, and could be cut through at the same time easily. If WORKMAN has a good sale for thin firewood, why not start a small engine—say, from 1 to 2 h.-p.? then he would have the advantage over the hand saw. Unless a circular saw is driven at a high speed it is merely a drag.—A. R.

Glass.—J. L. (*Bexhill*).—I fear you would not be able to bevel the edges of your pieces of plate glass; it would be an intensely laborious and tedious operation for an amateur. Several different kinds of wheels must be used, some of sandstone used with water, others fed with sand and water, emery and water, and, finally, polishing wheels; and the expense of providing these for the small amount of work I gather from your letter you wish to do is not to be thought of, being prohibitive; and without them I do not see how you are to do it. There are files sold to take off the rough edges of glass; why not use these? or, if not content with this, I would certainly advise you to send to a manufacturer. As regards your second question—mounting photographs on glass—this you could easily do, and need have no fear of spoiling the pictures; the process is the same as what are called "opalines" at the photo. shops. If your prints are by the gelatine, chloride, or bromide processes, nothing is needed but to clean the glasses well. Soak the prints in clean cold water for about half an hour, place the glass in the water, under a print (which must be face downwards), and bring both up together; rub down to remove air bubbles and wrinkles, and, when dry it can be trimmed; it is then finished. Should they, however, be silver albumen prints, as will most likely be the case, the process is a little different: Soak about 1 oz. of soluble gelatine in cold water until soft, then add sufficient boiling water to make a rather thick solution, say about half a pint; when thoroughly dissolved, if needed, strain through muslin; pour into an earthenware dish, which will stand in another containing boiling water, so as to keep the solution warm and melted. Immerse a print in the solution, and when thoroughly soaked, lift it on to the cleaned glass as quickly as possible, and rub down; or both glass and print can be put in the gelatine, as in the first method, and lifted together; when cold, the superfluous solution can be cleaned from the face of the glass. Should you not be able to tell by what method your photographs are produced, and do not know anyone you could ask, if you will send me one (through the Editor) to look at, I shall be pleased to inform you.—W. E. D., JR.

Secrétaire.—AMATEUR.—I cannot tell AMATEUR where to get the spring steel in his town, unless he went to a clockmaker, which would be an expensive way to buy it. I am inclined to think from the quick curve sketched that neither steel nor shutter hinges would be suitable; I should prefer chair webbing or leather straps. There would be no difficulty in mortising the laths with $\frac{1}{16}$ in. holes if AMATEUR first bores, with a twist bit and brace, several holes near each other to each mortise, to weaken the core and give clearance for the chisel, afterwards paring the sides with a ⅛ in. or ¼ in. chisel, very sharp. I have mortised right through 1½ in. by ¼ in. stuff with a $\frac{1}{16}$ in. chisel without difficulty. I give section of the end of lath, showing best form for the projection into the grooves, to enable them to run round the rather too sharp curves in his sketch (Fig. 1). I scarcely know what is meant

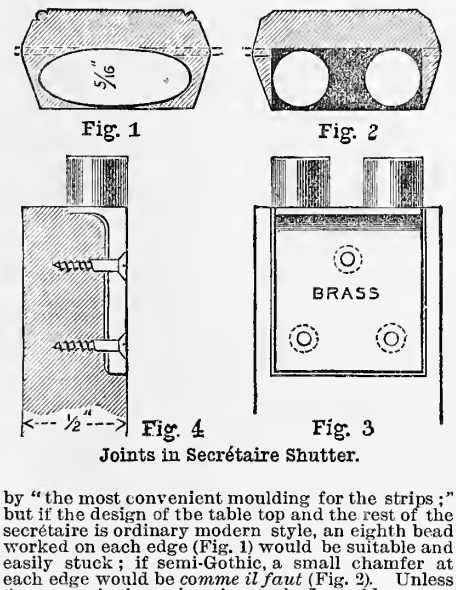


Fig. 1 Fig. 2 Fig. 4 Fig. 3

Joints in Secrétaire Shutter.

by "the most convenient moulding for the strips;" but if the design of the table top and the rest of the secrétaire is ordinary modern style, an eighth bead worked on each edge (Fig. 1) would be suitable and easily stuck; if semi-Gothic, a small chamfer at each edge would be *comme il faut* (Fig. 2). Unless AMATEUR is clever in using tools, I would suggest that the strips, instead of being left long enough to cut away for sliding in grooves, should be shot to exact length, which is much easier, and that brass plates similar to Figs. 3 and 4 should be screwed from back of each. Fig. 3 is top view and Fig. 4 is side view; both full size. Fig. 2 shows section of brass end. A small pattern in mahogany is easily made, and brass runs much more smoothly in wood than wood would do. The groove should be well black-leaded or soft-soaped at first, in either case.—J. W. H.

Xylonite—Acids.—W. B. (*No Address*).—The address you wish to find is: The British Xylonite Co., Limited, High Street, Homerton, London. As to your other question, I gather you have been using the gas for engraving on glass; if it is the acid you wish for, use hydrofluoric acid.—W. E. D., JR.

Garden Wall.—TAMAR.—I should advise you to point the wall with quick-setting Roman cement, mixed with three parts of clean, sharp sand. You can lay it on to within one hour of the water rising above it, as by that time it will be set. The joints should be well raked out, and any damaged stones should be cut out and new ones fixed, bedded, and jointed with cement.—M.

Bearings for Lathe Mandrel.—LITTLE JIM.—Whether cone or parallel bearings are best for a lathe mandrel is a matter of opinion; some think one way, and some another. Cone bearings are most usual in 6 in. lathes; parallel bearings are necessary in lathes with traversing mandrels; and there is a very good kind of parallel bearing used in America, in which the collar, while parallel inside, is coned outside, and fits a coned hole in the headstock. The collar is split lengthways, so that by drawing it into the coned hole by a nut, it can be slightly collapsed upon the mandrel neck. I do not know what is the plan adopted by Mr. J. Holroyd; you must send us a drawing of it if you want an opinion: you must tell me the dream if you want to know the interpretation, as I am not Daniel, but only—F. A. M.

Table.—T. C. (*Dewsbury*).—Please furnish further particulars. You state that you have already made a table, but you are not satisfied. If you tell us where you have failed, or where special difficulties appear in your way, you shall have our best attention. There are many others who have failed to realise their ideal, but it may be that these people are making good progress. Write again.—B. A. B.

Toy-Whistles.—D. McD. (*Glasgow*).—(1) Upcott Gill publishes a good work on "Toy-making" (*Bazaar* Office, Strand). (2) Whistles can be made of any hard wood such as box; they are usually turned and bored on the lathe. (3) Ordinary turners' tools and a few boring-bits. (4) If you mean by toy machinery, models—advertise. If you mean machinery to make toys—any maker of light machinery for the material of which the toys are to be made.—B. A. B.

Pantograph.—LITTLE JIM.—I have read reply referred to in No. 24, page 382, Vol. I., but find no *promise* of an illustration, as you state; but explanations have been given, accompanied with an illustration, too, on page 669 of our first volume. The following, taken from an old edition of "Treatise on Mathematical Instruments," by J. F. Heather, M.A. (Weale's Series), will, I think, just supply what is lacking on page 669:—"When the instrument is correctly set, the tracing-point, pencil, and fulcrum will be in one straight line. . . . The motions of the tracing-point are then each compounded of two circular motions—one about the fulcrum, and the other about the joints at the ends of the rulers upon which they are respectively placed."—B. A. B.

Staining Maple.—CONSTANT READER.—When it is required, as in your case, to stain the veneers right through, it is called dyeing. When the article is made before colouring up, it is termed staining. For the former process it is advisable to soak the veneer at least half a day in clean water; then take it out and allow a few hours to drain before inserting in the dye bath; this will cause the dye to strike more readily and be more evenly distributed, but for staining purposes this is, of course, impossible, nor is it necessary, as only the surface is stained. To give a list of all the materials and how they are used for all the different colours, as you wish, would take up more room in "Shop" than can be spared at present. I have already promised several correspondents that I will write an article on the subject, which will doubtless appear in due time; for the present I will confine myself to the two colours enclosed. Silver grey: (1) Acetate of iron made by steeping rusty nails, turners' swarf, or rusty iron of any description (say 4 lb.) in one gallon of vinegar; to this add 2 gallons of water. Immerse the veneers in this, and if possible bring up to boiling point; then add ½ lb. extract of logwood and 2 oz. bruised nut galls. (2) Take the iron solution as above, soak the veneers, then to each gallon add ¼ lb. of green copperas. (3) The ebony stains much diluted should give the required shade, especially if afterwards coated with a weak green stain made by dissolving verdigris in hot vinegar, or both in combination. (4) Hermes grain, to which has been added copperas and tartar, is said to give many beautiful shades. Yellow: turmeric, tustic, Persian berries, gamboge, saffron, picric acid, and Barbary root all give shades of yellow. We cannot give the exact proportions of each; experiment must decide. As a guide, if barbary root is used it requires 1 lb. to 1 gallon; when cool, add 2 oz. of aquafortis to make the dye strike more readily. The veneers should afterwards be allowed to dry in the open air, not by the fire. If it is found impossible to immerse the veneers in a bath, apply frequently as hot as possible by means of a brush. Sometimes it is found sufficient if decoctions of the various roots, barks, etc., are thus applied, and the stain fixed by brushing over while the last coat is still wet with alum water (2 oz. alum to 1 quart of water), or pearlash, 2 oz. to 1 pint. Gamboge and turmeric can also be dissolved in spirits; 3 oz. of the former, 1½ oz. of the latter, to one quart of spirits makes a useful stain. You will be wise to experiment on odd pieces of veneer till you have gained the required shades previous to attempting large quantities.—LIFEBOAT.

Blueing Gun-barrels.—R. K. (*Hastings*).—The barrel must be highly polished, and the ends plugged with fireclay. Make up a clear fire, with an iron muffle or length of stovepipe in the fire, so as not to let the flame touch the barrel. Insert your barrel when the pipe is red hot, watch for the change of colour, draw it out in time, and let it cool in the air. Or you may get a more even heat to thick and thin parts of barrel alike by putting it into a molten lead bath till you get the colour you want. To prevent the surface of the lead from oxidising quickly, lay on powdered charcoal or powdered wood ashes. I hope this will suit your requirements, but blue gun-barrels are not usual things.—J. C. K.

Dye for Sheepskin.—ANXIOUS INQUIRER.—You can use aniline dye, but the skin must first be washed and cleaned, to remove all dirt, grease, etc. If one application of the dye is not dark enough, repeat the process till of the required colour. But, speaking from experience, I should recommend you

not to dye it, as the dye appears to rot the material, and it does not wear well after. You can improve the appearance very much by well washing with soap and water.—M.

Power of Gas Engine.—W. T. B. (*Cradley Heath*).—The one-horse nominal, if the Otto, I should get to drive three small screw-cutting lathes, two drilling machines, one 24 in. fan, and one 6 ft. grindstone; but you had better rely on what the makers tell you.—F. A. M.

Work, No. 42.—K. P. (*Stoke-on-Trent*).—Advertise for this in the Sale and Exchange column.

Elephant-man.—J. H. (*Stockton-on-Tees*).—Write to the Secretary of the London Hospital.

Bent Iron Work Patterns.—W. S. S. (*Leeds*).—Get all the numbers of Work in which Bent Iron is treated, and you will have patterns enough.

Plaster Casts of Ecclesiastical Figures.—H. F. B. (*Norwich*).—Try C. M. Rock, 106, Great Russell Street, London, W.C.

Improved Fastening.—W. M. (*Accrington*).—We have examined the arrangement, sketches, and description sent, and considered the subject. The idea is ingenious, but we fear that, in use, it would not give satisfaction, inasmuch as each movement would be likely to cause it to unfasten. This, however, can only be decided by practical use. We do not remember to have seen it proposed or applied to the purpose named, but a precisely similar plan is in use and adopted in some of the modern breech-loading artillery, and for some other purposes. A well-considered and well-drawn specification might be made to cover the invention for the purpose proposed, and so create a property in it; but then comes the question: Is it an arrangement that would be taken up by the public? The solution of this question in a satisfactory manner is the only thing which could justify W. M. in encountering the worry, trouble, and expense which are always the accompaniments of ownership of patent property.—C. E.

Pantograph—Printing Press.—J. R. L. (*Aberdeen*).—For the former, see Work, No. 187; for the latter, kindly await forthcoming papers.

Forecourt.—Tenant.—Take off the turf and soil, and cover the top of the cellar with a layer of asphalte ½ in. thick, with a slope to one side, and a drain laid from it to carry off any water which may sink through the soil when replaced. The top of cellar should be perfectly dry when the asphalte is laid on, and may require levelling up with cement to receive the asphalte, which may be dissolved in hot tar (about 1 cwt. to 30 gallons of tar, more or less, as it sets, which can be tried). The tar must be stirred while boiling, and boiled till all moisture is expelled. The cost would be from £4 to £5, according to the facilities for doing the work.—M.

Cost of Cottage.—Cottage.—Without knowing the cost of materials and labour, and how you want the work finished, an approximate cost can only be given; but, under favourable circumstances, you might get it done for £200. The best thing to do is to have a plan and specification prepared, and get an estimate from a builder on the spot. If you have no plan, send me particulars of what you want, and I shall be glad to help you. I should advise you to form a cavity in the outer walls, or they will be damp. You will also find it much more convenient to make it two storeys high instead of cellaring.—M.

Proposed Arrangement for Astronomical Telescope.—W. L. (*Middlesbro'*).—The arrangement which you show in your sketch is useless for the purpose you have in view. The 5 in. lens would have to be achromatic; there is absolutely no other way of correcting the colour. The practical effect of the introduction of the smaller lens would be to lengthen the focus. Experiments have been made with a telescope having an arrangement of lenses such as that which you suggest, and success was attained when the correcting lens (of much larger size than that which you show) was a fluid lens, made of the liquid sulphuret of carbon, enclosed between two concave discs of glass. But, necessarily, the arrangement was not of any permanent value. If you want to avoid the expense to which you refer, and yet desire to possess a perfect instrument, you should make a large reflecting telescope. Read the articles which are now appearing in Work on the "Hand-working of Specula for the Newtonian Telescope," and carefully follow out the instructions contained in them. As you are a skilled mechanic, you ought not to find any difficulty either in the grinding and silvering of the glass or in the making and mounting of the eye-pieces and tube.—E. A. F.

Clock Chime.—X. Y. Z. (*Derby*).—Unless you know something of clock work (and from your third question I should judge you do not), I think it impossible for you to make a chime quarter clock from an ordinary grandfather's clock, as there would have to be a lot of new dial work made and fitted, and the present altered and added to. Then the plates are not large enough to take a third set of wheels to work the chimes, and the winding hole would come on the edge of dial. Then, too, there is the making and fitting up the train of wheels; and, lastly, making and pinning the barrel for the chimes. To give you any idea at all of the work would require a page or two of Work, and then I doubt if I could make you understand, unless you have some knowledge. I shall be pleased to assist you if our Editor can find room, but chime quarter work, in my opinion, is beyond the capabilities of the majority of amateurs.—A. B. C.

Book.—C. R. (*Nottingham*).—I am glad to hear that the furniture designs in Work are so useful to you. Plenty of books are published with designs, but I find they do not generally give working details. You may get some hints from the "Art and Craft of Cabinet Making," which was reviewed in No. 151, Vol. III.—F. J.

Boring Bits.—Ignorant.—Several answers to part of this question have appeared in back numbers. Besides centre bits there are "pin bits"—like a gouge; "spoon bits," like a rather pointed teaspoon at the cutting end; "nose bits," which have an edge bent at an angle with the stem. There are also several types of "auger bits," having a screw nose like a gimlet. These are Gedge's, Jennings's, Douglas's, and Whitehouse's, all excellent, especially Jennings's. I have seen and tried a very good copy of the "Morse twist bit," made in Germany, which I can recommend for holes between $\frac{3}{16}$ and $\frac{7}{16}$. There are also single twist bits of French and Swiss manufacture, the latter being often called Norwegian gimlets, some of which may be imported from Norway. These are good boring tools, and sold here under the name of "diamond twist bits." It is impossible to say how many form a full set; some are made to every sixteenth within their range of sizes, and some to every thirty-second, while pin, spoon, nose, and centre bits vary by small and apparently accidental differences; so much is this the case, that many tool dealers give an opportunity for trial of the bit, and the buyer measures the hole produced. There are also bits provided with moving blades, which can be set to various sizes; but, though handy, their performance is not so good as separate bits.—B. A. B.

Bread and Cake Knife.—W. S. (*Rydal*).—The address is Christy Knife Co., Fremont, Ohio, U.S.

IV.—Questions Answered by Correspondents.

Fret Monograms.—F. J. K. (*Tufnell Park*) writes:—"W. H. W. (*Castleton*) writes for monograms 'E. L. E.' and 'P. L. V.' for fretwork. I hope

"P. L. V." and "E. L. E." Monograms for Fretwork.

the enclosed designs will suit W. H. W. Being plain and simple, I think they are suitable for fretwork."

Time.—M. L. (*Naples*) writes to A. R. (*Moseley*) (see No. 185, p. 462):—"To find clock time, modify solar time as follows:

January.			May.			October.		
1	add	4 m.	6	deduct	4 m.	2	deduct	11 m.
3	,,	5	25	,,	3	5	,,	12
5	,,	6	**June.**			9	,,	13
7	,,	7	2	deduct	2 m.	13	,,	14
9	,,	8	8	,,	1	17	,,	15
12	,,	9	13	,,	0	23	,,	16
15	,,	10	18	add	1	**November.**		
18	,,	11	23	,,	2	11	deduct	15 m.
21	,,	12	27	,,	3	19	,,	14
25	,,	13	**July.**			23	,,	13
30	,,	14	2	add	4 m.	26	,,	12
February.			8	,,	5	29	,,	11
7	add	15 m.	15	,,	6	**December.**		
15	,,	14	**August.**			2	deduct	10 m.
25	,,	13	7	add	5 m.	5	,,	9
March.			14	,,	4	7	,,	8
2	add	12 m.	19	,,	3	9	,,	7
7	,,	11	23	,,	2	11	,,	6
11	,,	10	27	,,	1	14	,,	5
14	,,	9	30	,,	0	16	,,	4
18	,,	8	**September.**			18	,,	3
21	,,	7	3	deduct	1 m.	20	,,	2
24	,,	6	6	,,	2	22	,,	1
28	,,	5	9	,,	3	24	,,	0
31	,,	4	12	,,	4	26	add	1
April.			15	,,	5	28	,,	2
3	add	3 m.	17	,,	6	30	,,	3
7	,,	2	18	,,	7			
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14	,,	0	26	,,	9			
17	deduct	1	29	,,	10			
22	,,	2						
28	,,	3						

Coffins.—A Country Cabinet Maker writes:—"Will you allow me to supplement the reply given by Chopstick (No. 177, p. 534) to W. P. W. A. (No. 170, p. 222), by describing the plan we usually adopt. We make the coffin plain, and fit the lid on, then brad the battens (about ½ in. thick and 2½ in. or 3 in. wide, and moulded or bevelled on one edge) round bottom of the coffin, and also round the top, flush with top of lid, but bradded on to sides of coffin, *not on the lid*. Then lay another set on the top of lid just flush with outside of those on the side—slightly overhung and edges rounded gives a good effect. These must be mitred (or, rather, jointed) across the pinion, and the best plan is to put on the side-pieces first, and then cut the ends in, cutting away the moulding and fitting them between—just the reverse of those round the coffin, where the end pieces are put on first and then the sides. By this plan the lid forms a sunk panel. This makes a good medium-class coffin (we do it both in oak and in pitch pine); but if a first-class one is required, it may be full panelled by cutting pieces of the same batten stuff in between those of the head and foot, so as to make stiles there, and the same at both ends of the sides, and a double piece over the pinion and a single one moulded on both edges halfway between pinion and foot. There is no difficulty about it, except at the pinion, where two pieces have to be carefully fitted in and shot to fit, so that they can be rounded off without showing a bad joint. I have seen some men get over the difficulty by putting in a single-width stile moulded on both edges just above or below the pinion; it saves trouble, but does not look so well. I have also seen them done with square battens and a separate moulding, either plain or blacked, fitted in instead of moulding the edge. As to shape, I must differ from Chopstick. I venture to think his head and foot are too wide. I will just give size of one or two which I can recommend as being good shapes:

Length.	*Head.*	*Foot.*	*Pinion.*	*From Head.*
6 ft.	8½ in.	7½ in.	20½ in.	20 in.
5 ft. 4½ in.	8¼ in.	7¼ in.	18 in.	18½ in.
5 ft. 11 in.	8 in.	7 in.	20 in.	19¾ in.
About 12 in. or 13 in. deep at head and 11 in, or 12 in. at foot.				

These and similar proportions will, I think, give satisfaction. I hope these notes may be of some help to W. P. W. A., and if I can help him with any further hints, I shall be happy to do so. One word of caution: Be sure and remove any screws used to temporarily fix the lid before nailing the battens on the top over their heads, and do not brad the top batten of the coffin both to side and lid. I have seen both these mistakes made."

V.—Letters Received.

Questions have been received from the following correspondents, and answers only await space in Shop, upon which there is great pressure:—H. E. (*Clapham*); Engineer; T. H. (*Lisburn*); H. A. (*Handsworth*); Electrician; Tar; B. B. B.; Dum Dum; W. H. C. (*Ilkeston*); W. J. D. (*Brecknock*); Spero; Conductor; J. K. (*South Bromley*); J. K. (*Bishop Auckland*); J. S. W. (*Methwold*); A. W. (*London, N.E.*); Student; N. E. R. Signalman; Donald; C. R. T. (*Newington*); J. B. M. (*Dorset*); C. P. T. (*London, W.C.*); F. P. (*Bristol*); J. S. (*Ainsty*); J. R. T. (*Ashington*); W. S. C. (*Birmingham*); H. R. C., Jun. (*Hounslow*); J. W. B. (*Huddersfield*); J. T. (*Sheffield*); W. H. B. (*Queenstown*); E. J. S. (*Maidstone*); D. M. C. N. (*Manchester*); J. N. (*Lancaster*); A Twelve Months' Reader.

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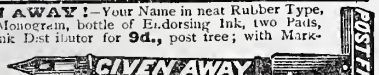

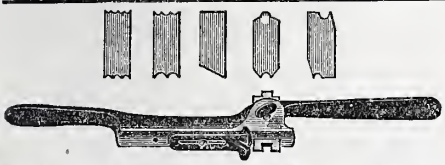

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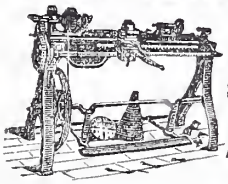

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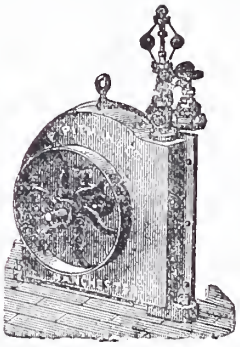

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Vol. IV.—No. 200.] SATURDAY, JANUARY 14, 1893. [Price One Penny.

WORK WORLD.

Coal-cutting machines are finding great favour in our northern collieries, one of these machines being able to cut twenty feet per hour in very hard coal. As many as seventeen are used in one colliery.

* *

It seems probable that the Panama Canal may yet be completed. The Columbian Congress has closed its extra session, and it is stated that the Canal question has been arranged to the advantage of both the State and the proposed new company.

* *

The various trade combinations throughout the United Kingdom are busy in an agitation to urge upon the Home Secretary the necessity of increasing the staff of factory inspectors, so that the existing Acts should be more efficiently enforced. There is little doubt that evasion of the Acts does occur, owing to the smallness of the staff, and certainly this is a cause which can be remedied to the advantage alike of employer and employed.

* *

At Leicester during the past year there has been a great revolution in the shoe industry. Working in factories has been substituted in place of working at home, which has come to an end to the benefit of master and workman alike. In a great measure this is the result of the further introduction of machinery, which is computed to be greater in Leicester than in the whole of the other districts in England and Scotland combined.

* *

The Common Council of Middleton, Ohio, recently granted the Middleton and Cincinnati Railway Company the right to carry their railway across Sixteenth Street. As soon as the permission was given, a large body of men was set to work and the crossing completed in one night, much to the astonishment of a committee of citizens, who appeared in the morning armed with an injunction to restrain the railway authorities from proceeding with the work.

* *

The electric lamps used in the vehicles of the London General Omnibus Company are specially designed to occupy as little space as possible, and one is suspended horizontally in the centre of the conveyance it is intended to illuminate. The battery weighs about eight pounds, and is put in a wooden box under one of the seats. The box is fitted with two brass spring terminals, which automatically make contact with the battery when it is lowered into position.

* *

Commodore Melville, of the United States Navy, now proposes the use of "nickel steel" for parts of marine engines and boilers. Its tensile strength of 90,000 lbs. per sectional inch, as compared with 65,000 lbs. for ordinary steel, with an elongation before fracture practically the same, would seem to offer great advantages in affording means of lightening the machinery without reducing its strength. Some practical experiments are to be made in this direction.

* *

In Austria-Hungary slate as a material for billiard tables is being displaced by marble slabs in single pieces for each table. The ordinary sizes are about seven feet by three feet six inches by one inch thick. These slabs are not polished; they are merely dressed and ground on both sides. The cost is from thirteen to fourteen francs per square metre, free on board at Buda-Pesth. Up to the present time Carrara marble only has been used, the veined qualities being unsuitable for the purpose.

* *

The iron ore from the mines at Tiehshau yields on various assays an average of nearly sixty per cent. of pure iron. So plentiful is iron ore in this district that it has been used for economy to ballast the line of railway from Huangshihkang to the mine—about seventeen miles long—though there is limestone all along the line. In former times the iron mines of this district were largely worked as indicated by hills of slag, but when the country was disforested the Chinese were prevented from smelting for the want of charcoal.

* *

It is sometimes necessary to force to an elevation boiling water or other liquids by means of a pump. At first this would seem impossible, on account of the vapour rising from the surface of the liquid and destroying the vacuum created by the pump. To get over this difficulty, sink the pump below the lowest level of the vessel containing the boiling liquid and connect the suction of the pump to that vessel. On the plunger or ram of the pump being lifted the liquid will follow it, and thus the pump barrel will be filled, the force of gravity causing the liquid to endeavour to find its own level. On the ram descending the liquid will be forced beyond the delivery valve and the object is accomplished.

* *

The results of recent armour-plate trials appear to have completely assured the adoption of nickel as a constituent in steel armour-plates, and the use of this metal may be regarded as a certain feature of the steel trade of the future. The effects of the adoption of nickel steel are likely to be felt in the heavier trades of Sheffield. The tests which have been successfully withstood by armour-plates of this material altogether upset the idea among military and naval authorities that it was no longer necessary to further develop the size of heavy guns, as the existing weapons were more than equal to the penetration of the heaviest armour. The consequence is that the huge hydraulic forging plants laid down by the Sheffield steelmasters are likely to gain more employment than at one time seemed probable.

* *

In the United States nickel steel is now being applied to the construction of heavy guns, the Ordnance Bureau having succeeded in making an alloy of steel with twenty-five per cent. of nickel, that possesses all the best qualities and strength of steel with high elasticity, and almost entire non-liability to corrosion. The American authorities assert that nickel steel will become the recognised material for naval gun construction, as well as for armour-plates, and also for many other purposes. In the lighter Sheffield trades nickel steel is likely to exert a wide influence. A French metallurgist claims to be able to alloy the two metals so as to produce a material which will compete both in price and appearance with electro-plating. The qualities which nickel, in different proportions, imparts to steel are so varied, that it will be at once understood what an important part it will play in the future of the Sheffield trades.

ABOUT BORDER ORNAMENT.

BY CHARLES KELSEY.

Anthemion Borders.

Introduction—Modifications: Their Causes—Advantages of the Study of Ornament—Description of the Illustrations—Conclusion.

Introduction.—The preceding paper on Anthemion borders dealt chiefly with the Greek varieties of this type of ornament, the examples illustrated being taken exclusively from the works of that nation. The present paper deals with the modifications made by the workers of other nations who subsequently adopted the type.

How universal was this adoption may be gathered from a glance at the various sources of the specimens shown in the accompanying illustration. This general adoption was due, no doubt, in a great measure to the inherent beauty of the variety of radiation these patterns exhibit: a point dealt with more fully in the preceding paper.

Modifications: their Causes.—Every civilised nation of the past has utilised these patterns, and have evolved varied modifications of them, these variations being due to the influences of changed race or creed.

The influence of the religions of nationalities was, in the past, the most potent agent in the development of changes in ornament. To trace these variations and to note these influences cannot but prove interesting and instructive to modern workers.

Advantages of the Study of Ornament.—The study of ornament thus pursued adds additional interest to every-day work. It causes familiar patterns to no longer appear as meaningless arrangements of lines and curves, but each differing variety observed, ofttimes proves a witness to some influence which was powerful enough to affect the lives and work of those who produced these relics of the past.

To modern designers the observation of these varieties is very helpful: they suggest further possible modifications along the lines of variation indicated.

This is a legitimate use to which to subject these old examples. The modern student of design will be foolish indeed if he does not make the best possible use of them, and endeavour at the same time to discover and absorb for future use the underlying principles of the craft which they exhibit. The systematic study of ornament becomes a necessity in those cases where the production of a work in a particular style is aimed at. The knowledge will prevent the introduction of incongruous forms, anachronisms which would detract from the purity and beauty of the work.

Description of the Illustrations.—Fig. 1, the most ancient example illustrated, is an Assyrian specimen from the ruins of Nineveh.

Most authorities fix upon these Assyrian examples as the prototypes of the modern varieties. They certainly exerted a powerful influence upon the Eastern varieties—notably upon those of Persia and India, and in a lesser degree upon those of China. The varieties of the Western nations appear to owe most to Greek influence, many specimens of which were illustrated with the preceding paper.

Some authorities consider the radiating form in the Assyrian examples to be a conventionalised rendering of the date-tree, and to have had some symbolic reference to Asshur, the supreme deity of the Assyrians, the lord and giver of life. The fruit of the date-tree forms the staff of life in the region of the Euphrates valley, and hence that tree would naturally be consecrated to Asshur as the "Sacred Tree" or "Tree of Life." Specimens of these "sacred trees," made up of similar radiating forms, frequently with winged figures of priests or kings on either side, kneeling in attitudes of worship or adoration, may be seen upon the Assyrian sculptures now exhibited at the British Museum.

Fig. 2 is a Persian example of the sixteenth or seventeenth century, taken from pottery in the South Kensington Museum.

Fig. 3 is a Chinese example from the same source.

Much of this early Persian pottery is decorated with forms copied from the finer porcelain of the Chinese, specimens of which found their way into Persia as articles of commerce. Almost identical forms may be seen upon Chinese works in the same collection. In both these figures the Assyrian influence may be traced.

Fig. 8 is a Pompeian specimen—a stencilled wall decoration. The workers who decorated the villas at Pompeii were mostly Greeks, engaged to beautify the summer residences of their Roman conquerors. This accounts for their striking resemblance to Greek specimens. They are frequently more elaborate, but that is in deference to the luxurious taste of the Roman employer, who was not content with the simple grace of pure Greek work. They also exhibit a certain thinness of character: probably due to the method of their execution and the technical limitations of the stencilling process.

Some fine remains of Pompeian wall decoration are exhibited in the British Museum, which will well repay careful observation. Zahn's "Pompeii" is also a veritable mine of wealth in the decorations of this period.

In Fig. 5, a Byzantine specimen, a further change of character will be noticed. This is partly due to the contact with Oriental art and artists, which the transference of the seat of government of the Roman Empire to Constantinople brought about. The religious influence was also brought into play. Christianity was fixed as the State religion, and classical art was looked upon with distrust as a relic of Paganism. The artists were thus under the necessity of changing the appearance of the traditional forms of decoration, and presenting them in a new guise when utilising them to decorate Christian churches. Symbolism was largely used in early Christian art. It was not until Paganism began to be a thing of the past that the classic forms were used to any great extent, and then only in their changed form.

Figs. 9, 10, and 16 are modern Indian examples from articles in South Kensington Museum. The first is from painted pottery; the second, silver damascened work; the third, engraved work on brass. The latter example has a marked Byzantine appearance.

Figs. 4 and 6 are Arabian examples, the originals of which appear in the decorations of the Mosque of Touloon at Cairo, erected A.D. 876 for the followers of Mohammed.

Here religious influence has again worked its part in the change of the character of the ornament. The Arabs, possessing neither artists or art of their own—if a certain love of finery inherent in most uncivilised races be excepted—employed Byzantine Greeks to build and decorate these early mosques. They were charged to observe the commands of Mohammed, forbidding the representation of any natural object in the decorations. The result was the still further conventionalising of the Anthemion form. These decorations were executed in stucco, the plaster being brought to a smooth surface, and the ornament traced upon it, whilst still in a plastic state, with some blunt instrument, which rounded the edges in its course.

Not a little of the special character of the ornament is due to this method of execution. The scroll, which in the Greek examples encloses and connects the radiating forms, becomes transformed into an intervening leaf. This change will be apparent by comparing them with the Greek specimens of the preceding paper.

Fig. 15 is a Turkish example, the original from one of their mosques in Constantinople. Based upon Arabian examples, it yet has a character sufficiently distinct to mark it as the work of a different race, although dominated by the same religion.

Fig. 7 is the late Gothic ornament, known as the "Tudor flower," frequently met with in Gothic buildings of the Perpendicular period. It exhibits a character which stamps it as a remnant of the old Byzantine art of the early Christians.

Figs. 11, 12, 17, and 18 are specimens from the Italian Majolica, exhibited in South Kensington Museum, dating about A.D. 1500, the period of the Renaissance. They show the process of elaborating the ornament intervening between the radiating Anthemion form until it becomes the principal feature in the pattern. They are in character most closely akin to Roman work. In Italy the Renaissance was essentially a revival of Roman classical forms; the earlier and more pure Greek art was at that period almost unknown.

Figs. 13 and 14 are examples of the French Renaissance. The former is from the pottery of Rouen in the South Kensington Museum, a relic of which type of design may be seen upon the outer border of the well-known "willow-pattern" plates. The latter is from carved wood in the Hôtel Cluny of the time of Francis I. The Anthemion form in this latter example is tending towards the development of the hollow shell, which forms so prominent a feature in the Rococo decoration of the time of Louis XV., a revival of which style is just now in vogue.

Conclusion.—With these remarks on the development of this type of pattern through many centuries, the matter is left in the reader's hands. The remarks should prove instructive to many students of ornament and design, and the illustrations will enhance their stock of patterns from which to draw helpful suggestions for future work. To those readers of Work in want of patterns for embellishing objects, those given will prove useful; they, no doubt, will be able to turn them to good account in various ways, which will almost suggest themselves. It may be stated, in conclusion, that in addition to serving as horizontal bands or borders, nearly all may be utilised also for borders for circular objects, with a little alteration in the spacing of the various parts; indeed, all the pottery examples are in the originals upon circular objects, such as plaques, etc. They have been represented in a horizontal position simply to economise valuable space.

Agates.—These have taken their names from the river Achates, in Sicily, where it is said they were first found. This is quite likely, for an agate is only a variety of pebble.

SCREW-CUTTING IN THE LATHE.

BY J. H.

Miscellaneous Examples.

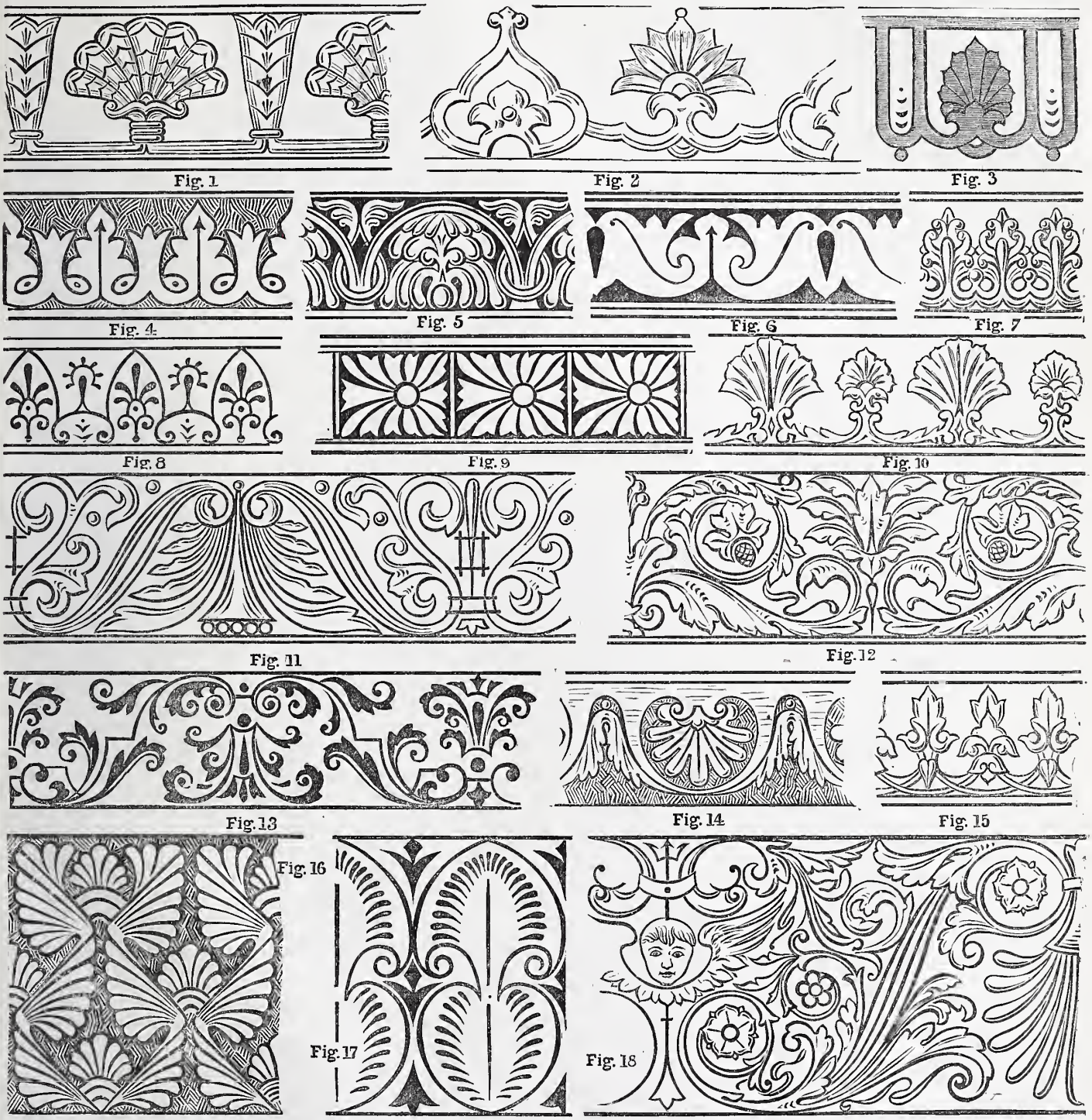
The Case of Coarse and Fine Screws — How to Prove Wheels—Millimetre Pitches—Position of Saddle — Double and Triple Threads — Range of Choice in Change Wheels—Prime Numbers.

The Case of Coarse and Fine Screws.—Take now the cases of screws coarser and finer than the example just given. Say we want to cut a screw of three-inch pitch, and then one having thirty-five threads to the inch. First, When we have to cut screws coarser than one-inch pitch, it is necessary to introduce into the vulgar fraction the number of threads contained in that distance of the leading screw, which corresponds with the pitch or length of the screw to be cut. Here, having a leading screw of four threads per inch, and a screw to be cut of three-inch pitch, we must write $4 \times 3 = \frac{12}{3}$; twelve representing the number of threads in the length of three inches on the guide screw. Then, adding a cypher $\frac{12}{3} = \frac{120 \text{ driver}}{30 \text{ driven}}$, and these will cut a screw of three-inch pitch.

Second, to cut a screw of thirty-five threads per inch, we say $\frac{4}{35} = \frac{40 \text{ driver.}}{350 \text{ driven.}}$

But there is no wheel of 350 teeth, so we must obtain factors for other numbers. Thus, for example:— $\frac{40}{350} = \frac{5 \times 2 \times 4}{5 \times 7 \times 10}$, adding cyphers and cancelling $\frac{\overset{25}{\cancel{50}} \times 20 \times 40}{50 \times \underset{35}{\cancel{70}} \times 100}$.

We cancel one 50 above the line, because there are not two 50-toothed wheels in a



Examples of Anthemion Borders. Fig. 1.—Assyrian. Fig. 2.—Persian. Fig. 3.—Chinese. Figs. 4 and 6.—Arabian. Fig. 5.—Byzantine. Fig. 7.—English, late Gothic. Fig. 8.—Pompeian. Figs. 9, 10, and 16.—Indian. Figs. 11, 12, 17, and 18.—Italian Renaissance. Figs. 13 and 14.—French Renaissance. Fig. 15.—Turkish.

set, and to preserve the ratio, we cancel 70, and have 35 below the line; and then 25, 20, and 40 will drive, and 50, 35, and 100 be driven wheels.

How to Prove Wheels. — Mistakes will sometimes occur in working out the wheels, especially in compound trains; and it is, therefore, always safer to prove the accuracy of the results before beginning to cut the thread, lest the work should be spoiled. There are two methods by which the wheels can be proved, each involving a reference to first principles. One is as already laid down in Art. I.: The same ratio must exist between the driver and driven wheels as exists between the guide screw and screw to be cut. Thus, taking the first example of the coarse thread, the product of $\frac{120}{30}$ $\frac{\text{driver}}{\text{driven}}$ must equal $\frac{12}{3}$ $\frac{\text{guide screw}}{\text{screw to be cut}}$ = 4, which is the case. Again, in the second example of the fine thread and compound train, $\frac{4}{35}$ = ·114, and $\frac{25 \times 20 \times 40}{50 \times 35 \times 100}$ = ·114. The other rule is:—Divide the driven by the driver; or, if a compound train, the *product* of the driven by that of the driver. Multiply the quotient by the number of threads of the guide screw; the result will equal the number of threads in the screw required to be cut. This is essentially a proportion or ratio sum, thus:—As driver : driven : : guide screw : screw to be cut. In the first example, a screw of three-inch pitch; $\frac{\text{driven}}{\text{driver}}$

$\frac{30}{120}$ = ·25
4 guide screw
1·00
3 inches = length of pitch
3·0 inches = screw to be cut.

In the second example:—

$\frac{\text{driven}}{\text{driver}}$ $\frac{50 \times 35 \times 100}{25 \times 20 \times 40}$ = 8·75
4 guide screw
35·00 screw to be cut.

These examples will be sufficient.

Millimetre Pitches.—The case of millimetre pitches should not be omitted. Few possess lathes having a guide screw of a metrical pitch; yet it is desirable sometimes to cut threads of millimetre pitches on ordinary English lathes. It is very simple, and is done as follows:—The metre is equal to a length of 39⅜ inches—more exactly, 39·37079 inches, and this contains 1,000 millimetres. A leading screw of the same length of ¼ inch pitch contains 157½ threads = 157·5, so that the ratio between the two stands thus: $\frac{157·5}{1,000}$, or reduced $\frac{157·5}{1,000} \div 2·5 = \frac{63}{400}$. If we have a 63 prime wheel, therefore, we can cut millimetre pitches in a lathe with a leading screw of ¼ inch pitch. The error caused by using such a wheel will only amount to $\frac{1}{240}$ of an inch in the metre length. This number 63 must be multiplied by the number of millimetres in the pitch of the screw. If the screw is of 3 m.m. pitch, multiply 63 by 3; if of 10 millimetres pitch, multiply 63 by 10, the number 400, of course, remaining constant. Evolving the figures in the usual way, we may write in the first case named $\frac{63 \times 3}{400} = \frac{63 \times 30}{4,000} = \frac{63 \times 30}{40 \times 100}$. Since 3 m.m. is finer than the pitch of the leading screw, the wheels 63 and 30 will drive and 40 and 100 will be the driven. In the second case named $\frac{63 \times 10}{400} = \frac{63 \times 100}{4,000} = \frac{63 \times 100}{40 \times 100}$; and not having two wheels of 100 teeth in a set, we alter $\frac{63 \times 100}{40 \times 100}$ to $\frac{63 \times 50}{20 \times 100}$; and since 10 m.m. is coarser than the pitch of the leading screw, the wheels 63 and 50 will drive, and 20 and 100 will be driven.

The proof of the correctness of the wheels lies in the fundamental rule already given in the first article: that the ratio existing between the driving and driven wheels is the same as that which exists between the guide screw and the screw to be cut.

In the first case, that of $\frac{63 \times 30}{40 \times 100}$, the ratio of the driving and driven wheels is $\frac{63 \times 30}{40 \times 100} = \frac{1,890}{4,000}$ = ·4,725 and the ratio of the guide screw and screw to be cut is $\frac{63 \times 3}{400} = \frac{189}{400}$ = ·4,725; therefore the wheels $\frac{63 \times 30}{40 \times 100}$ are proved to be correct.

In the second case, $\frac{63 \times 50}{20 \times 100}$, the ratio of the driving and driven wheels is $\frac{63 \times 50}{20 \times 100} = \frac{3,150}{2,000}$ = 1·575; and the ratio of the guide screw and screw to be cut is $\frac{63 \times 10}{400} = \frac{630}{400}$ = 1·575; therefore the wheels $\frac{63 \times 50}{20 \times 100}$ are proved to be correct.

Position of Saddle.—In many instances the position of the saddle for commencing a cut is a matter of indifference. But in others there is only one position at which it must be set for commencing a cut. These instances occur in the case of screw threads, which are neither multiples nor aliquot parts of the pitch of the guide screw, and also in the cutting of multiple-threaded screws. It is usual in these cases to make a certain mark upon the change wheels, or to place some kind of stop on some portion of the lathe as a guide for the starting of the saddle for each cut.

Double and Triple Threads.—In the case of double and triple threads, the mandrel wheel is chalked in two and three equal divisions of teeth respectively, and these marks are brought successively opposite the corresponding space in the driven wheel for the starting of the cut for the second and third threads respectively; the rocking plate of the lathe being lowered for the purpose.

Range of Choice in Change Wheels.—There is much range of choice possible in an ordinary set of change wheels. A set usually numbers 22 wheels. There are 21 wheels, ranging from 20 teeth to 120, advancing by 5 teeth; and there is one duplicate, usually a 40 or 60, for cutting threads of the same pitch as that of the leading screw. Having obtained the required ratio between the driving and driven wheels, it is very necessary sometimes to be able to substitute some wheels for others in compound trains; either because two wheels having equal numbers of teeth occur in both drivers and driven, or because some wheels which came out in calculation do not happen to be included in the set. It becomes necessary to halve, double, or take away, or add fractional parts, and the ultimate result is not affected in the least; provided that the *total products of the drivers and the driven wheels are altered in exactly the same ratios.* Thus, in the case of $\frac{50 \times 20}{100 \times 20}$ as we have not two wheels of 20 teeth in a set, we must alter above and below the line. We cannot halve, because no wheels run so low as 10 teeth. If we double, we get either two of 100 teeth or two of 40 teeth, which we may not have in one set. But we can add one-half to two of the wheels thus:— $\frac{50 \times 20}{100 \times 20} = \frac{75 \times 20}{100 \times 30}$, 75 and 30 being substituted for 50 and 20 cancelled. In this way many new combinations are often possible.

Prime Numbers.—In certain cases none of the change wheels in a set are available for cutting the thread required. This happens in the case of some of the prime numbers which cannot be broken up into factors, and in these cases it is necessary to have a change wheel having a prime number of teeth. This does not often occur in engineers' practice. The prime numbers above 23 up to 100 are 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97.

I have thus briefly laid down the leading principles of screw-cutting, but the details of the practice are so extensive that a bulky treatise would not exhaust the subject.

AN ORGAN FOR THE COTTAGE.

BY MARK WICKS.

The Pipes.

The first thing we shall require to enable us to make a set, or stop, of pipes is a scale by which we can at once determine the length and diameter of every pipe. I may say that the one scale may be used for making all the stops by adapting it as I shall hereafter explain. First draw a perpendicular line 4 ft. 6 in. long on a piece of board. The diameter of our largest Dulciana pipe is 2½ in., so at the top of the perpendicular line set off a line 2½ in. long at right angles, as shown in Fig. 2. From the end of this short line draw a sloping line down to the bottom of the first line, then commencing at the bottom of the perpendicular line, mark off 6 in. by a line right through that and the sloping line, and write against it the word "mouth;" from that point mark off 12 in. by a line joining the two others, and mark that c^1; mark off another 12 in. above that, and write against it "Middle c," and you will then have 2 ft. left. The bottom space above the mouth line must now be sub-divided at 6 in., 3 in., 1½ in., and two ¾ in., and these points marked c^2, c^3, c^4, and c^5, respectively. This will give you all the c's in the scale from tenor c upwards. Each of these divisions (between each c) must now be divided into twelve equal parts, and the names of the tones and semitones in the scale written against each, as shown in the top division of the sketch. It will be seen that the lines in the top division are 2 in. apart, in the next 1 in., then ½ in., ¼ in., and so on, each octave being half the length of that above it. The speaking length of a pipe is measured from the line marked "mouth" up to the horizontal line of the required note, and the length of that horizontal line will give you the internal diameter of the pipe; and these dimensions are those of the cylindrical tubes of the pipes shown in Figs. 3 and 4. The stopped diapason will be 4 ft. long and 3 in. diameter for its lowest note, and by setting off 3 in. at the top of the scale, and carrying a sloping line

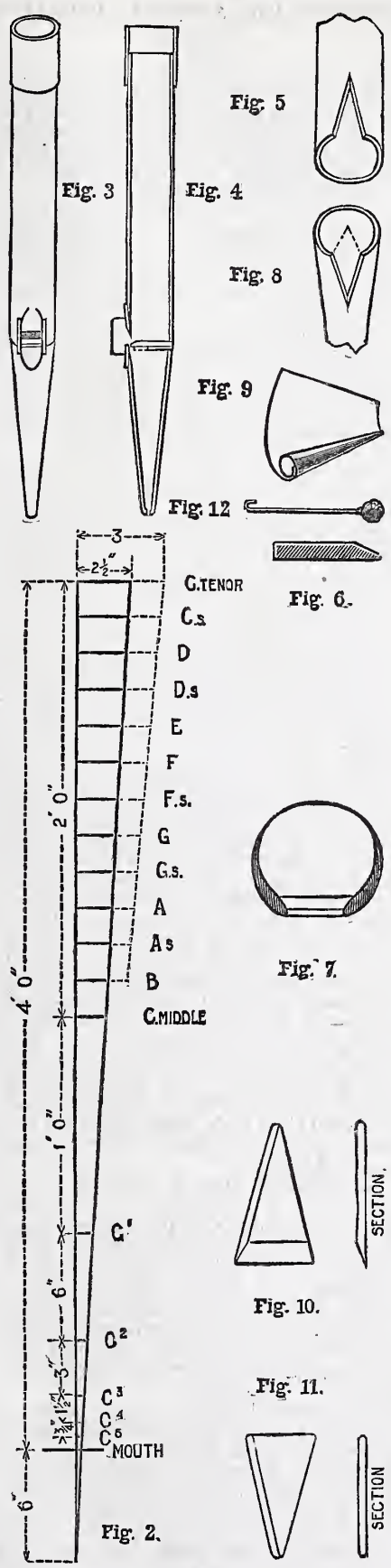
down to the point, as in the first instance, and then dotting the cross lines as far as this sloping line, we get the scale for this stop also. As it only consists of twelve pipes from C C to B, there is no need to carry the scale any lower than is shown in the sketch. This scale must be carefully preserved, and the sizes taken from it for all the pipes.

The pipes now about to be made are paper pipes, and we shall, therefore, require a stock of paper for the work. For pipes up to 2 ft. long, cartridge or stout writing-paper will be suitable. The pages of an old ledger or account-book answer the purpose admirably. For longer pipes, stout brown paper is best. At many stationers', general stores, and oil-shops it is possible to obtain brown paper 4 ft. 6 in. wide in continuous lengths, at from 2s. 3d. to 3s. a dozen yards, and this is excellent for the purpose, as it is rolled up and contains no creases. The very small pipes can be made of the leaves of an old copy-book or any other smooth paper that is not too thick.

Some kind of a mandrel is obviously necessary to roll the paper on when forming a pipe. All that is necessary for the smaller pipes is to roll some smooth paper tightly up, so that it forms a cylinder as thick as the diameter of the pipe, but it should be a good bit longer, so that it can be used for others by simply rolling more paper round it to make it thicker. The size having been obtained, glue the outside of the edge of the paper and fasten it down smoothly, rubbing it well with a round stick to secure this result. Make four or five of these templates of different sizes up to about 2 ft. or 2 ft. 6 in. long. It is as well not to tackle either the very small pipes or the very large ones until you have acquired the knack of working; you will find the medium-sized ones the easiest, and therefore affording the best practice for a novice.

We will commence on the 12 in. C pipe, and following the same general instructions will enable you to make any other. Take a sheet of smooth cartridge or account-book paper, and having made a mandrel about 18 in. or so long, and the same diameter as the length of the cross-line on the scale, marked C^1, cut the paper to about $1\frac{1}{2}$ in. longer than the distance from the mouth up to this line, which will make it $13\frac{1}{2}$ in. long, and it must be wide enough to roll say four times round the mandrel, so it must be cut about 12 in. wide. Give it one turn round the mandrel, and mark that distance on the paper by a pencil-line; lay the paper flat, and cover all the rest of the paper with thin hot glue, using a good brush so as to brush it quickly and smoothly over the surface. Leave no lumps or hairs on the paper. Allow about a minute for the glue to soak in and the paper to stretch, and then take the paper up, lay it on a flat bench or table, and place the template on the unglued part and roll it up tightly and carefully, rubbing it down well with a round stick as you roll it up, so that every thickness adheres smoothly to the other, and rub well down when you come to the outside edge. Slip it off the mandrel, and stand it up endwise to dry, but not near a fire, or it will warp in drying.

While it is drying you can make the conical foot. Cut a piece of paper to the shape of Fig. 9, and roll it up to a conical shape, commencing at the bottom, as shown in the sketch. The paper must be long enough to make a cone about 8 in. long, and wide enough to have about six thicknesses when rolled up to the requisite size. You need not be particular as to the exact



Organ for the Cottage. Fig. 2.—Scale for Pipes. Fig. 3.—Pipe Complete. Fig. 4.—Section of Pipe. Fig. 5.—Cutting for Lip of Pipe. Fig. 6.—Section of Languid. Fig. 7.—Languid. Fig. 8.—Cutting for Lower Lip. Fig. 9.—Shape of Paper for making Cones. Fig. 10.—Upper Lip. Fig. 11.—Lower Lip. Fig. 12.—Sponge Mop for painting inside of Pipes.

diameter of the cone, providing it is large enough, as it will be trimmed down at the top and bottom when finished. After rolling it up, open it again, glue it all over on the inside, and roll it up again—it will readily assume the conical shape now—and then rub it down (with a round-pointed stick, like a meat skewer) inside and out.

While this is drying you can prepare the lips and languids. The lower lip is merely a conical piece of thin wood, but the upper lip is chamfered off at the wide end, as shown in Figs. 10 and 11. The languid is shown in Fig. 7; it is merely a piece of thin wood the same size as the outside diameter of the bottom of the pipe, the front edge being cut square and then chamfered off. Make the wood a complete circle first, then mark off a straight line rather less than a quarter of the circumference in length, cut it off, and chamfer the top edge, as shown. By this time the tube and cone are dry, so take them, and trim them up with the scissors so that the ends are square; lay a piece of glass-paper flat down on the bench, and holding the pipe upright on it, rub the ends smooth. Mark on the bottom of the pipe the place where the ends of the straight portion of the languid come, and with the scissors cut out a triangular hole in the pipe from these points, about 1 in. high. (See Fig. 5.) Glue the languid on to the bottom of the pipe, and while it is drying you can attend to the foot. Make a circular languid the same size as the one on the pipe, but instead of cutting it straight across, cut out a triangle extending to about the centre; trim the wide part of the cone down to the exact size of the straight tube, cut out a triangle similar to that in the tube, but not quite so long (see Fig. 8), smooth off the top and glue the last mentioned, or under-languid, as it is termed, on to the top of the cone, making the triangle in it correspond with that in the cone, as shown by the dotted lines. When dry, fold a piece of glass-paper round a flat block of wood, and by rubbing it across the pipe flatten the edges of the triangle so that the upper lip will lay flat on it. Do the same with the lower lip on the cone. Trim off the bottom of the cone so as to make the length of it about 6 in., and chamfer off the bottom end with a penknife. Wet the chamfered part, then take a china egg-cup, and put it on the end of the cone like an extinguisher on a candle. Work it round gently, and the foot will be coned inwards; with a pointed stick (a lead pencil will do) make a hole in the bottom of this coned-in part about $\frac{1}{8}$ in., or rather more, in diameter, inserting the point with a screwing motion. When dry, this part will be quite hard.

Now tie the upper lip on to the front of the pipe so that its lower edge is about one-fourth of its width above the edge of the languid, and tie the lower lip on to the cone so that it projects slightly above the under-languid. Place the two languids together so that the lips are parallel, and having a very narrow windway between the edge of the lower lip and the languid (about wide enough for a thin visiting card to pass), blow gently through the pipe, and you will be rewarded by a musical note. A very little adjustment of the pipe and lips will enable you to determine the exact position required for each, and you can then glue the lips on, binding them with tape or thread to keep them in position, and finally glue the foot on to the pipe. You can test and adjust the parts before the glue is set, and so make sure that it is all right. When dry, rub down the edges of the lips with glass-

paper so that they are level with the face of the pipe, and look neat and true. Then glue two little pieces of thin wood on each side of the mouth to form the ears, as shown in Figs. 3 and 4. These prevent the wind coming through the foot from being wasted.

Cut off about 1½ in. from the top of the tube, and keep it for further use, trim off the pipe, and slightly chamfer the outside top edge with glass-paper. The tuning-piece should be about 1½ in. long, and is simply a bit of tube made round the pipe itself, so that it fits tightly on it, but can be slipped up and down. Chamfer the top and bottom edges of this piece.

In making the pipes generally, we make each about 1½ in. in the foot longer than speaking length, as the piece cut off will form the tuning-piece for a smaller-sized pipe, and thus save the trouble of making them separately.

I should have stated that the pipes must be protected with two coats of paint inside and out. The outside can be painted with a brush, the inside with a mop, made of a piece of sponge tied on a cane, the sponge being cut so that it just goes easily into the pipe. Dip it in the paint, and work up and down two or three times in the pipe, and you will find it smoothly and very quickly done. Of course, this must be done before putting the pipes together. Voicing the pipes will be dealt with in the next chapter.

NEW BLEACHING PROCESS.

A NEW bleaching medium for silk and wool, or for fabrics containing those fibres, is a compound of sodium superoxide, which would probably be represented by the chemical formula $Na2O_2$, and is analogous to barium and hydrogen peroxides in its properties. All these bodies bleach by virtue of their containing an excess of oxygen ready to act upon any colouring matter with which it may come in contact. The advantage which the new sodium superoxide has over the old peroxides can be seen when the amount of active oxygen contained in each is compared. Hydrogen peroxide of the usual twelve volume strength contains 1·5 per cent. of active oxygen; barium peroxide contains 8 per cent., while the new sodium peroxide contains 20 per cent. It is sent out in the form of a white powder, readily soluble in water to a strongly alkaline solution, which, on adding acids, forms a clear neutral liquid containing peroxide of hydrogen. This can be used for bleaching by the ordinary well-known bleaching processes. A method of working consists in taking from 10 to 30 per cent. of the sodium superoxide, adding 30 per cent. of Epsom salts, the percentages being of the weight of the fibre which is being bleached. For wool and ordinary silk, about 10 per cent. will be required; for tussur silk, 30 per cent., on account of the darker colour of the fibre. It takes from two to three hours to bleach with this new material—a much shorter time than is required for peroxide of hydrogen, while the bleach is just as effective. It is rather hygroscopic, and, therefore, has to be stored with great care; but, with proper storage, it is very stable, being much superior in this respect to either hydrogen peroxide or barium peroxide. It is also said to be cheaper.

WHITE-LEAD should never oe used as jointing material for acid pipe joints, or the joints of acid cisterns. Red-lead, mixed with boiled linseed oil, makes a good joint.

ENGLISH AND AMERICAN CARRIAGE WORK.

I SELECT work in carriages for comparison; we have them on the spot, side by side with English carriages, or I should have preferred buildings for comparison. It would not be consistent to compare vehicles of a distinctly different manner of build.

I can at once, with pleasure, testify to the lightness of American carriages generally, and their adaptability to stand the strain and shock of bad roads, and to their neat finish and excellent painting, lining, and varnishing.

In carriages by the best makers of the two nations the difference is not appreciable, except, perhaps, in some perch or spring proportions, or automatic head-lift actions, which are mostly English specialities, which the Americans adopt as soon as their merits are detected.

But coming to work of second-class, the difference is favourable to the English work in some material points, due more to the system of piece-work than to inferior make in their respective departments of work; or in other words, the body-work, carriage-work, and iron-work. Leather, lining, paint-work, and wheels may be of equal make to the English; but in America, with the isolation of each distinct branch of work that has afterwards to be so intimately blended, to stand excessive strain and exposure to the weather, the good work is greatly spoilt, and rapid wear and decay result.

Say a Landau body is sent to the carriage-maker to fit his carriage and under-gear to, which has been made, sometimes by the score, to certain fixed patterns to suit Landau, Brougham, or Victoria. The wrecking begins; holes are bored through seat, bottom-sides, somewhere between panel and edge-plates, the root-bolt of back-loop mostly cutting through the corner-pillar tenon—for this form of framing is used by second-class workmen; perhaps the boring cuts through an edge-plate screw or cuts away half a bolt—if some sort of edge-plate has been adopted. The loops are at last fixed, and their accuracy to take the springs tested. The fore-carriage, in like manner, is bored on to boot bottom-sides, and if an arch slopes where the bolt-heads come, a large piece is roughly gouged out for the head.

A foot-board stay is fixed on to the hunter-bolt in wheel-plate. Being piece-work, hurry and drive is the rule; the heavy hammer drives and starts joints the body-maker took such pains to make perfect.

Springs are fixed; axle to springs. Wheels with axle-boxes truly bored in hubs are put on, and the carriage is on its wheels. But with second-rate work the axles have not been set for truth, perhaps. It is nobody's job, so it is left undone.

Wing-stays, lamp-irons, and incidental iron-work are fixed with as little care as the carriage, so long as the job can be knocked off quickly. Smash, push, drive seem to be the words suited to the work by the "piece." The master does not care so long as he can turn out quantity, nor the man so long as his work will pass muster somehow, and more rapidly come to hand.

Now the painter takes over the carriage, and gets his job done as fast as he can, so as to earn all he can in the shortest time. The trimmer, in like manner, works against time to turn out a showy job. The plater and beader put the embellishing points on, and the thing is wheeled into the show-room. Anyone with a critical eye can see it is a second-rate-built piece-work job, by a glance at the wheels, which do not line or track, and throw out differently, and the tires do not rest flat on the floor, but ride on the front edges; showing that cylindrical tires have been put on coned wheels, which will cause the wheels to fail soon in fair work. The door-handles are not fast in the locks, but play a little, soon to rattle. The lamps, to look pretty, are quite upright, or "near enough," and throw the reflected light in a line with the horse's head instead of on to the road in front of him; the steps may be level, or one may droop at the front edge. The shafts may be a good or bad fit; the pole the same. Each man has done his part, regardless of the requirements of the other branches of the trade. The master may be a workman used to this system, and all seems right to him; or if ignorant of the trade, except the money-getting part of it, he is ignorant of the way to make a first-class carriage: to carry out a system that shows bad results.

In England the same system prevails where piece-work is the rule; but with day-work, and no motive for doing things "anyhow, so long as it will pass," there is a genial feeling between the various branches of the trade. The body-maker will consult the smith about his edge-plates, and the carriage-maker about boring-on. The carriage-maker will consult with the foreman as to the best form of body-loops and spring-stays, and their easy taking apart and putting together for paint-loft arrangements and "hanging." Bolt-heads will be dotted or notched, to show their cant in putting together easily.

The trimmer will be asked by the body-maker about what wood shall be left on or taken off bottom-sides, pillars, and elbows, so as to have a proper amount and surface for trimming, nails, and lining bearing. The painter will suggest the sharp angles being off iron and wood, where rubbing or wear would soon cut them through.

The master would not shout bullyingly to men to stick to their own bit, and not interfere with other workmen, but join in, and aid the aim to turn out good work; even though it might not be first-rate at all points, each workman would be doing his level best with a pride in his efforts, and a knowledge that the whole was aided by his good work.

Having seen the system of coach-making and cart-making at work, and having been engaged in the supervision of scores of men, as well as the teaching of youth singly, in all branches, I unhesitatingly condemn the scamping piece-work system, when adopted as a general rule. In some mechanical work it may be partially adopted, but it is debasing if made the rule of work. The workman's mind becomes mechanised; he often works in ignorance of results, and does things wrongly from habit or hurry—as, for instance, a man working at a particular job in getting out parts of wheels by machinery, which is often faulty in construction.

In some crafts a man may go on for a time at a task without even knowing what his particular bit of work is for: as a smith was set to make several gross of irons of a small size. He made them without a thought, till asked if he knew what they were for. His answer was: "I don't know, and don't care; but I suppose they may be for buckets."

"No," said his questioner; "they are for pack-saddles."

The answer was: "All right. Now I know that, I shall not be so particular."

And the rejoinder was: "You are making them so badly, that I do not see how they can be worse."

Piece-work coach-making may be summed up as a combination between employer and workmen to get work together by scamping, and all try to avoid detection; day-work coach-making the combination of master and men to do the best work in a reasonable time, and to be proud of it when done. Day-work is more general in second-rate carriage-building in England than America, and the work is of a higher and more lasting grade in consequence.

THE SELECTION OF TIMBER.

BY J. H.

REMARKS COMPREHENSIVE ONLY—SEASONING—SOUNDNESS—KNOTS—GRAIN—SAP—MODE OF SAWING.

Remarks to be Comprehensive.—I am not going to write about the selection of standing timber trees or of logs, but of boards and planks already cut up in the timber-yard. Neither can I write about the numerous kinds of timber in use, but must make my notes of a comprehensive character, applicable to timber in general.

Points to be Considered.—In the selection of timber many matters have to be considered, such as (1) seasoning, (2) soundness, (3) freedom from knots, (4) condition of grain, (5) sap, (6) mode of sawing.

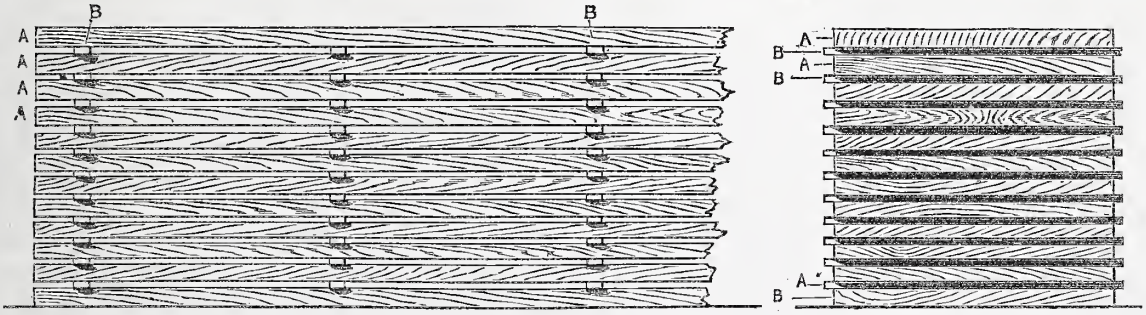
Seasoning.—Seasoning signifies the drying of boards, and their consequent freedom from the fluids originally present in the tree. Timber will take from one to two years in seasoning. First, it will lay on the ground for a good while—several months, at least, after felling—then, perhaps, for a few months in its squared condition, or in balk, and always for a very considerable time after having been sawn into boards or planks. After valuable stuff has been sawn out, it is stacked horizontally in piles, and stripped for several months previous to being used. Mahogany, yellow pine, birch, and furniture woods are thus treated. Spruce deals, flooring boards, and rough builders' materials are not so treated, but are simply stacked vertically on end in timber racks, or laid, variously, crosswise, horizontally in piles.

Stripping is performed by laying the boards, A (see figure), horizontally one over the other, with thin-sawn strips of wood, B, from ½ in. to ⅜ in. thick, between. These strips are laid at intervals of from 2 ft. to 4 ft. A pile may consist of from twelve to twenty-four boards. Stones or weights are laid on the top board to load the mass.

The boards being kept apart by the strips, the air currents circulate freely between and carry off moisture from the face of each board. The boards are, therefore, preferably stripped in covered, draughty sheds, exposed to wind, but not to rain. Also, the stuff does not warp or curve by unequal shrinkage, but each board being coerced by the load above it, and by the straight strips, dries in the position in which it is stripped. Excessive local shrinkages are prevented, and, when the boards are removed, they retain the true form imposed upon them during stripping and drying. They are then ready for stacking vertically in the shop racks for use.

In the more valuable hard woods it is also customary to nail strips on the ends, to assist in preserving the boards from becoming warped.

All boards, however, are not dried in this efficient manner: timber merchants will not afford the time necessary. A novice should, therefore, know that a board may look and feel dry, and yet not be well seasoned. The best way to tell whether a board is dry throughout is by lifting it, and judging by its weight. This, of course, requires some experience, but it is experience that is soon gathered. It is not even an absolute test in itself, because the specific gravity of one pine or mahogany board may be, and often is, greater than that of other pine or mahogany boards from other logs; but this is a matter also for judgment, and a practised hand judges by weight more than by any other means.



Timber stacked and stripped.

But there are also other signs, not to be neglected, that assist one in forming a judgment. A board whose surface-skin only is dried will generally feel colder to the touch than one which is thoroughly well-dried throughout; or there will be streaks of damp here and there visible over the surface; or, if the boards are thick, the damp will show at the central portions of the ends. Moreover, any sawdust that may still cling to the surfaces will not be fine and powderish, but will feel dampish or fluffy, and incline to cling to the surface of the wood. These, therefore, are lesser tests, which, taken in conjunction with the principal one of weight, indicate, after a little experience, the internal condition of well-seasoned or partially seasoned boards.

Soundness.—Of (2) soundness, little need be said. Shakes are usually visible when they exist in well-seasoned boards, being already open. In wet boards, however, the lesser shakes are not visible to a casual glance; but a close scrutiny will usually reveal them there. The common qualities of boards will seldom be entirely free from shakes; but boards can always be had perfectly free from both shakes and knots by paying a first-class price.

Knots (3) are always visible. Whether they are hurtful or not depends, of course, upon the purpose to which the boards are to be put. Small knots are of little importance. In most work, knots running perpendicularly, or nearly so, through a board are less objectionable than those which run a considerable portion of the way across or diagonally. Knots may run so badly that a board may be, practically, severed by them.

Grain.—(4) The condition of grain may or may not be a matter of much importance, being dependent on the purpose to which the timber has to be applied. In most cases, however, a crooked disposition of the grain should be avoided. It is difficult to plane crooked stuff, and the strength of the timber in which cross grain occurs is also impaired. It is easy to observe the course of the grain fibres in any sawn wood. Some woods, of course, are seldom, others are never, found with straight grain. I may instance Spanish mahogany, walnut, oak, lignum vitæ, etc. In some cases the curving and interlacing of fibres is an advantage, either on the score of beauty or of utility, but for structural and builders' work, and for patterns, the straighter the grain the better; and if, as is often the case, cross-grained stuff has to be used in positions where it is better that it should not be used, then all that can be done is to put, if possible, the more cross-grained portions in positions where they will be subjected to the least strain.

Sap.—It is very important that (5) sap-wood should be avoided as far as possible. It is good for nothing, and, except for the roughest work, must needs be wasted. A little edging of sap-wood cannot always be avoided in timber of second-class quality and price, but it should not be accepted when purchasing the best stuff. It is also difficult to obtain large squared balks altogether free from sap. There is no mistaking sap-wood. It is green, or greenish, in colour, is sharply separated in appearance from the heart-wood, and cannot be cut cleanly with the planes and chisels.

Mode of Sawing.—(6) Lastly, there is the way in which the timber is sawn. It should be evenly cut, and the boards be of equal thicknesses. In some stuff, badly cut, there will be quite ⅛ in. difference in the thicknesses in different places—sometimes more than that. This means loss of time in planing, and waste of the material, consequent on having to reduce the thicker down below the thinner-gauged portions. Also, stuff is sawn hollow crosswise and crooked lengthwise, and uneven, due to the saws being in bad order, badly sharpened, or badly set, or being improperly fixed in the frames. Some of the commoner material is cut with circular instead of with frame saws, and then the surface is often badly scored and grooved.

TO FASTEN LEATHER TO IRON.—First paint the iron with some lead colour, say white-lead and lamp-black. When dry, cover it with a cement made as follows:—Soak glue in cold water until it is soft, then dissolve it in vinegar at a gentle heat, add one-third of its bulk of white turpentine, mix thoroughly, and use hot. Apply the leather quickly, and press it tightly in place.

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THE recent accident to the Cunard steamer, the *Umbria*, has proved a powerful object lesson in giving a practical denial to the repeated statement that British artisans are depreciating in their ability, and it has also been an excellent example of what a practical workman can do under great difficulties. Engineer Tomlinson is the hero whose knowledge, combined with perseverance, enabled him to carry out repairs which were necessary to save a magnificent vessel and about 500 human beings. The facts appear, that in mid-ocean and a terrific gale the propeller shaft, which was twenty-five inches in diameter, and made of solid steel and strengthened with collars, became fractured, and although the vessel was rolling and pitching in a heavy sea, Mr. Tomlinson was, by dint of great ingenuity, equal to the occasion. He drilled three holes out of solid steel in the collars, and fitted steel bolts into them. These bolts were five inches in diameter, and Mr. Tomlinson was compelled to shorten them and reconstruct the massive nuts. He then fitted their ends so that they should not interfere with the machinery. All this was done with *hand drills*, *hammers*, and *cold chisels*. A better piece of work was never done at sea. A start was then made of the machinery, and after two hours' trial one of the heads of the connecting bolts gave way and was wrenched off under a tremendous strain, when Mr. Tomlinson prepared another bolt which fitted into the place, the machinery was again started, and the *Umbria* was able to enter New York harbour. When we look at the difficulties of working on the ocean, combined with, so to speak, primitive tools, Englishmen may well be proud of Mr. Tomlinson's successful achievement. The fact that the *Umbria* is coming back to England with this makeshift shaft, in order to obtain a new one on this side, speaks highly for the supremacy of English shipbuilding and machinery industry. It is estimated that the cost of a new shaft in England would be less than the price of it in the United States. The accident to the *Umbria* rudely disposes of the pleasing assumption that our ocean-going steamers had reached the highest point of safety, as well as comfort and speed. It can no longer be supposed that a steamer equipped with one shaft only is anything like as safe as one furnished with two. A daily contemporary boldly asserts that no ship of the class to which this vessel belongs should be allowed to cross the ocean unless it is fully provided with the machinery which experience has proved to be necessary as a safeguard against accidents. The *City of New York* and the *City of Paris*, as well as the *Majestic* and the *Teutonic*, are all, it is said, provided with two shafts, and if one shaft should snap, each of these ships would still be under control and able to proceed on her voyage. The question of providing two shafts instead of one in a ship of sufficient size is only a matter of expense, and so many of our big ships on the Atlantic and other routes run the risk of going to the bottom.

SHOEMAKING for corpses is a curious industry which, for nearly a decade, has been carried on most successfully in Chicago, and in one factory where the trade is the exclusive industry no less than 20,000 pairs have been turned out in one week. The shoes are certainly nice to look at, and are not expensive, the cost being from one pound to three pounds per dozen pairs. The soles are cut out of pasteboard, and are covered with grained paper. The uppers are a combination of quilted satin and crochet work. A ribbon, inserted at the top and tied in a neat bow-knot, holds the shoe to the foot. Men's shoes are always black, and shoes for women are always white. At this factory during the dull season the average monthly output is 13,000 pairs.

THE MANUFACTURE OF OIL-GAS.—In a paper read before the Institute of Civil Engineers by J. B. Ball are given some interesting particulars of the manufacture of oil-gas at the Holloway works of the Great Northern Railway Company. The method of manufacture is the Pintsch System, and the apparatus is designed to produce 60,000 cubic feet of gas per day; at present the make is only 15,000 to 18,000 cubic feet. The 10 in. D retorts are made of 1 in. metal, and are 6 ft. long; they are worked in pairs, and are kept as nearly as possible at a cherry-red heat. Each pair will make 300 to 400 cubic feet of gas per hour, and 600,000 to 700,000 cubic feet of gas before they require renewing. The furnaces consume 160 to 180 lbs. of coke for every 1,000 cubic feet of gas produced. The oil used is a once-refined shale oil, and is stored in a galvanised cistern of fifty-gallons capacity; from this it runs, by means of a 1 in. supply-pipe, regulated by a micrometer cock, into a ¾ in. syphon pipe, 12 in. deep, connected to the retort; it then falls on to a loose tray in the retort, and is immediately vaporised. The gas issuing from the retorts passes to the hydraulic main; then through air condensers, washers, and purifiers, into the gasholder. The cylindrical steel store-holders are 17 ft. 6 in. long, 4 ft. 3 in. diameter, and are tested by hydraulic power to 300 lbs. per square inch. There are six men engaged at the works, and the total cost of buildings and machinery amounted to £14,740.

HOW TO MAKE A TOILET GLASS.

BY LAUNCELOT GUBBINS.

HERE is an article indispensable to every household—a toilet glass; not a very heavy job, but an easily constructed affair, and one within the scope of almost every reader of this paper.

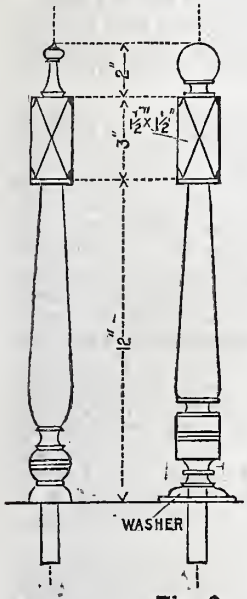


Fig. 1. Fig. 2

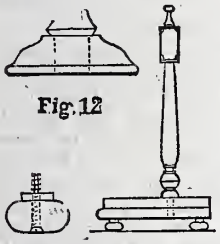


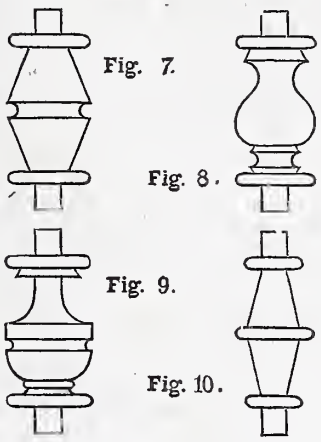
Fig. 12

Fig. 11 Fig. 5

Figs. 1 and 2.—Uprights. Fig. 5.—Side View. Fig. 11.—Foot. Fig. 12.—Washer for Fig. 2.

The glass I am about to describe is in existence, having been made by me, mostly of pieces of an old packing-case, in a few hours. I mention this in order that my amateur friends may be induced to try small jobs of this kind oftener.

First get the silvered plate-glass. This is now very inexpensive plain (bevelled glass is about twice the price of plain). To anyone, however, to whom price is no object, I would say, Get it bevelled. Let it be 17½ in. by 12½ in. Make the frame (Fig. 3) to hold the glass of the sizes and shape shown in the drawings. The side pieces and bottom are 1¼ in. wide, and the rails for the pillars are ⅝ in. and ¾ in., respectively, top and bottom. All are 1 in. thick when planed up. The sides are mitred to the bottom and the joint is tenoned—that is, a saw-cut is made on the edge of the corners when fitted, and a thin chip of wood is glued into the saw-cut, and left until set. This does not form a *very* strong joint, but, there being no strain in this case, it is strong enough for our purpose. Should any reader prefer a more solid joint, it is quite easy to have a hidden mortise and tenon-joint with the wedges inserted before driving home as usual. Care must be taken, however, that the cheeks of the mortise are not burst in driving home the tenon. The joints of the top cross-bars are made in this manner, but with the top rail there is no need to use wedges; the end pieces are merely sunk into the mortise, and firmly glued into position. The top ornament is now cut out with a fine saw, and glued on to the rail. The pillars (see Figs. 7 to 10) will now be turned and inserted before the frame is finally glued up. These are turned from ¾ in. stuff, and the holes into which their lugs are inserted are bored in such a manner as to allow of the rails being flush with the face of the work. The side uprights (Figs. 1 and 2) are next to be done. They are first to be planed true, 1½ in. square, then centred, and put into the lathe and turned to the design in the drawings, or to whatever fancy the turner prefers. The square pieces near the top must be left, however the lower part is turned, for the reason explained hereafter. The lower



Figs. 7, 8, 9, and 10.—Various Designs for Pillars.

end pin must be turned a perfect fit for the ¾ in. hole that is to be bored in the base, so that the uprights will be as steady as possible. Next we have the base (Fig. 4), which is comprised of two flat pieces, each 1 in. thick, of the shape shown in the drawings. The bottom piece is ¾ in. wider on three sides than the top one, and this ¾ in. projection is rounded off to form a nosing. Both may be shaped out, for sake of appearance, as shown, and, besides being glued, are screwed together from the underneath; but in the one I have made the pieces are left quite straight. I left them so in order that I might be able, after a time, to separate the two pieces that comprise the base, and, by inserting a thin piece on edge on each side and back, form a recess, and make a drawer to fit it, if ever I felt inclined to do so. When the base is done, we will bore the two ¾ in. holes, and glue the uprights into them. Use Jennings' double spur-bits; they make a very perfect hole. Be sure that the holes are bored quite square with the base. Now turn the feet (Fig. 11), and fix them on with a screw to each, countersinking for the screw-heads, and gluing them before finally screwing them home. The next thing now is to insert the glass into the frame; and as we have made the frame with an opening of the same size as the glass, we must tack on a narrow beading, of ¼ in. in thickness and about ⅜ in. wide, to the inner edge of the frame, to form a rebate to hold in the glass. These beadings will be rounded on the outer edges, and be mitred neatly into the corners and be set true, so that the glass will rest on all the four pieces evenly. They are to be glued and tacked into place, and, when finished, the glass is to be laid in and held in with a sheeting for a back made exactly a true fit, so that in driving the sprigs the back will not rub the silvering off by shifting. A clean piece of blotting-paper inserted between the glass and back is an improvement. All that remains now is to fix the frame to the uprights. This may be done with the ordinary knobs or with the ball-clamps, which is much the better plan. The square pieces at the top of the uprights are purposely left to sink the clamps into in this case; or in case the knobs are used, they form a kind of platform for the edge of the frame to work on—this latter arrangement, however,

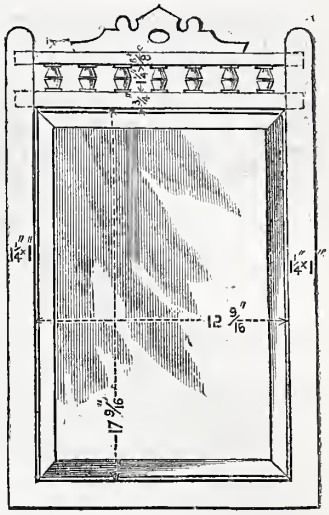


Fig. 3.

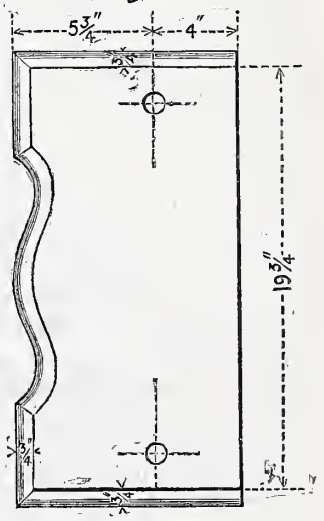


Fig. 4.

Fig. 3.—Frame. Fig. 4.—Base.

Fig. 6.—Perspective Sketch.

causes the paint to rub off—and a small thin brass washer on the screw is an improvement. Clean off all now with sand-paper, and give a coat of glue-size and two coats of Aspinall's hedge-sparrow egg tint, and we have a very pretty toilet glass indeed, the materials for which have cost us only about 5s.; or if with bevelled glass, 7s.

COUNTRY CARPENTRY.

BY CHOPSTICK.

Farmyard Gates: How to Make and Hang them.

Technical Names for the Various Parts of Farmyard Gate—Setting out Gate—Forms of Mortises and Tenons—Putting Gate Together—Hinges for Hanging—Hanging Gate—Staple and Pin Fastening—Automatic Latch and Catch.

The subject of this chapter is a very familiar one to the carpenter who has lived all his life in agricultural districts, and who has, most probably, made them by the dozen. To such I will only say: Pass it over, as you will not see anything fresh in it; but to those who have learnt their trade in a smoky town, and have drifted into the country, as a great many do from various causes, this chapter may be of some service; for if such an one were shown a pile of timber, and told to make it up into gates, some of each hand, he would find himself in a quandary without some instructions; and employers do not relish wasting time on instructing journeymen, and I am afraid that the apprentices nowadays have to do without it in too many cases.

Having said so much by way of introduction, I will show how to make those very necessary articles—farmyard gates. I think I had best give the technical term for each part, and hereafter throughout the chapter each part will be known by its own name—if a piece of timber can be said to have a name.

All the following are shown in Fig. 1: A, the "har;" B, the "beam;" C, the "head;" D, the "brace;" E, the "slits;" and F, the "downrights," or, as sometimes called, the "uprights." Gates are sometimes made with four slits, and sometimes five slits. The one I have drawn is a "four-slit" gate; and as the mode of procedure is the same in each case, the only difference being placing the slits closer together to make room for the extra one, my instructions must be taken as applying to the four-slit.

The part to commence on is the beam. This is usually about 9 ft. 6 in. long, 10 in. deep at the wide end, tapering to about 8½ in. or 9 in. at the "frank" (G, Fig. 1), which is about 33 in. from the end. The depth of the remainder of the length tapers from 5½ in. or 6 in. at the "frank" to 3½ in. at the small end. In thickness, the beam tapers from 3½ in. to 2¼ in. The first thing to do is to cut a tenon on the large end of beam. Here the iron square comes in useful, the 1 in. part being used to mark the distance of tenon from side of beam, and the 1¼ in. part being used for the tenon itself. The shoulders must also be squared off about 6 in. from end of beam. This tenon can be cut, and then the bottom of it cut off so as to form a taper tenon in width. (See dotted lines at H, Fig. 1, and also Fig. 2, which is a perspective sketch of the tenon we have been cutting.)

Some old-fashioned carpenters make the tenon taper in thickness as well as width; but this I consider a very bad plan, as in driving the gate together there is a danger of splitting the har, and with a wedge-shaped tenon I always think that the pins have too much responsibility on them. But this is a digression.

The large tenon on beam being finished, cut another one at the small end. This will only require to be ¾ in. shoulder and 1 in. tenon, and must be left parallel, not tapered. Now take the har (this is 4 ft. 6 in. long, 5½ in. by 3½ in.); lay it flat on the ground, and lay the tenon of beam on it, leaving about 7 in. of the har projecting above top of beam, and keeping the shoulder of tenon in close contact with edge of har; then mark along each side of tenon; remove beam and squaring over the marks on each edge of har; strike the mortises with the square in the same way as the tenon was marked; then bore three or four holes through, and knock out mortise, turning the har over and working from each side. Now bore two pin-holes (¾ in.) in the positions shown in Fig. 1, and fit the har and beam together. If all has been done correctly, they should fit on both sides, but it is a great chance if they are sawn exactly square; and if not, then one shoulder will be up before the other. If so, this one must be "saw-scarfed"—that is, the saw must be run in at the joint of beam and har. This must be continued until a good joint is obtained; but be careful and not run saw in beyond the shoulder, or you may find the tenon cut half-way through. The pin-holes should now be "pooked" for draw-boring (see first chapter of "Country Carpentry"), and leaving the beam and har still together, the head must be laid under the tenon on small end of beam, keeping it close up to the shoulder, and about 6 in. projecting above beam. Then mark the tenon across on the head in the same way as the har was marked, and, without moving any part of the gate, lay on the four slits. Place the bottom of the bottom slit 3 ft. 6 in. from top of beam at the har end, and 1 in. less at the head. Then even out the other three slits, leaving a space of 4 in. between first and second, 4½ in. between second and third, and 5½ in. between third and fourth, counting from the bottom. Now mark the length of slits. The bottom one should go through the head, and about 3 in. into the har; the other three should only go 1½ in. into each (see Fig. 1, dotted lines). The slits should now be numbered and taken off the gate, and the brace laid on in about the position shown in Fig. 1, though the exact position does not matter, some preferring to bring it forward nearly to the front end of the gate; but my opinion is that it should be at about an angle of 45°. Anything flatter than this reduces its utility—or, at least, I think so.

Whatever position it has to be in, it must be placed there, and lines marked on the *top*, as it lays, for the shoulders. The tenons being barefaced, it will require no shoulders underneath. A mark must also be made along each edge of brace on both beam and har, and then the whole can be knocked in pieces.

The har can now be finished. Square over each mark made on the side, across the inside edge, and draw a centre line up through. This will show where to bore for the slit mortises. These are simply two holes bored, and the wood knocked out between them. They are shown at I (Fig. 5).

The brace mortise, K (Fig. 5), must be done differently. Mark on thickness of brace for inside of mortise (this is usually 1½ in.), then mark off ¾ in. from that mark for the mortise itself. The top part of mortise must be sloped in to the same level as the brace will be when in its place, and which is shown by the mark made on side of har; but the bottom of mortise must be made in square with edge of har.

Of course, in speaking of top and bottom, I mean as it will be when the gate is hung, and not as it lays flat. A glance at dotted lines at K in Fig. 1 will help to make my meaning plainer.

When making the slit mortises in har, do not forget to make the bottom one in about 3½ in. and the other three about 1¾ in. The har can now be laid on one side, and the head mortised. This will be done in the same way, the mortise into which beam fits being set out the same as its corresponding tenon was, and knocked out square, from both sides, of course; also a pin-hole bored. The bottom slit mortise must be made through the head, but need only be knocked out between the two holes; and the remaining slit mortises only need to go in a full 1½ in. This finishes the head so far, and it can be laid aside with the har while the beam is got on with. The mortise for the brace is made in this in just the same way as in the har; so we will pass over it as done with, and proceed with the mortises for the downrights.

These are made the same as the slit mortises, but, as will be seen, the first and second from the har must be made at the back side of centre mark; otherwise, they will come in contact with the brace. The front one next the head can be made the front side of centre, so as to be on same side of gate as the brace is. Fig. 1 and Fig. 6 (which is a plan of under side of beam) will explain what I mean. A ¾ in. hole must be bored through the brace mortise to take pin, and then the brace itself can be taken in hand. The shoulders of this are already marked at each end. The brace can be cut off about 2 in. longer than these, and to the same bevel, and the tenons struck from the opposite side to the shoulder marks. They can then be cut, and the extreme point cut off square with the shoulders. (See Fig. 3, which shows one end of brace with tenon cut.)

The "frank" of beam can now be finished. The usual shape to make it is shown in Fig. 4, though sometimes it is simply rounded off. It really does not matter which way it is done, but the "O.G.," as Fig. 4, looks the best, and it can be easily struck out with the compasses.

The tops of head and har can now be cut. For the former, square a mark all round, 4 in. above mortise, and another 1 in. above that. Then make diagonal marks from the centre of the latter to the outside of the former, and cut the pieces outside these marks off. Then centre the thickness, and mark and cut again. This forms a point in the centre, and looks very neat. The har can be done in the same way, except that it must be left 1 in. longer, and the point can be made 1½ in. high instead of 1 in.

Fig. 7 shows the top of har finished in this way. The beam, har, head, and brace must now be chamfered on the corners, as shown in Fig. 5, and more clearly in Fig. 7, stopping it neatly at the ends, and also where the various parts come together, as shown. The brace will only want chamfering on one side, as the slits come to the other side. The drawing-knife is the proper tool to do this chamfering with, and, if necessary, a smoothing-plane can be used to finish with. The latter tool should also be run along

each corner of the slits, to take off the sharp edges. The pin-holes should now be made in the tenons of the beam and brace, allowing proper draught, so that the pins will pull up the joints, and the gate can be put together.

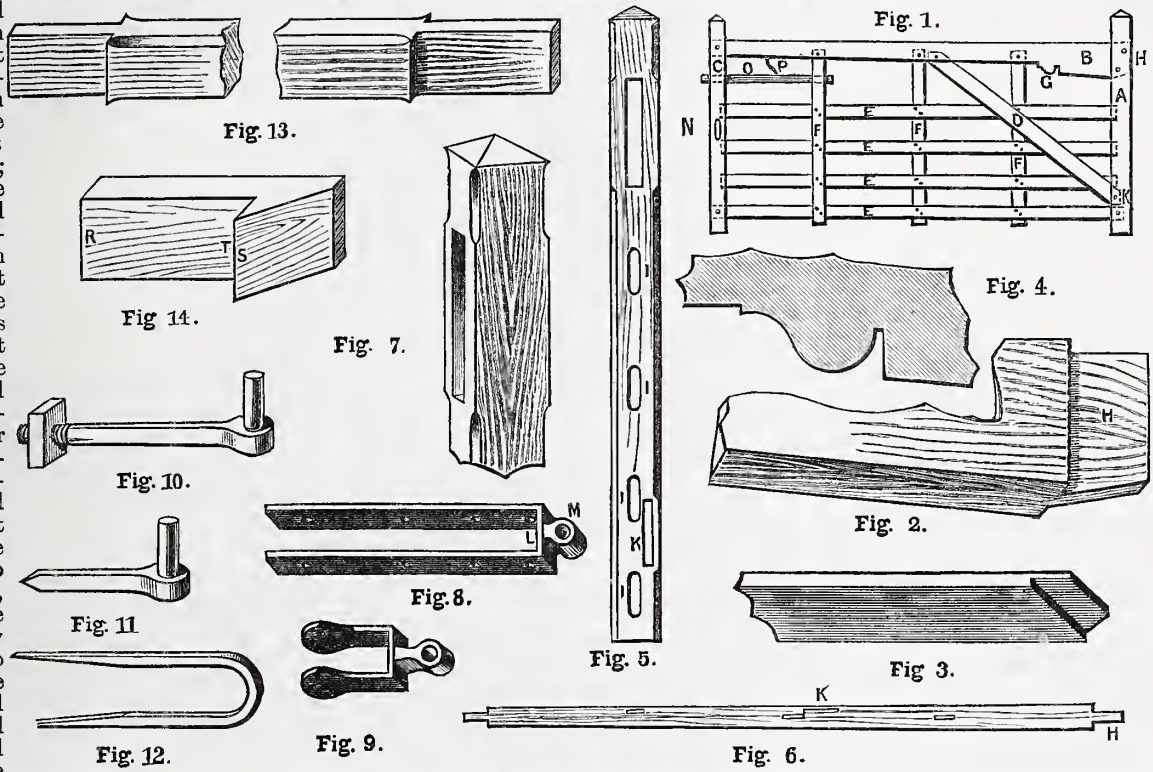
To do this, first drive the har on to the beam, putting in the brace and driving it up at the same time. These three pieces can then be pinned together, after which the slits must be driven in, and finally the head driven on. A $\frac{3}{4}$ in. hole must be bored through both har and head, and a pin inserted to hold bottom slit. The three downrights can then be driven in and pinned, and two nails driven in at each place where they cross the slits, and well clinched. Both slits and downrights must also be nailed well to the brace.

The head and har can now be cut off 3 in. below bottom slit, and the downrights 2 in. below; and the pins and ends of tenons which project through the mortises being cut off, the gate may be said to be finished as far as the making is concerned, and the next thing to be done is to hang it, which we will now proceed to do. The hinges used are called hooks and rides. The hooks are shown in Fig. 10 (the top one) and Fig. 11 (the bottom), and the rides in Fig. 8 (the top) and Fig. 9 (the bottom). The top ride is fixed first, along near the top of beam, the part marked L (Fig. 8) fitting close up to har. Holes are then bored in beam and har corresponding with the bolt-holes in the ride, and the bolts being inserted, the fixing is complete. The gate is then blocked up against the posts in the position it has to occupy, and a hole bored in the post just under the eye (M, Fig. 8) to fit the hook (Fig. 10). This hook can then be put in and screwed up, and the gate hung on. The bottom ride (Fig. 9) can then be put on the har at about 3 in. from the bottom, but not nailed, and a hole for bottom hook is then bored in the post, and the hook driven in. The gate can now be tried, and if it swings correctly and is the right height (the front should be about 3 in. higher than the back), the bottom ride can be nailed; but if the gate requires raising or lowering at the front, it can be easily done by placing a small block between har and bottom ride in the former case, or cutting a small piece out of har in the latter case. By this means any little mistake in boring for the hooks can be easily rectified.

The gate now requires a fastening. For farmyard gates there is no better one than a large staple (as Fig. 12) driven into post, and a mortise made in head of gate to slide over it (N, Fig. 1). An iron pin, being fixed to gate with a short piece of chain, is then passed through, and there is no chance of cattle opening it.

Another method of fastening is shown at O (Fig. 1), which, if made properly, has the merit of acting automatically. A mortise is made through head of gate, midway between beam and top slit, and a short piece of board nailed on to beam and first slit, opposite the front downright, thus forming a slot the thickness of the slit. A piece of wood long enough to project, as shown at O (Fig. 1), and about 2 in. by $1\frac{1}{2}$ in., is then taken, and a tenon cut on each end small enough to slide easily in the slot before mentioned. The distance between shoulders being about 2 in. shorter than the distance between the head of gate and the first downright, the edges must also be chamfered off, as shown in Fig. 13, which also shows the tenons. This is then placed in the mortise and slot made for it, and hung there with a short piece of chain and staples, as shown at P (Fig. 1). A wood catch is then made, as Fig. 14, and the part R mortised into post, so that the gate will just close without the catch, S, touching the head. If the gate is now allowed to fall to, the bevelled part of catch, S, will force the piece, O, back until it is past the catch, when it will fall forward into T and fasten the gate. In order to ensure this fastener working right, the chain, P, must be placed on the bevel, as shown, thus giving the handle a good fall. If this is attended to, it will always act properly. There are other methods of fastening, and also other kinds of hinges in use, but I have shown those most common, and the others will be easy enough to get at if required.

In my next paper I will show some other simple forms of farm gates and how to make them.



Farmyard Gates. Fig. 1.—Elevation of Farm Gate. Fig. 2.—Shape of Tenon of Beam. Fig. 3.—Shape of Tenon of Brace. Fig. 4.—Shape of O.G. worked on "Frank." Fig. 5.—Edge of Har, showing Mortises and Chamfers. Fig. 6.—Plan of Under Side of Beam, showing Mortises for Downrights and Brace. Fig. 7.—Sketch of Top End of Har, showing Method of cutting Top and also Chamfers. Fig. 8.—Top Ride. Fig. 9.—Bottom Ride. Fig. 10.—Top Hook. Fig. 11.—Bottom Hook. Fig. 12.—Staple for Fastening. Fig. 13.—Sketch of Alternative Form of Fastening. Fig. 14.—Catch for ditto. References to Letters—A, Har of Gate; B, Beam of Gate; C, Head of Gate; D, Brace of Gate; E, Slits of Gate; F, Downrights of Gate; G, "Frank;" H, Tenon on Beam; I, Mortises for Slits; K, Mortises for Brace; L, Part of Ride to fit against Har; M, Eye of Ride; N, Mortise in Head for Staple Fastener; O, Bar of Automatic Fastener; P, Chain forming Fall for ditto; R, End of Catch to fix in Post; S, Bevel of Catch; T, Notch of Catch which holds O.

CEMENTS.

The following recipes will be found useful to many of our workers:—

Cement of Pompeii, or Universal Cement.—Dissolve 8 oz. of sugar in 24 oz. of water in a glass flask on a water bath, and to the thin syrup add 2 oz. of slaked lime. Keep the mixture at a temperature of about 70–75° C. for three days, shaking frequently; then cool, and decant the clear liquor. Dilute $6\frac{1}{2}$ oz. of this liquor with as much water, and in the mixture steep 16 oz. of fine gelatine for three hours after heating, to effect solution. Finally, add to the mixture $1\frac{1}{2}$ oz. of glacial acetic acid and 15 grs. of pure carbolic acid. The latter will serve as a preservative.

Diamond Cement.—Fine gelatine, 5 oz.; water, 4 oz.; glacial acetic acid, 1 oz. Let these stand together for several hours; then heat, to effect solution, and add 10 grs. of carbolic acid to preserve the cement.

Liquid Glue (Sydetikon).—For this use 4 parts of the above-mentioned saccharated solution of lime, and dissolve 6 parts of glue or gelatine in it, as there directed. Then neutralise the lime with a third part of oxalic acid, and add carbolic acid in the above-mentioned proportion, as a preservative.

Cement for Porcelain.—Twenty parts of white-lead and 12 parts of pipeclay, carefully dried, are incorporated with 10 parts of boiled linseed oil, heated on a water-bath. The cemented articles are dried slowly in a warm place.

TRADE: PRESENT AND FUTURE.

**** Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

FLANNEL TRADE.—One firm in the Rochdale district having given notice of a reduction in wages, the operatives threatened to come out on strike unless it was withdrawn. This the firm declined to do, and the consequence is that about 120 weavers are out, about half of which number belong to the Weavers' Association. This is the only case of dispute in this trade in the district.

ENGINEERING TRADE.—The prospects for the new year, so far as the Lancashire section of the engineering trade is concerned, are not of the brightest. Boiler makers are somewhat better off for work than they have been for some time, but they complain greatly of the new railway rates, which, in many cases, represents as much as 30 per cent. increase in cost of carriage. As a set-off, they intend to form a syndicate for purchasing a steamer to carry boilers and heavy work. Stationary builders continue fairly busy, but in most other branches continued scarcity of orders is reported.

IRON TRADE.—There is little business doing in the iron trade of the Lancashire district, but prices still exhibit a tendency to harden. For good foundry brands 46s. is being quoted.

STEEL TRADE.—Raw material remains low in price, and ordinary foundry qualities in hematites do not reach more than 55s. 6d., and steel billets £4 6s. 6d. In manufactured steel, however, a decided hardening tendency is noticeable, and £6 12s. 6d. now represents the average price for good boiler-making qualities.

COTTON TRADE.—The somewhat improved outlook in the cotton trade has led to the consideration of the situation by the masters. It is suggested that reduced wages and short time shall be accepted until the condition of trade warrants a return to the previously existing rates. There are signs that the crisis is coming to an end. The situation may be summarised as follows: The masters say, "There is no profit in the business; we must reduce wages. You men are well paid, and can easily afford to work for a little less in order to keep the trade going." The men say, "We admit that we are well paid; but if you reduce our wages the saving will be infinitesimal, and you will have to reduce the price of yarn in corresponding ratio, and neither masters nor men will gain thereby. Reduce the output—work three days a week; prices will harden, and all will be well." The masters reply, "We cannot afford to run our mills three days a week. The standing expenses—rent, rates, interest on capital, managers' and other salaries, etc. etc.—all go on as usual. It really cannot be done." The compromise is likely to be as follows: The men will work at the reduced rate for three days a week, until stocks are sufficiently clear to enable full time to be run at the old rate. The contest has been conducted with the utmost good feeling and propriety on both sides. The operative spinners are well able to hold out for a lengthy period, but, in view of the distressful condition to which the card-room hands and other members of the trade, out of the union, are reduced, they are willing to strain a point: an evidence of sympathy with their fellow-workmen which should be noted by other trades.

IVORY TRADE.—Owing to the increasing scarcity of ivory, manufacturers are putting on the market quantities of plated knife handles, known in the trade as "solid-handled, hard-soldered" work, which are being made to carry steel blades. These present a most durable appearance, and for ships, hotels, and restaurants are serviceable. They are, however, inferior to ivory or whole handles of any description. The tone of the ivory market for 1892 has been much firmer, yet the uncertainty which attends the acquisition of a supply sufficient to meet the great demand is such that manufacturing cutlers will have to look for a substitute in order to make themselves safe from possible surprises, as ivory is in increasing request.

BOOT AND SHOE TRADE.—The handsewn bootmakers at Northampton and district have commenced the year 1893 under most favourable circumstances. A new statement of wages to be paid has been adopted jointly by masters and men, which gives an increased wage to the worker, and the master has an equivalent in more uniformity in the different classes of work, and thereby has the beneficial effect of weeding out the unscrupulous manufacturer who could hitherto, through want of uniformity, undersell the manufacturer who acted fairly with his *employés*.

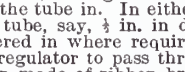
SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

**** In consequence of the great pressure upon the "Shop" columns of* WORK, *contributors are requested to be brief and concise in all questions and replies, which will in future be dealt with week by week as received.*

I.—LETTERS FROM CORRESPONDENTS.

White Bricks.—A READER.—It is a very difficult matter to remove stains from white brickwork, especially if they have been on for any length of time. You must first have the gutter cleaned out and the joints made watertight; then scrub the stains with a brush, soap and water, and wash off. If this does not remove all, rub the face of the stained bricks with a soft brick of the same kind, using alum water, but do not wash off. If this, when dry, is not the colour of the other bricks, there will be nothing but painting. The paint should be mixed with turpentine, and the bricks should also be dry when the paint is laid on. It will be advisable, in either case, to try a few bricks at first, and allow them to dry, to see the effect before doing the whole. The alum water should be kept from the joints. See that the downpipes are clear, as, if stopped, they will cause the water to overflow.—M.

Incubator.—F. B. (*King's Heath*).—Your machine is known as the "British Farmers' Incubator," and is supposed to need no regulator. An incubator without one is, however, an expensive toy. From its construction it is somewhat difficult to adapt my regulator, unless you have two egg-trays, and room between to stand a glass tube. If so, see my article in No. 143, on "An Atmospheric Incubator." If this will not do, Durnford's regulator might, perhaps, suit you. In this case, you will need to lengthen the flue where the lamp enters, making it this shape:  , so that the heat, when the temperature rises above a given point, may pass straight away, instead of going through the tank; or you might ventilate the egg chamber by making a tube about 2½ in. in diameter, long enough to reach from 1 in. above top of case to ½ in. below the bottom of tank, cutting a hole through the tank and soldering the tube in. In either case, you will need another tube, say, ½ in. in diameter, which must be soldered in where required to allow the lifting-rod of regulator to pass through. You also want a damper, made of ribbon brass, fixed across top of case in a line with the centres of the tubes fixed, working on knife-edges at a point about 1 in. beyond the small tube on the side farthest from the large one. At one end a circular flange of sheet metal must be fixed to cover the large tube, and a suitable balance weight adjusted at the other end, allowing the flange end to be slightly the heavier of the two. When the heat rises beyond its limit, the regulator-rod will rise and lift the damper, thus allowing the lamp heat to pass straight away, or, if the second plan is followed, allowing a current of air to pass through the egg chamber.—LEGHORN.

The Disposal of Town Refuse.—J. T. (*Bishop Auckland*) writes:—"The disposal of town refuse is a problem which, in many towns, will have to be dealt with in the near future. It has been an almost general custom to cart it on to the land within a distance of two or three miles, but, owing to the accumulations and to the rough nature of the material, farmers are declining to take it. In districts where coal is cheap, a good many cinders are thrown out which might be burnt. A grating might be fixed in front of the kitchen fire, over which all the ashes might be passed, the finer portion falling through, and the rougher being burnt again; or, where this is not practicable, a screen could be fixed over the dustbin, and the ashes passed over it—the cinders falling into a box from the screen to be reburnt. In some towns 'destructors' are being used. These consist of large furnaces connected to a tall chimney for inducing a draught and carrying off the burning fumes. The furnaces are fed through an opening in the top, regulated by a door. The material burns to a slag or clinker, which is ground and used for mixing with concrete, or for road-making or ballasting. Another method is to grind the material to powder in a disintegrator, which makes it suitable for use as a manure. It has been found, from experiments, that the cost of grinding is about 6d. per ton. To this must be added the cost of carting to the machine, interest and depreciation on the plant; but if a market can be found for the material, at a considerably less price than any artificial manures in use at present, this method would yield a profit; it might also be mixed with chemicals to suit different kinds of crops."

Circular Saws.—A. R. (*Scorrier*) writes to A NEW READER:—"It is not true that four high teeth in a circular saw, the difference being but little, will cause it to run out of truth. Experience teaches me that a saw may run perfectly true with even eight or nine or more high teeth on one side (or range, as we term it), while another saw may, with four or five high teeth, deviate from a true path. (1) *The Diameter of Saw.*—A NEW READER will know that a circular saw, with the exception of the packing, is self-supporting. Therefore a saw, say, 50 in. diameter, with the same number of high teeth, will deviate from a true path quicker than a saw of half that diameter—the distance from point of teeth to centre of saw being greater, and having to pass through a greater depth of timber. (2) *The Thickness of Saw.*—Two saws may be of the same diameter and driven at the same speed, both having the same number of high teeth on one range. One saw is of No. 11 gauge, the other of No. 9 gauge. While the latter is running quite true, the one of No. 11 gauge runs out of truth; for the simple reason that the stouter saw requires more friction to heat it similarly to the thinner saw, and, being stouter, the high teeth do not have the same effect on the saw plates. (3) *Space of Teeth.*—A saw with teeth 3 in. from point to point, same gauge, diameter, etc., will draw thick or thin, as the case may be, while one with teeth 2 in. apart will be running perfectly true. In the one saw sixty teeth are passing through the timber; in the other ninety teeth pass through. The lesser number having the same amount of work to do in the same time, consequently, will be more liable in this saw to run out of truth. (4) *The Bevel and Rake of Teeth.*—Two saws may be of the same diameter, etc. The rake and bevel of teeth in one may be more than in the other. The saw having the teeth with most rake and bevel, and the same number of high teeth, will deviate from a true path while the other may be running quite true—the cut being so much faster in one than in the other. (5) *The Speed of Saw.*—A saw with high teeth, at a speed of 6,000 ft. per minute, may be running perfectly true, but if increased to the standard speed of 9,000 ft. per minute will at once run out of truth. Again, a saw of a certain gauge at a speed of 6,000 ft. may run out of truth, while one of stouter gauge at same speed will run true, both having the same number of high teeth. (6) *How the Saw has been Packed.*—This is a very important point. If a saw is not properly packed it will be liable to run out of truth, whether the teeth are uniform in length or not. A saw may be so packed that, with several high teeth, it will run for a while perfectly true; or it may be so packed that it will run out of truth as soon as set to work, with rake, bevel, etc., of teeth uniform. Therefore, it will be seen that care has to be taken in the packing, as well as in the sharpening, of a circular saw. If a large number of high teeth are one side, the saw will run out of truth. My advice is that the teeth be kept as uniform in length, etc., as possible. A saw that is being worked time after time with high teeth will soon become crippled, the high teeth causing undue strain on the saw-plate. Very thick saws are often preferred by sawyers, because so much care is not needed in their working and sharpening as with thinner ones. The teeth should be kept at uniform length by holding a piece of medium hard grindstone against the teeth while the saw is revolving, so grinding off all high points. When all the teeth have been touched with stone, the saw will be round. File top of teeth carefully until places caused by the stone disappear."

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Bootmakers' Drag Knives, etc.—AMATEUR.—Your best plan is to get a set of kit files, or one or two half-round fine files, and when your knives get blunt take them out of their holders and file them on the concave side, holding them firm in the pincers or vice, with the cutting edge towards you, and taking strokes with the file in a direction from you, holding the file very flat upon the blade, so as not to make it thick. This can be done with a medium file and then repeated with a very fine one. If you do not let them get too unfit, you may be able to dispense with the files and only use the following, which, if the files are used, must be resorted to as finishing touches:—Take about a foot of a thin broom handle, and paste a piece of fine emery cloth round the centre, about five or six inches wide; this will leave about three inches each end to form the bandles. This you use in the same way as stated above for the files, and will be handy as it has a handle each end. This is best for heel shaves, while an edge knife would need a finer stick. To finish, a stone must be used to give them a keen edge, but, as you say, "they cannot be laid flat upon it," therefore you must make the stone round, to suit the knives, and use that as above stated. The judge-wheel and seat-wheel are slightly heated before use, and the parts that they are going to be used upon should just be damped a little first, more particularly where the judge is about to be used, and you should use these tools very firmly and steadily, pushing them and bearing upon them with the same pressure the whole time they are in use.—W. G.

Welding Cast Steel.—TOM DOCTOR.—Fluxes, composed of ground bottle-glass and fine sand, and of finely powdered limestone or marble, are used in welding cast steel. The steel must be heated in a clear fire to a creamy heat, and kept from burning by a frequent application of the flux.—G. E. B.

Bronzing Iron Frames.—TWO YEARS' SUBSCRIBER.—It will be necessary to first fill up all minute holes and prevent suction either by giving a coat of paint, or, if a better result is desired, mix whiting with patent size, and give several coats, allowing it to dry between each coat, and smoothing down with fine glass-paper. A coat of japanners' gold size is then generally given as a medium for fixing the bronze; but as bronze applied thus will soon tarnish, which you wish to avoid, I would advise giving a coat of copal varnish instead. When this is just tacky to the touch, apply the bronze powder by means of a piece of new washleather, camel's-hair brush, or wadding. When all is dry, you may still further prevent it from tarnishing by giving a coat of parchment size or clear varnish.

The former is made by dissolving parchment cuttings in warm water till it forms a jelly when cold. By the way, a cheap, quick method is to mix the bronze powder with French polish or spirit varnish and apply with a brush like paint.—LIFEBOAT.

Ebonising Wood.—TWO YEARS' SUBSCRIBER.—Use any of the ebony stains as advised in "Shop," Vol. III., p. 332. When smoothing down any black work, use a little linseed oil on the face of the glass-paper. Mix a little vegetable or common black with the "filling in," and when "hodying up" use a little gas black or Frankfort black in the polish, which, for black work, should be what is called white or transparent, made by dissolving white shellac in methylated spirits, taking the precaution to well crush and dry the gum before adding the spirits. Finish off with clear polish, without any black.—LIFEBOAT.

Gassner Dry Battery.—R. S. (*Felixstowe*).—The outer zinc case may be of any shape or size, but should be proportioned to the height and shape of the carbon element employed therein. The thickness of the zinc may vary from $\frac{1}{16}$ in. to $\frac{1}{8}$ in., or may be thinner than $\frac{1}{16}$ in. if preferred. It should be best rolled Belgian zinc plate, and the case must be made watertight. In the ordinary size of Gassner cell, the case has a height of 7 in., and a diameter of 3 in. A glass disc is placed in the zinc case, and coated with melted paraffin. On this insulated false bottom rests the cylinder of specially prepared porous carbon. The space between the outer sides of this cylinder, and the inner sides of the zinc case, is packed with the depolarising mixture of zinc oxide, lime sulphate, ammonium chloride, etc., which forms the subject of the Gassner patent.—G. E. B.

Electric Light Installation.—H. McD. (*Glasgow*).—(1) To replace the gas lights in your two rooms with electric lights of equivalent lighting power, you will require, in the room 12×12×10, an electrolier of three 8 c.-p. lamps, or three brackets with the same number of lamps, one on each bracket. In the room 14×12×10 you should have an electrolier of three 8 c.-p. lamps in place of the gaselier, and a 16 c.-p. lamp on a bracket, or two 8 c.-p. lamps on two brackets, to replace the No. 5 burner at present in use. (2) If you employ 25 volt lamps, you will require a current of 8 ampères, at a pressure of 25 volts, to keep the lamps all alight at once. (3) The 200 watts of current required may be supplied from a Gramme or a Manchester dynamo direct, driven by ½ h.-p. gas engine, or it may be furnished by thirteen accumulator cells of the E.P.S. L type, charged with current from the dynamo during the day, and used to light the lamps at night. I have recently had the pleasure of inspecting a private installation in a gentleman's house, fitted up by this method with electric lights. The gas engine and dynamo are in a small shed at the bottom of the garden, and cables lead from this to another shed near the house, containing the accumulators. These are charged by running the engine for a few hours twice or thrice in the week, and are switched on at night to the lamps. The installation gives great satisfaction, and has been running for sixteen months at very little cost. (4) The Gramme or Manchester dynamos will be superior to the Siemens for this purpose. In ordering the castings, state fully your requirements, and then they will be sent of a size suitable to the work. You will need about 4 lbs. of No. 16 cotton-covered wire, and from 8 lbs. to 10 lbs. of cotton-covered No. 22 wire. The larger size enclosed in your letter is No. 22, and this will do to go on the fields if coated well with paraffin. The smaller size is No. 25, and is too small to be of use in this work. The castings may cost 35s. If you order them from Mr. Bottone, he will give you instructions respecting the quantity and size of wire for winding the machine.—G. E. B.

Armature for Dynamo.—H. J. C. (*Uxbridge*).—You should have no difficulty in getting laminated iron punchings for an armature to go in a tunnel 3½ in. by 6 in. Write to Mr. Bottone, Wallington, Surrey, and state the case to him. He will, probably, be able to furnish you with the requisite number of punchings for either a Siemens H or a drum armature. The number required to make up the length are strung on the spindle of the armature, and held together by nuts on each end of the spindle. When these are tightened, the whole may be turned down in a lathe if the diameter is too full. With a Siemens H armature you will only require a two-part commutator. With a drum armature you must have as many parts on the commutator as you have coils on the armature. In winding a drum, some six, eight, ten, or more separate coils are wound over the discs side by side. Get some coloured cottons or silks, and tie the ends of each coil with a scrap of separate colour. When all are wound, connect the finish end of one coil to the starting end of its neighbour on the same bar. The coloured scraps of cotton or of silk will aid you in locating the right ends.—G. E. B.

Incubator.—E. B. (*Leicester*).—It is a vexed point as to whether help should not be given at hatching time to chicks unable to extricate themselves from their shells, but for my own part I always give it, although I believe it is only the weaklings that need it, and consequently they are not so robust as those which require no help. I prefer to keep the temperature the same throughout the whole period. The size of tube is immaterial, provided there is a sufficient surface of mercury presented to the float to overcome the small amount of dead weight there is in the damper. The larger, up to a certain point, the better, but it should not be less than ¾ in. At hatching time the live chicks can easily be distinguished by placing them in warm water as advised. If they are not out twenty-four hours after, chip the shell slightly and remove gradually.—LEGHORN.

Wardrobe.—NIL DESPERANDUM.—(1) Three feet or 3 ft. 6 in., as preferred. (2) Fig. 1 will explain, in plan, how to unite the frame to adjoining horizontal boards; and Fig. 2 further assists understanding by representing a front view of the frame. (3) Yes; satin-walnut is very suitable. (4) Yes; you should experience no difficulty in getting wood the desired width.—J. S.

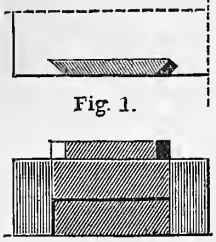


Fig. 1.

Fig. 2

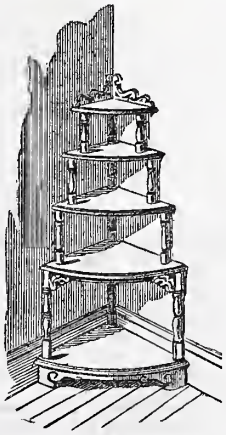
Fig. 1.—Method of joining Frame to Horizontal Boards. Fig. 2.—Front View of Frame.

Electric Indicator.—H. W. R. (*Kilburn*).—An electrical indicator, with mechanical replacement, is described and illustrated in No. 20, Vol. I., at p. 313. Mr. Dale is now doing business in Dyer's Buildings, Holborn.—G. E. B.

Carved Furniture Designs.—E. C. J. (*Kyneton, Victoria*).—By all means send your articles on approval. We shall be glad to peruse your MSS.—ED. WORK.

Parts of Electric Battery.—CONSTANT READER.—If you do not know of any druggist or metal dealer in Penzance who will get the parts of electric or galvanic batteries for you, send to a dealer in London or other large town, and have them forwarded to you by rail.—G. E. B.

Whatnot.—L. G. (*Bradford*).—This sketch will, I daresay, be sufficient for your requirements. The radii of shelves are from 8 in. to 20 in., and the total height is 4 ft. 6 in. The shelves should be fixed at graduated heights to taste, and supported on 1 in. turned posts.—F. J.



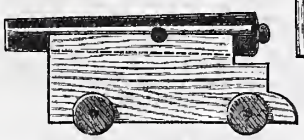
Whatnot for Corner.

Electro-motor for Yacht.—F. J. H. (*Stoke Newington*).—I am afraid you will not find the little electro-motor described on p. 783, in No. 154, Vol. III., of WORK, sufficiently powerful to drive a model yacht 3 ft. long. The nearest thing described in WORK is the model motor mentioned in No. 108, Vol. III. Even this would be scarcely suitable to the purpose, as it has only a two-part commutator, and, therefore, would be liable to stop on a dead centre. You want a motor with a six-part commutator, such as those made by Messrs. King, Mendham & Co., and this should be connected direct to the propeller shaft and furnished with a thrust block. We have not described in WORK such a thing as you require.—G. E. B.

Electric Bell Maker.—J. H. W. (*Halifax*).—Good electric bells at reasonable prices are obtainable from the Electric Stores, London.—G. E. B.

Carriage for Model Cannon.—In answer to your letter it seems the cannon for which you require design for carriage must be a fortress or ship gun, as it is too heavy for a field gun. Fig. 1 is an illustration of the kind of wooden carriage on which model cannons are generally mounted. As you know the length of the cannon, you can easily calculate the sizes of the various parts of the carriage. It is chopped out of a block of oak or boxwood, and is furnished with four wheels and a wedge, which latter is used for levelling the cannon, and is attached to the carriage by a small length of chain. Fig. 2 is a section of the front of the carriage.—R. W. C.

Fig. 1



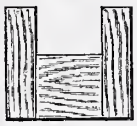


Fig. 2

Fig. 1.—Side View of Carriage. Fig. 2.—Front View.

Wire Coupler.—A. E. N. (*Broadstairs*).—Wilcox's patent wire coupler is an American invention, but it is to be had of G. N. Marsh, 29, Temple Street, Bristol.—B. A. B.

Clock Materials.—J. J. J. (*Morriston*).—I find Messrs. Haswell & Sons, 49 and 50, Spencer Street, Clerkenwell, and Messrs. Grimshaw & Co., 35, Goswell Road, Clerkenwell, E.C., very good; but if you require trains, castings, forgings, etc., of clocks only, then J. Mayes, 55, Red Lion Street, Clerkenwell, would probably be the best, as he makes a speciality of them.—A. B. C.

Incubator.—M. F. (*Oldham*).—The disc R D (Query R D D) (see No. 143, p. 609) is "not made to radiate;" it serves to radiate the heat passing up the lamp flue against the sides, and thus to heat the water contained in evaporating-tray. The thickness of the rod R R may be about the substance of a fine knitting-needle, which article will answer very well for the purpose, although brass or copper would be preferable.—LEGHORN.

Bevelled Plate.—A. B. C. (*Alnwick*).—You could certainly get the pieces of bevelled plate-glass through a cabinet-maker, but nearly any of the glass manufacturers would supply you. As to cost, it is difficult to say; there are at least four qualities of glass, and the price varies on each of these for nearly every superficial foot; again, bevels run from ½ in. by eighths up to about 2 in., and not only is a different price charged for each, but it varies according as the glass is small, large, or medium; so you see it is nearly impossible to give you an idea of the cost without knowing full particulars.—W. E. D., JR.

Motor Connections.—S. T. (*Londonderry*).—As to connecting up the small model motor in Vol. III., No. 154, with a battery, you will, doubtless, before seeing this, have noticed answers to other correspondents upon the same subject.—J. B.

German Silver Tubing.—F. S. B. (*Queensbury*).—German silver tube of any diameter can be procured from Messrs. Smith, metal merchants, St. John's Square, Clerkenwell.—G.

Organette Paper.—HARRISON.—I think you would obtain the paper you require for American organette from Brown, Brough & Co., Warwick Lane, City.—G.

Polish, Varnish, and Bookcase.—NEVER SATISFIED.—(1) French polish is made by dissolving about 6 oz. of shellac in 1 pint of rectified naphtha or methylated spirits. If the work is to be done in the domestic workshop, the latter is the most agreeable; in cold damp weather or cold shop use the naphtha. If you get the best orange shellac—the cheaper are dark-coloured—you will have a light-coloured polish suitable for most purposes; but for the white woods, such as holly and sycamore, you will require white shellac. This gives a semi-transparent polish, but is more difficult to make. The shellac, being kept in water, must be crushed up fine, spread on paper, and allowed to stand in the sun or in a warm room till dry, previous to adding the methylated spirits. (2) Varnish is made by adding to the polish something to make it brighter and stronger. It is generally sufficient to add to each pint of polish 2 oz. or 3 oz. of gum benzoin, or if a cheaper varnish is preferred, a small quantity of resin is added instead. I do not advise the making of varnish in small quantities; I would rather advise you to go to a respectable oil and colour merchant's (not chemist's), and buy some best brown hard spirit varnish. This may be used alone; but if you use equal parts of this and polish of either kind, you will have a varnish suitable for all practical purposes. (3) The red and brown stains and varnish, as used on walking-sticks, etc., have already been given in "Shop." (See No. 131, p. 429, Vol. III.) (4) The size you give for a bookcase—2 ft. 6 in. by 2 ft.—is not a suitable one to stand on the floor; it is more the size of a hanging bookcase. Have you seen the design in No. 44 for "Our Prize Bookcase?" If not, I strongly advise you to get it, as you want one with a fair amount of work in it. You will have there a design sure to please, with details of size and construction. By omitting the shelves at the sides and bottom, using only the centre portion, and adding a plinth at the bottom about 4 in. deep, you will have a design for one to stand on the floor.—LIFEBOAT.

Tin Goods.—MAC.—You can obtain tin goods of excellent quality from either of the following firms: Wilson & Co., Wardour Street, London; Henry Loveridge & Sons, Merridale Works, Wolverhampton; Perry & Co., Limited, Wolverhampton; S. H. Hopkins & Sons, Granville Works, Birmingham. If you state requirements, no doubt the firms will give you their terms.—R. A.

Copper and Zinc Plates.—H. Y. W. (*Bromley*).—To polish copper and zinc plates has not as yet been successfully accomplished by machinery as far as getting them up to a *true surface* goes. Whatever machine method is to be employed, it must be a *grinding* one. First anneal the plates, if copper, and pass them through a pair of rolls; this will take out all the buckling, but will impart a slight sweep to them. This can be taken out by putting them through another pair of rolls; this will make the plate perfectly flat. Now make a similar arrangement of machine that you can see at any plate-glass works for grinding plate glass. These lapidary machines have scrubbers similar in shape to those shown in the figure, but a number of them all geared to one another; the scrubbers in this case to be made of good chilled cast iron, and fine flour emery to be used to grind up the surface. You will better see what I mean if you pay a visit to any large plate-glass works; there the scrubbers are made of copper, but in your case they will have to be made of good chilled cast iron.

The experiment is decidedly worth while trying first on a small scale, and I may say that I shall take great pleasure in giving you any assistance that I am able.—T. R. B.

Electric Lamps for Shop.—W. W. (*Gravesend*).—A butcher in my neighbourhood has fitted his shop with electric lights supplied with current from a dynamo driven by a gas engine. The shop-front is illuminated by a fine arc lamp, and the interior by a number of 16 c.-p. incandescent lamps. He has done all the work himself. You may do likewise. Your shop will require lamps giving a total light of at least 180 c.-p. These will absorb nearly 1 h.-p. to drive the dynamo. If you use a gas engine for other purposes during the day, you may use it for the lights at night.—G. E. B.

Salt for Electric Battery.—READER.—A piece of flannel, or blotting-paper, or similar bibulous substance, dipped in a solution of any salt, and placed between a plate of copper and a plate of zinc, gives evidence of an electric current. Common table salt is as good as any for this purpose. Sal-ammoniac is also a good salt to use in an imitation voltaic pile.—G. E. B.

Electric Light Engineering.—MOTOR.—My reply to SUSPENSE, on p. 300, No. 175, gives a few ideas respecting the steps to be taken in qualifying for an electrical engineer. Replying to your question, if you wish to increase the voltage without altering the machine, drive the armature at a higher speed, but the alteration in speed would be very great to raise the voltage from 10 to 35 volts.—G. E. B.

Japanning Tea Urns.—G. H. (*Oldham*).—Please state wants more definitely. The most suitable colour certainly depends on the owner's taste.

Paint for Glass of Conservatory.—W. H. (*Plaistow*).—For the purpose of partially obscuring the light in a conservatory, I would recommend zinc white (ground) mixed with turps and gold size—about equal parts of the two latter. Add sufficient brunswick green to give the colour a faint tint of green; this will be found an agreeable tone, although the smell is rather disagreeable for a few days. Great care should be taken to see that the glass is perfectly dry at the time of painting, or the paint will not adhere; neither should the paint be put on thick enough to blister; it dries very quickly with a dead surface.—C. M. W.

Paint for Damp Walls.—D. P. (*Birstall*).—Whether brick or plaster surfaced, nothing can eradicate the evil of a damp wall save the removal of the primary cause. The two only cures are: *external*, slating (assuming the shuting and roof have been thoroughly overhauled); and *internal*, matchboarding. The former, of course, is wisest. Cement facing to a wall is seldom a *thorough* cure. When a wall is thoroughly dry, then it should be painted. Otherwise, it is money thrown away. "Patent knotting" is a good preparatory internal coating. So far as external coatings go—if this is determined upon—I would only advise using tar, or, if not a large surface and desired a lighter colour, to give two coatings of old "smug" paint, to be purchased at any firm of house-painters, before using the white-lead paint.—F. P.

Hydrostatic Accumulator.—H. T. (*West Bromwich*).—The circumstances cannot be as you indicate. The pressure per square inch at the outlet must be the same as that at the inlet, as water presses equally in all directions. The ratio of the velocities of the water at the inlet and outlet will depend upon the rate at which the pumps are driven as compared with that of the presses or other machinery served by the accumulator. This latter will depend on the resistance offered by these machines. If the resistance is less than 100 lbs. per square inch the water will flow out more quickly than it enters, and the accumulator ram will fall, but if the resistance is greater, the ram will rise. The pressure in the accumulator is constant while the load ram is at rest; to lift it, a slightly higher pressure is necessary than that which will hold it stationary.—F. C.

The Winter Ring.—J. M. (*Nantwich*).—The ring is merely an enlargement of the prime conductor, consequently the position is not of very great importance, but the usual plan is by far the most convenient. Sealing wax could be used, but it is not nearly so satisfactory as the wooden ring. Indiarubber also has been tried, but was discarded in favour of the wooden ring, which has never been equalled.—C. A. P.

Heelball.—J. W. M. (*Sheffield*).—For "fake," get one hard heelball and half a white one (Ullerthorne's); break them up small, and put them into a tin, and cover them with naphtha or turps (the former is best), and let the tin stand on the hob, but not near a flame, until it is of even consistency. Stir, and let it get cold. It can be put on with a brush, but the finger is all that is necessary. Let it lay on a short time, and then rub it off lightly with the heelball cloth. The edge should be well ironed before applying. A "fake" tin can be bought; the rim of the lid reaches down to the bottom, to prevent evaporation of the spirit.—W. G.

Watch and Clock Cleaning Tools.—D. C. (*Godalming*).—For the principal tools required for watch and clock cleaning and repairing, see WORK, No. 179, p. 356.

Trousers Stretcher.—R. D. (*No Address*).—A description of trousers stretcher has recently been sent to "Shop." Doubtless it will have appeared before this reply is printed (see No. 197, page 654).—B. A. B.

Chair Making.—T. H. (*Blackburn*).—I am not aware of a book treating solely on chair making, but there are interesting chapters in Spon's "Mechanic's Own Book." Hair-seated chairs—that is, chairs covered with hair-cloth—are upholstered in a manner similar to that for leathers, etc. The framing for upholstered chairs is put together as described in Hall Chair, p. 518, Vol. IV., the exception being that the front, back, and side rails are rebated about ¼ in. in and 1 in. deep to take the binding and studs.—E. C. R.

Photo Printing.—E. P. (*Islington*).—There is no work published treating especially on this subject. Almost all firms make a secret of their methods of procedure, and possibly have some speciality of their own they esteem an improvement on those of other printers. An impression is taken of the screen on the same plate as the subject, and both developed together; it is immaterial which is impressed first. With regard to retouching, the plate is rolled up, a print made, and retouched with the graver wherever it may be deemed necessary.—D.

Working Sketch of Small Lathe.—W. H. B. (*Stockport*).—You will find what you require on p. 621 of Vol. I., the number of WORK for Dec. 14, 1889.—F. A. M.

Making a Coloured Cast of Foot.—D. J. D. (*Manchester*).—(1) In No. 88 (Vol. II., p. 579) are given full directions for making such a cast, with diagram of mould for foot. (2) Full information about plaster, methods of mixing it, etc., will be found in No. 74 (Vol. II., p. 349). (3) Tint by dissolving colouring matter, of the kind and shade you desire, in the water with which you mix the plaster for your cast.—M. M.

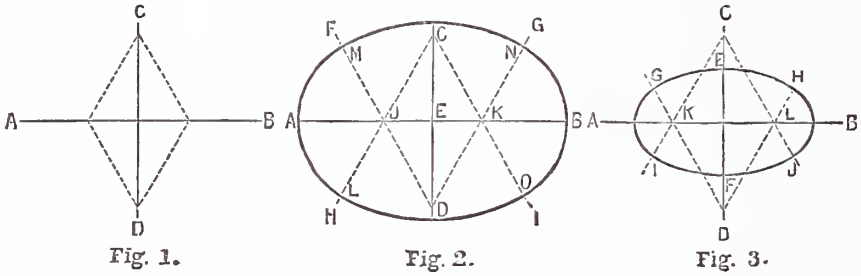


Fig. 1.—Two equal Equilateral Triangles, forming a Rhombus. Fig. 2.—Oval drawn from the Four Points of a Rhombus. Fig. 3.—Another Example.

Watch and Clock Cleaning.—D. C. (*Godalming*).—Articles appeared in WORK, Nos. 179, 180, 183, 188, and 190.

Varnish for Signboard.—E. J. S. R. (*Linwood*).—Remove all dust by carefully washing with clean water. Wipe dry with a window leather, and apply carefully one or two coats of the best outside oak varnish. Avoid the cheap variety: use that costing from 12s. to 16s. per gallon.—LIFEBOAT.

Handrailing Papers.—G. S. (*Montreal*).—I have to thank you for your complimentary remarks. In reference to handrailing papers, your wish is anticipated, as a series is now well in hand.—G. F. C.

Electric Battery.—K. Z. Y. (*Lincoln*).—An electric battery is composed of a number of stoneware jars containing acids and materials for generating an electric current. The acids and the materials differ in a large number of various forms, the battery being constructed for a definite purpose. No one variety of battery will suit all requirements. If you will tell me what you wish to do with the battery, I will tell you how to make one to suit your requirements. Several different batteries have been described in back volumes of WORK, as you will find by consulting the indices.—G. E. B.

Magnets for Belts.—SAMAEL.—Mr. Bonney, Avenue Road, Lewisham, S.E., will get you any magnets or studs for experiments in making magnetic and electric belts. Materials for this purpose can be obtained from Mr. A. Caplatzi, 3, Chenies Street, Tottenham Court Road, London, W., who advertises in WORK.—G. E. B.

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Barometer.—J. H. (*Stonehouse*) writes to W. T. T. (*Houghton-le-Spring*) (see No. 189, p. 526):—"My father has used two bottles for, to my knowledge, twenty years. One is a large sweetmeat bottle, the other a hair-oil bottle. The neck of the hair-oil bottle is turned upside down into the neck of the other bottle, which is sufficiently full of water—preferably rain water—that the oil bottle is immersed ¾ in. in it. In a few days, if weather changes, the water will ascend for fine weather and descend for rain; also, for fog or wet weather, the upper bottle will be covered with mist and drops, in addition to the water going down. I have known the water ascend as much as 2 in. for fine weather."

Oval Drawing.—EDDIFRA writes, in reply to OVAL (see p. 446, No. 184):—"An oval is a plane figure, bounded by a continuous line formed by arcs struck from the four points of a rhombus. A rhombus is formed by placing two equal equilateral triangles together, base to base. In Fig. 1 two equal equilateral triangles are drawn, forming a rhombus drawn on the line A B, which is the major axis or greater diameter of the proposed oval, and the line C D, which is the minor axis or smaller diameter of the oval. To describe an oval on any given line which is the major axis of the oval, draw A B the given length, and C D an indefinite length, bisecting line A B at E. Draw rhombus as in Fig. 1, but let the lines C H, C I, D F, and D G be of indefinite length, bisecting line A B. Set compasses to the distance from A to J, or K to B, and, with J and K as centres, strike arcs L A M and N B O, and then set compasses to the distance from D M or D N, and, with C or D as centres, strike the arcs M N and L I, and thus complete the oval. To describe an oval on any given line which is the minor axis of the oval, draw lines A B and C D with rhombus, as in Fig. 2, and on line C D, Fig. 3, mark the required length of minor axis, as E F. Set the compasses to the length from E to D and E to C, and, with C and D as centres, describe the arcs G E H and I F J. Then set them to the distance from G to K or H to L, and, with K and L as centres, describe arcs G I and H J, thus completing oval. It will be noticed that the larger the rhombus drawn, the longer will be the major axis in proportion to the minor axis, as the points K and L, Fig. 3, are placed wider apart than the points I and K in Fig. 2, in proportion to the lengths of the axis majors. Or the distance from I to K in Fig. 2 equals one-third of the length of the line A B, whereas the points K to L equal, in Fig. 3, more than one-half the length of line A B."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers will appear in an early issue:—W. B. (*Deptford*); C. W. (*Sutton*); A. P. (*Tooting*); R. McQ. (*Anfield*); W. S. C. (*Glasgow*); W. C. (*Wallsend-on-Tyne*); BOILER (*Pimlico*); A. P. (*Wigan*); C. C. (*Bathgate*; T. D. (*Oldham*); W. S. (*Longsight*); F. L. (*Leeds*); J. W. B. (*Huddersfield*); C. H. (*Islington*); J. P. (*Glasgow*); A SUBSCRIBER; W. C. (*Hurst*); McC. & S. (*Londonderry*); T. G. (*Kirkgate*); BINDER; J. O. P. (*Wrexham*); J. O. N. (*Manchester*); CONSTANT FRIEND OF "WORK;" J. B. (*Peterboro'*); C. H. L. (*Greenhithe*); WAITING; ORGAN BUILDER; LATENT; J. P. (*Dowanhill*); P. A. DE P. (*South Kensington*); W. S. (*Pendlebury*); ANXIOUS; H. O. (*Seaford*); E. T. L. (*Bath*); T. J. O'C. (*Dublin*); J. C. (*Southampton*); S. H. (*Windsor*); AN APPRENTICE CABINET-MAKER; W. M. (*Plaistow, E.*); E. P. S. (*Stoke-on-Trent*); F. J. D. (*North Camberwell*); C. W. S. (*Isle of Dogs*); J. J. (*Camden Town*); SEYDOR; J. A. (*Glasgow*); J. K. (*Manchester*); E. E. (*London, E.C.*); J. H. (*Newcastle-on-Tyne*); P. T. (*London*); M. H. F. (*Camberwell*); F. B. (*Warlington, S.O.*); J. T. (*Brixton*).

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